Sea Grant
Delaware

DELAWARE SEA GRANT COLLEGE PROGRAM
NOAA National Sea Grant Program

DESG Site Review Briefing Book

(Review Period 2014–2017)

May 7–9, 2019

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Sea Grant Delaware

Science serving the Delaware coast!

Introduction

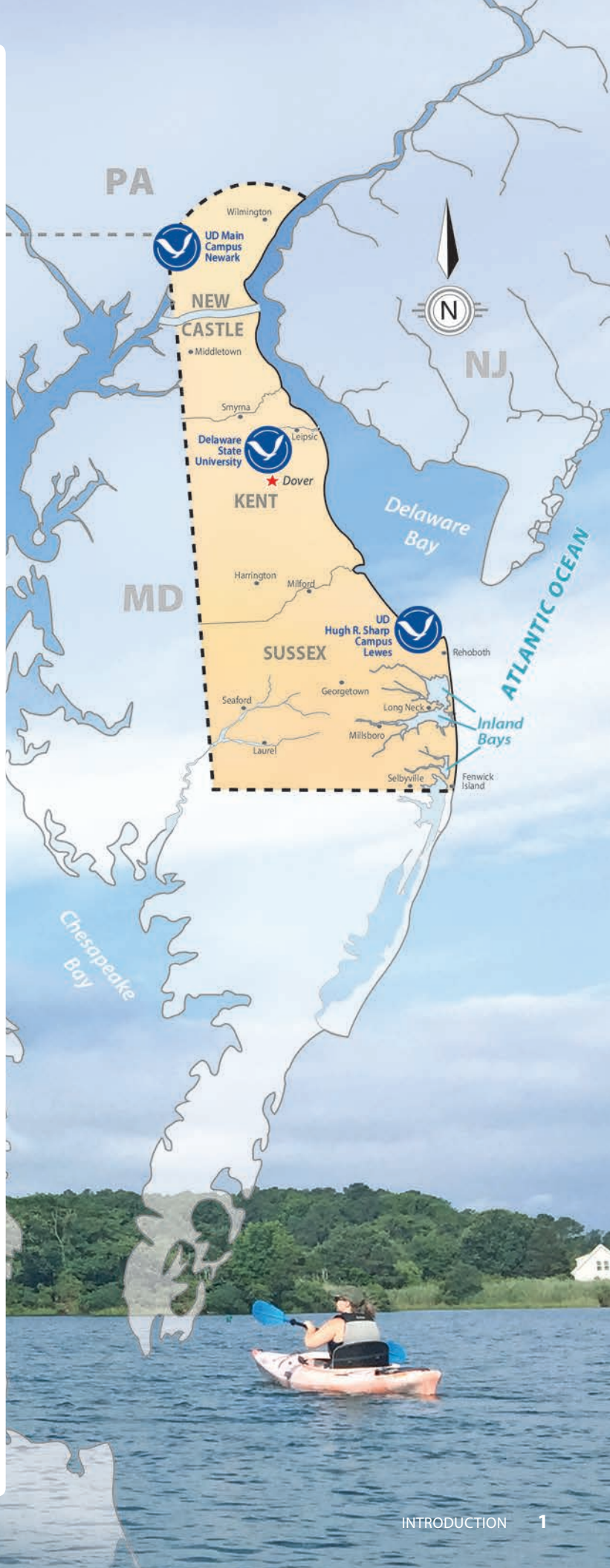
The State of Delaware lies along the Atlantic coast of the United States, occupying the northeastern two-thirds of the Delmarva Peninsula. Delaware features 381 miles of tidal shoreline, including 24 miles of ocean coastline, and about 90,000 acres of tidal wetlands. It is bordered by the Atlantic Ocean and Delaware Bay to the east and Maryland's Eastern Shore and the Chesapeake Bay to the west; no point in the state is farther than eight miles from a tidal waterbody. These coastal resources are widely recognized as being of global ecological significance. Except for the small area of the state that drains directly to the Atlantic, everywhere in Delaware is part of the watershed for a National Estuary Program: the Chesapeake Bay, the Delaware Estuary or the Inland Bays.

In addition to supporting significant ecological resources, Delaware is also densely populated; in 2010 the state was home to approximately 461 people per square mile, which is anticipated to grow 22 percent over the next 30 years. Population growth, significant commercial and industrial investments in the state, a $3.3 billion tourism economy, and the predominance of agriculture over much of the land area have all raised critical challenges regarding coastal issues. Delaware has the lowest mean elevation of any state and so is facing increasing challenges from sea level rise and flooding. Other areas of concern include species loss, water quality, changing economies, extreme weather from drought to supercharged storms, and more.

The state also has considerable advantages. Seven institutions of higher education (plus Widener University's Delaware School of Law) operate in the state, led by the publicly supported University of Delaware, Delaware State University, and Delaware Technical and Community College. At 1,981 square miles of land area, and recently referenced as a size comparison for a calved Antarctic iceberg, Delaware is the second smallest state, which means it is easier than in most places to connect the human resources from government, business, academic institutions, and others to make real impacts on community needs.

The Delaware Sea Grant College Program has been at the forefront of addressing stakeholder concerns for the past 40+ years. Our team has provided sound scientific information and policy analysis on issues related to our coast and our coastal economies. We have worked to translate science into applications that have positive impacts for our fellow Delawareans and visitors.

This briefing book serves as an overview of Delaware Sea Grant (DESG) and its activities from February 1, 2014 to January 31, 2018 (the 2014–2017 program years). We are pleased to be able to share our successes with the site review team, and we look forward to continuing the proud tradition of serving Delaware's communities, people and environment in the years to come.



Program Management

ORGANIZATION

Setting and Reporting within University Structure

The DESG College Program is based at the University of Delaware (UD), a private university with public support. UD is a Land Grant, Sea Grant, and Space Grant university and has been recognized as both a Carnegie Research University and a Carnegie Engaged Institution.

DESG was created in 1968 to conduct oyster research, something that remains a priority to this day, and was named a Sea Grant Institution in 1971. Five years later, the University of Delaware became the country's ninth Sea Grant College, in recognition of its high-quality programs.

DESG's home within the university is the College of Earth, Ocean and Environment (CEOE), which includes the School of Marine Science and Policy, the Department of Geography, and the Department of Geological Sciences. With full support from college and university leadership and access to institutional resources, DESG has maintained a close working relationship with faculty in all three academic units of CEOE, as well as others in UD's Colleges of Agriculture and Natural Resources, Arts and Sciences, Engineering, and Education and Human Development. Other frequent UD collaborators include staff at the Delaware Geological Survey, the Center for Environmental Monitoring and Analysis, Cooperative Extension, and the Institute for Public Administration.

Delaware Sea Grant College Program Management

This section will describe how the program and its leadership are structured. It should be noted that DESG underwent significant reorganization during the time period of this review as many long-term staff members, including those in leadership positions, retired or moved on to new opportunities. This reorganization was ultimately positive, allowing us the flexibility to evolve as a program and remain both viable and productive as we continue to address the complex issues of our state. Although some of the roles of our management team have been combined in different ways over recent years, the basic elements of DESG administration address six primary functions in order to provide an effective team approach to support our research, education, and outreach programs.

Director—Provides strategic direction and vision for the DESG College Program, interacts with UD and CEOE administrators, the Delaware Sea Grant Advisory Council (SGAC), and members of local, state and federal agencies, and elected representatives to advance the mission of DESG.

Associate Director—Responsible for program planning, reporting, and evaluation. Together with the fiscal officer, oversees PIER reporting, Omnibus proposal submission, overall coordination with partners, and DESG's program development and graduate student education portfolios.

Research Coordinator—Administers DESG's competitive research program, from drafting and issuing the Request for Proposals to gathering required reporting from principal investigators. Also coordinates the pre-proposal and proposal evaluation panels and works with graduate students supported by the research awards to increase their familiarity with Sea Grant and marine career opportunities.

MAS Director—Oversees the Marine Advisory Service (MAS), DESG's extension team. The MAS director manages the extension staff and works with them to develop programs. The organization of MAS has evolved over the reporting period as well, but specialists have expertise and responsibilities in coastal ecology, community development, emergency preparedness, hazard mitigation, fisheries, aquaculture, and marine education.

EPE Director—Oversees the Environmental Public Education Office (EPE), the communications arm of DESG. In addition to the director, EPE comprises a science writer/editor, a digital content specialist, an art director, and a production editor. The office often hosts one or two interns, in writing and digital media, to provide workforce development and expand the amount of coverage it can provide. Members of EPE work half-time for DESG and half-time for CEOE, allowing greater specialization and more available communicators.

Fiscal Officer—Administers financial awards supporting DESG from the National Oceanic and Atmospheric Administration (NOAA) and the Delaware General Assembly. The fiscal officer supports DESG staff in budgeting, contract and grant administration, and financial report preparation. The fiscal officer also coordinates the activities of the SGAC for DESG. The fiscal officer works half-time for Sea Grant and half-time for CEOE.

Through the years of the review period, leadership roles were filled by various staff in different ways, as reflected in Table 1.

Table 1. Leadership Rolls From February 1, 2014 through January 31, 2018.

	2014	2015	2016	2017
Director	Dr. Nancy Targett	Jim Falk	Jim Falk	Ed Lewandowski
Associate Director	Jim Falk			
MAS Director	Jim Falk	Ed Lewandowski	Ed Lewandowski	Ed Lewandowski
Research Coordinator	Dr. Jen Merrill	Dr. Jen Merrill	Dr. Jen Merrill	Dr. Jen Merrill
EPE Director	Katy O'Connell	Katy O'Connell	Katy O'Connell	Mark Jolly-Van Bodegraven
Fiscal Officer	Lisa Ridenour	Lisa Ridenour	Lisa Ridenour	Lisa Ridenour

Current Leadership

The current leadership structure of DESG coalesced in 2018. The program director, **Dr. Kathryn Coyne,** is a member of the faculty of CEOE. Coyne provides the strategic vision and oversight for the entire program. Associate Director **Christian Hauser,** whose role now includes coordinating DESG's research program in addition to federal reporting and evaluation, supports her.

The MAS director now exists as a stand-alone leadership role, which **Christopher Petrone** holds after serving seven years as DESG's education specialist, a member of the MAS team. There are now five full-time and three part-time MAS specialists, with two specialists in each focus area.

Environmental Public Education Director **Mark Jolly-Van Bodegraven** remains in his role overseeing the communications of both DESG and CEOE.

The role of the fiscal officer also remains the same, although **Lori Hans** has taken over these responsibilities from Lisa Ridenour. Lisa continues to work at CEOE. She and the former acting director, Ed Lewandowski, who remains on the MAS team, have graciously provided advice and institutional memory as Lori and the entire management team become established in their new roles.

To ensure effective communication, the DESG Leadership team meets on a regular basis to discuss strategic planning, educational and outreach opportunities, and other coastal and marine issues or problems that merit our involvement. Information is then disseminated to other DESG staff members through regular meetings among MAS and EPE personnel.

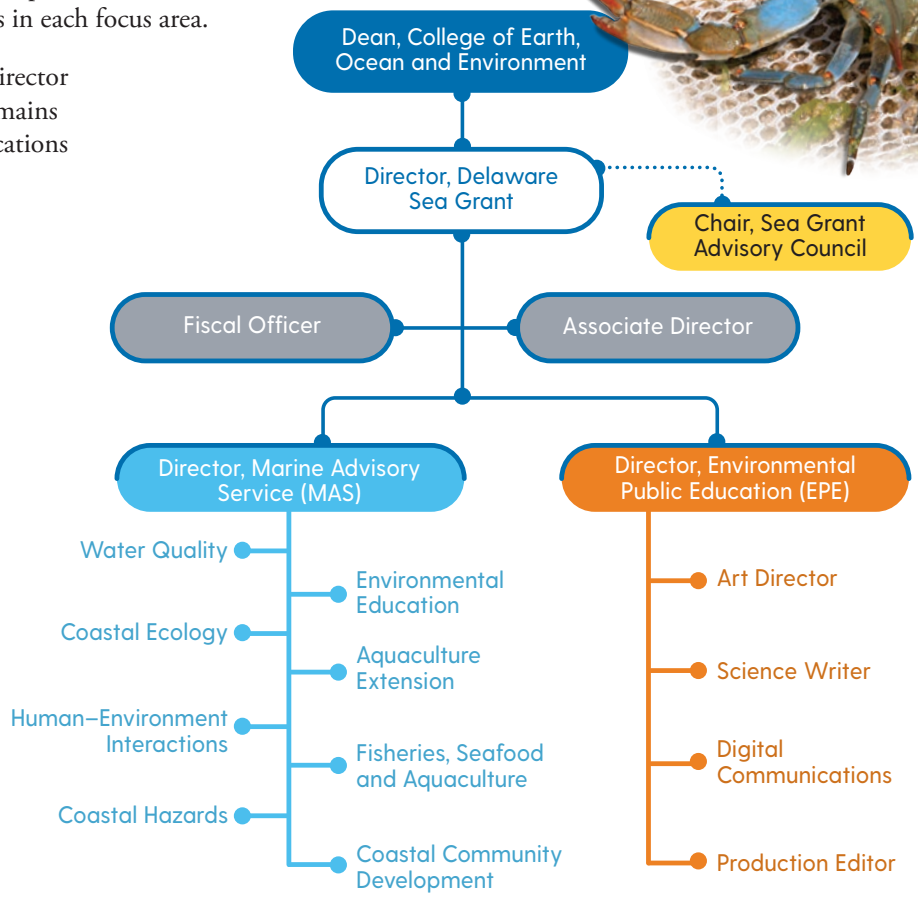


Figure 1. DESG organizational chart and reporting structure. DESG is based at the University of Delaware and administered by UD's College of Earth, Ocean and Environment.

Sea Grant Advisory Council

The Delaware SGAC exists to help the program ensure its activities are meeting community needs as identified by stakeholders themselves. Members of the SGAC represent the state General Assembly, state and local governments and agencies, private industry, and nongovernmental organizations involved in resource management and/or education. This breadth of expertise ensures the SGAC can advise DESG on its strategic plan and specific programs intended to address goals. Members of the SGAC also represent a broad array of DESG stakeholders, keeping us grounded in community needs and actionable projects. Their perspectives are incredibly valuable, particularly in the last few years when our program has seen tremendous turnover. They have kept us on our stakeholders' radar and assisted with getting new DESG staff up-to-speed and engaged with potential partners.

Members of the SGAC provide essential support in our research proposal evaluation process by helping evaluate the applicability of proposed research projects to specific Delaware needs. They are also often involved in stakeholder engagement, when they offer valuable insights that inform program research, outreach and education projects, and serve as conduits to the broader community.

The council meets twice a year, in the spring and the fall. These meetings provide an opportunity for updates from DESG staff, typically followed by a working session where SGAC members provide guidance or engage on specific programming activities. While DESG staff formally meet with the SGAC semiannually, the small size of our state provides opportunities to interact with council members in other meetings, workshops, conferences, and even ball games.

SGAC chair Gerard Esposito speaks at CEOE Honors Day 2018.

Table 2. 2018 SGAC Membership and Their Affiliations.

Council Member	Position Title / Organization	Year Joined
Gerard Esposito, Chair	*President* / Tidewater Utilities, Inc.	1999
Jennifer Adkins	*Executive Director* / Partnership for the Delaware Estuary*	2008
Gene Bailey	*Executive Director* / Diamond State Port Corporation	2003
Bill Baker	*Owner* / Bill's Sports Shop	2014
Chris Bason	*Executive Director* / Delaware Center for the Inland Bays*	2012
Mark Biddle	*Program Administrator* / DNREC Division of Water Resources, Watershed Assessment & Management Section	2017
Ruth Briggs King	*Representative* / Delaware General Assembly	2012
Kimberly Cole	*Environmental Program Administrator* / DNREC Delaware Coastal Programs	2017
Sarah Cooksey	*Director of Conservation Programs* / The Nature Conservancy – Delaware	2017
Brenna Goggin	*Director of Advocacy* / Delaware Nature Society	2017
Kate Hackett	*Executive Director* / Delaware Wild Lands, Inc.	2014
Simeon Hahn	*Regional Resource Coordinator – Mid-Atlantic* / National Oceanic and Atmospheric Administration	2017
Daniel Leathers	*State Climatologist* / University of Delaware	2014
Dyremple Marsh	*Dean* / College of Agriculture, Science, & Technology, Delaware State University	2014
David McBride	*Senator* / Delaware General Assembly	2012
Tonyea Mead	*Science Education Associate* / Delaware Department of Education	2012
William J. Miller, Jr.	*Executive Director (retired)* / Delaware River and Bay Authority	1990
Christopher Moore	*Executive Director* / Mid-Atlantic Fishery Management Council	2012
Betsy Reamer	*Executive Director* / Lewes Chamber of Commerce	2005
Michelle Rodgers	*Associate Dean and Director* / University of Delaware Cooperative Extension	2013
David Saveikis	*Director* / Division of Fish and Wildlife, Delaware Department of Natural Resources and Environmental Control	2012
F. Gary Simpson	*Senator (retired)* / Delaware General Assembly	2002
Halsey Spruance	*Executive Director* / Delaware Museum of Natural History	2009
Namsoo Suk	*Director of Science and Water Quality Management* / Delaware River Basin Commission	2018
Hilary Valentine	*Director* / Environmental Training Center, Delaware Technical and Community College	2014
Katherine Ward	*Executive Director* / Delaware Press Association	2002
Stuart Widom	*Director, Governmental and Regulatory Affairs* / Calpine Corporation	1999

*Environmental Protection Agency National Estuary Program

RECRUITING TALENT

Developing Research Priorities

Research funded by the DESG College Program supports the DESG Strategic Plan, our constituents and stakeholders, the National Sea Grant Office (NSGO), and NOAA. Our program's research portfolio also serves as the foundation for our graduate education and extension activities.

During the 2014–2017 period, DESG used four primary mechanisms to recruit talent in support of our research program. These consisted of the program's biennial research competition, a regional research competition, a mini-grant competition, and allocation of program development funds to support pilot-scale research. Competition for funding in each instrument was designed to produce the strongest package of applied research, education, and outreach possible to address coastal challenges and opportunities that were recognized as important to the State of Delaware. These research priorities were identified based on the DESG Strategic Plan (2014–2017), which synthesized Delaware's coastal issues into four focus areas, with associated goals, objectives, and desired outcomes.

Review Process for Research Proposals

BIENNIAL RESEARCH COMPETITIONS

The DESG College Program solicited research proposals through a biennial research competition for two funding cycles between 2014 and 2018. For each of the research funding cycles, proposals were solicited approximately 14 months in advance of the biennial omnibus cycle. The DESG Request for Proposals (RFP) was issued via a broad electronic announcement that was sent to colleges and universities throughout Delaware and was also posted on the DESG website. The proposal process included a required pre-proposal and a subsequent full proposal.

The pre-proposal process was designed to give potential investigators feedback about anticipated funding success and ensure funded projects were relevant to DESG's mission, stated goals, and implementation strategy. Pre-proposals were required to present a succinct but sufficiently detailed synopsis of the proposed research, including the research needs, objectives, methods, and applications. During each proposal cycle, pre-proposals were reviewed by a committee consisting of DESG management, MAS staff, and members of the SGAC. The reviewers evaluated each proposal's relevance to DESG priority areas, potential for linkages between projects, application of results, potential for significant impacts, and connection to outreach. Pre-proposals were scored as high, medium or low based on the review criteria. Comments and feedback were provided to prospective researchers to ensure that the value of proposed research to user groups was maximized. Regardless of the feedback, all prospective investigators that submitted a pre-proposal were welcome to submit a full proposal.

Prospective researchers were strongly encouraged to consider feedback from the pre-proposal review process when developing a full proposal. Full proposals were required to completely describe the importance and relevance of the research, research objectives, methods, anticipated application of findings, and extension and outreach plans. Review of the proposals consisted of: (1) external written peer review by at least three competent reviewers for rationale, scientific or professional merit of the project, innovativeness, and the professional qualifications of the investigators; (2) review and ranking by a panel of qualified scientists; and (3) assessment of programmatic fit based on the overall research portfolio balance, prior research, extension, and outreach performance, and the alignment of the projects with the stated goals and desired impacts for the DESG College Program. Following written peer review, each proposal was discussed individually by the technical panel, which included between four and five panelists from universities and institutions from across

the region. Each reviewer scored the proposals based on the criteria above, and the panel sorted proposals into three recommendations: fund, do not fund, and fund if resources are available. Decisions to recommend proposals for funding were made at the discretion of the DESG Director, taking into consideration review scores and the need to address DESG program priorities identified in the Strategic Plan. For each research cycle, proposals were funded at a level of up to $70,000 per year. In addition to those funds, researchers were also awarded funds to support tuition and stipend costs for a graduate student.

In fall 2017 the review approach for full proposals for the 2018–2020 cycle was modified so the assessment of programmatic fit and alignment with desired impacts (step 3 above) was conducted through review and ranking by a separate programmatic panel, meeting concurrently with the technical panel. Just as the technical panel comprises relevant scientific experts, the programmatic panel was composed of experts in the needs of the state—stakeholders with professional and personal experience in the subject matter of the proposals.

Research proposal activity under the Program RFP for the 2014–2017 period is summarized in Table 3.

Table 3. Biennial research proposal activity.

Submissions	2014–2016	2016–2018
Pre-Proposals	27	23
Full-Proposals	18	23
Funded Proposals	12	9
New PIs[1]	5 (42%)	3 (33%)
Graduate Students Supported	17	21
Funded Institutions	University of Delaware	University of Delaware, Delaware State University

[1] New PIs (Principal Investigators) are identified as those that were not funded in the prior two funding cycles.

OTHER RESEARCH SUPPORT

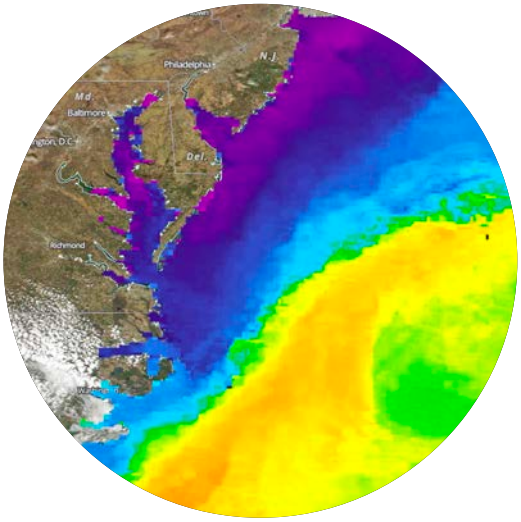
Regional Research Competitions—Recognizing that many research questions cross state boundaries, the Mid-Atlantic Sea Grant programs jointly released an RFP during each of the biennial omnibus cycles for collaborative and integrative research across the region that supported the Sea Grant mission. In the 2016–2018 omnibus cycle, one regional project was funded in Delaware with an annual budget of approximately $70,000.

Mini-Grant Competition—For the 2016–2018 omnibus cycle, DESG also funded research through a mini-grant competition, which drew eight applications. The mini-grant instrument was intended to address the need for timely, event- or opportunity-driven funding to enhance research, education, or outreach products, explore new technology, and respond to stakeholder needs. Up to $15,000 was awarded to four projects that assisted DESG in meeting our stated mission and goals.

Program Development Funding—Program development funds were provided as seed funding for researchers to support pilot-scale research in emerging or novel fields, to develop concepts, to collect preliminary data, or to improve methodology in preparation for the biennial grant competition. This funding mechanism was also used as an avenue by which new faculty and/or institutions could develop or strengthen partnerships with DESG.

Institutional and Geographic Scope of Research

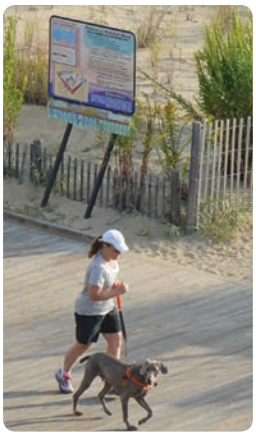
Research funded by the DESG College Program was performed at locations in each of Delaware's three counties: New Castle, Kent, and Sussex. The majority of the research was performed by faculty at the University of Delaware within the College of Earth, Ocean and Environment; College of Engineering; and College of Agriculture and Natural Resources. A mini-grant was also awarded to faculty at Delaware State University, a historically black, public university, which has a significantly smaller research component.



Stakeholder Engagement

Delaware's small geographic size allows DESG to develop close partnerships and strong collaborations. Our program has successfully leveraged these partnerships for impactful, responsive, and proactive stakeholder engagement.

By being in the community, statewide—both professionally and personally—DESG staff are able to identify stakeholders, engage them, work to pinpoint relevant needs, and then begin addressing those needs. In return, DESG stakeholders develop a relationship with our program and become our partners. Involving constituencies—both internal and external to DESG—has been a long-standing and integral component of developing and fulfilling our strategic plan. As our network continues to grow, our partnerships extend beyond Delaware's borders. Through collaborations with our peers in professional networks, our colleagues in other Sea Grant programs, and partners at other NOAA agencies, DESG staff members are continuously seeking and realizing opportunities to make an impact not only at home, but also in neighboring states, across the Mid-Atlantic region, nationally, and even internationally.



RELEVANCE

DESG's stakeholders are our partners in solving coastal issues and filling gaps in relevant services, through applied research, extension activities, education, or facilitation. DESG stakeholder groups represent resource managers, coastal communities, emergency managers, private citizens and consumer groups, formal and informal educators and their students, seafood and fisheries professionals, elected officials, and policymakers. With outreach specialists and extension agents now in each of the three Delaware counties, our door is always open to stakeholder input about DESG's research portfolio, extension activities, and education programs.

At the heart of our stakeholder engagement and programmatic activities is the DESG strategic plan. We utilize input from a host of sources, early and often, to develop a strategic plan that is meaningful to stakeholders and staff. The finalized strategic plan then guides the design and implementation of impactful projects that are relevant to stakeholder needs at the local, state, regional or national level.

Key Partners, 2014–2017

Beebe Medical Center

Consortium for Ocean Leadership, National Ocean Sciences Bowl

Delaware Center for the Inland Bays

Delaware Department of Education

Delaware Department of Natural Resources and Environmental Control

Delaware General Assembly

Delaware Geological Survey

Delaware National Estuarine Research Reserve

Municipal Officials in Bethany Beach, Bowers Beach, Laurel, Leipsic, Lewes, Little Creek, Milton, and Rehoboth Beach

National Estuarine Research Reserve System

National Weather Service

Sea Grant Programs in Connecticut, Hawaii, Louisiana, Maryland, New Jersey, North Carolina, Oregon, and Wisconsin

Southern Delaware Tourism

Sussex County

University of Delaware Center for Behavioral Economics and Applied Research

University of Delaware Center for Coastal Engineering

University of Delaware College of Earth, Ocean and Environment

University of Delaware Cooperative Extension

University of Delaware Institute for Public Administration

University of Delaware Landscape Architecture Program

University of Maryland

Key Stakeholders, 2014–2017

Academic researchers and students (undergraduate and graduate)

Beachgoers and tourists to eastern Sussex County

Delaware Bay watermen

Delaware Center for the Inland Bays

Delaware Department of Natural Resources and Environmental Control

Delaware coastal communities and their residents

Delaware and Maryland K–12 students

Downtown Laurel

Marine science educators, formal and informal

Mid-Atlantic Marine Educators Association

National Seafood HACCP Alliance for Training and Education

NOAA Fisheries

Oyster Gardener Program

Shellfish growers

Town of Leipsic

EXTENSION AND ADVISORY SERVICES

DESG assists state and federal partners with communicating risk assessment and mitigation strategies.

DESG has had long-standing partnerships with state and federal agencies to provide environmental programming and risk assessment. One such relationship is with the Delaware Department of Natural Resources and Environmental Control (DNREC) and its various divisions, sections and offices. DESG professionals partnered with DNREC to provide valuable expertise for a number of flood and wind risk workshops and mitigation projects for Delaware's coastal towns. DESG and DNREC were leaders in the formation of the Delaware Resilient and Sustainable Communities League (RASCL), which attracted nearly 200 participants to its first summit in November 2017, "Lessons of the 2017 Hurricanes: Learning from our past to prepare our communities for the future." Among the participants were representatives from the Federal Emergency Management Agency (FEMA), DNREC, and other state agencies, who provided local town management, professionals, and other stakeholders from Delaware and surrounding states with practical information on flood mitigation strategies and adaptation planning as we prepare for increased risk of hurricanes in the future.

DESG supports restoration, aquaculture, and water quality monitoring in local bays.

DESG professionals and researchers provide support for educational programming and research needs of Delaware's Center for the Inland Bays (CIB), a National Estuary Program. Among many collaborations, DESG has worked with CIB staff to provide technical support to enhance their oyster gardening program. This program now boasts over 65 sites and has produced more than 300 bushels of oysters that have been transplanted to restoration sites around the Inland Bays. DESG staff also supported CIB's efforts with water quality data through our extensive Inland Bays Citizen Monitoring Program. This program was designed to engage residents around the Inland Bays to provide a range of water quality data to support remediation and aquaculture efforts in the bays. In coordination with water quality monitoring, DESG researchers investigated environmental drivers that promote algal blooms and developed bloom mitigation and prevention strategies. DESG involvement in oyster gardening, as well as monitoring and research efforts, supported remediation efforts by CIB, and the recent expansion of commercial shellfish aquaculture in the Inland Bays.

In 2013, Delaware's General Assembly passed legislation to lay the groundwork for an Inland Bays aquaculture industry. Since then, DESG has been integral in moving the industry from words on paper to animals in the water. Working with potential growers, waterfront homeowners, state and federal legislators, DNREC, the media, nonprofits, and numerous other Inland Bays stakeholders, DESG provided applied research findings (e.g., ecosystem services, depuration techniques, consumer preferences), informational resources, a product branding initiative, and industry visioning. In 2015 alone, DESG held more than a dozen workshops for state officials and local community members on the potential impacts of aquaculture development. In 2016 and 2017, DESG helped potential shellfish growers navigate the leasing process for aquaculture plots in the Inland Bays, which was run for the first time in 2017. By fall 2018, the Inland Bays had produced its first commercially available oysters.

DESG helps communicate risk of injury to beachgoers.

Each year roughly 300 beachgoers, primarily tourists, are injured wading, swimming, and playing in the surf zone along the Delaware coast. Research funded by DESG aimed to quantify injuries and the role of environmental and human factors. Partnering with Beebe Medical Center in Lewes and local surf patrols, researchers surveyed beachgoers on their knowledge of surf conditions and risk of injury and also gathered data on injury, beach use, and surf conditions. This research produced several positive outcomes, including enhanced prediction of those conditions that are likely to cause injuries and communication of study results to local beach patrols and the National Weather Service (NWS) to enhance and improve beach hazard statements. An outreach campaign included production of a beach rack card with information about beach safety and a targeted program to educate elementary school students about surf zone injury and how they can be safer in the water. This program increased student awareness about specific safety practices they can use and communicate to family members when they go to the beach.

DESG also worked to increase awareness of rip current risks for Delaware beachgoers. DESG participated in a new NWS initiative to improve communication regarding rip current forecasts and safety by connecting NWS with Delaware beach patrols for participation in daily decision-support conference calls. Additionally, DESG organized and hosted a regional rip current and surf zone safety workshop to improve communication among NWS forecasters, beach patrols, and the academic research community. An important outcome from this interaction was a review paper on rip current science advances and important updates, published by DESG with North Carolina Sea Grant, which shared knowledge on this topic with a wider audience.

DESG provides leadership in community redevelopment programs.

DESG works closely with communities in many ways to help address issues and challenges they face living and working in our coastal settings. We develop workshops and seminars, conduct demonstration projects, create outreach materials, and provide one-on-one advisement *(see list at right)*. With support from the Delaware General Assembly, DESG provided leadership and coordination for an ongoing collaboration with University of Delaware Cooperative Extension and Institute for Public Administration (IPA) at UD to create the Sustainable Coastal Communities Initiative (SCCI). This program conducts research and outreach to address social, economic, and environmental issues facing coastal communities throughout the state. DESG's work with Cooperative Extension and IPA has also led to resiliency capacity building and beneficial courses for local government officials in flood mitigation and adaptation planning.

While few in number, Delaware's commercial fishing and water-dependent populations are proud, important communities steeped in tradition. DESG has established partnerships with local officials and stakeholders in some of these historic, working waterfront communities to address the need for economic development. By fostering an environment in which economic growth and environmental protection are viewed as mutually compatible and non-conflicting activities, DESG has encouraged community leaders to integrate economic development opportunities with environmentally sound practices. With support from DESG, the Town of Leipsic developed a brand to promote itself and held its inaugural oyster festival in October 2017, welcoming over 1,500 participants to the small town. The successful event was repeated in 2018, and the town plans to bring it back in 2019 as well.

In addition to maritime communities, Delaware's waterfront agricultural communities have also benefited from DESG assistance. DESG collaborated with the nonprofit Laurel Redevelopment Corporation and UD's Jules Bruck at the College of Agriculture and Natural Resources to engage community stakeholders in Laurel in a visioning process to reimagine the area of downtown that borders Broad Creek. DESG-funded researchers were also involved in this effort by mapping the bottom of Broad Creek prior to installation of a kayak launch site. The implementation of other DESG concepts for redevelopment is well underway and already improving visitation and pride in Laurel's waterfront area. More details are provided in the Productivity section under Resilient Communities and Economies *(page 18)*.

DESG supports Delaware coastal communities.

- Offered workshops and presentations to help educators and the general public understand the impacts of climate change (coastal communities, statewide).
- Worked with community partners to increase teacher awareness of potential field trip opportunities blending environmental and historical themes in a historic, waterfront community (Lewes).
- Developed a National Flood Insurance Program Community Rating System User Group in Delaware (coastal communities, statewide).
- Enhanced communication among local beach patrols and NOAA, NWS Forecast Office in Mt. Holly, New Jersey, through rip current outreach and coordination efforts (oceanfront communities).
- Provided funding, technical support, and education programs in Low Impact Development approaches to managing stormwater (Lewes).
- Co-created a book, "Images of America: Delaware's 1962 Northeaster," which was used in community workshops as a public engagement and risk awareness tool for future storm and flood events (coastal communities, statewide).
- Coordinated a Residential Coastal Construction training workshop for Delaware communities and building professionals, which provided information on wind and flood mitigation techniques and improving hazard resistance for retrofitting projects and new construction (Sussex County).
- Conducted workshop and presentations on changes to FEMA's flood insurance program and ways to reduce risk and flood insurance premiums (Sussex County).
- Coordinated the Sussex County Community Exchange workshop, which provided a venue for communities and government agencies to share ideas, lessons learned, best practices, products, and outcomes for environmental and resiliency goals (Sussex County).
- Worked with local bait and tackle shops to distribute information on safe handling of live bloodworms—and seaweed packing material—to prevent the spread of invasive species to the Inland Bays, Delaware Bay and coastal Atlantic Ocean (coastal communities, statewide).
- Coordinated a two-day, FEMA-approved HURRIPLAN course delivered by the National Disaster Preparedness Training Center that included modules on resilient community planning and building design strategies in hurricane-prone areas (coastal communities, statewide).
- Developed models for simulating flooding and draining processes in complex salt-marsh environments that reduce run-time and improve accuracy, which assists state and local resource management agencies (Delaware bayshore communities).

EDUCATION AND TRAINING

DESG delivers environmental education programming and professional training to a broad range of stakeholders.

Through both class field trips and instruction to the K–12 age group in informal contexts like scouts or other community groups, DESG provides the most up-to-date scientific information in grade-appropriate lessons for Delaware students throughout the year. Although each engagement is different, some successful programs repeat regularly. A Smyrna elementary school, for example, has been bringing students every year since 2012 for a lesson on wind energy at the Lewes campus. A critical piece of every K–12 education program is the focus on careers, for example, showing students in a wind energy program how a successful wind turbine requires Ph.D.-level scientists and engineers, maintenance staff, and highly skilled trade workers like blade repairers.

Another example of stakeholder engagement by DESG is the high-quality professional development provided to classroom teachers and informal educators, who rely on us for updated science content and resources. As an integral part of this process, DESG first works with state and regional educators to determine professional development needs and then delivers those programs using best practices for teacher training. Through single- and multi-day workshops, which include inquiry-based, differentiated activities, educators learned a wide variety of content and skills, including local weather and climate, water quality, watersheds, ecology, marine biology, renewable energy, and how to meet the Next Generation Science Standards (adopted in Delaware in 2013). These opportunities also included contact with practicing scientists and plenty of participant networking time. Professional development programs delivered by DESG provide experiences that build confidence and are re-energizing, while also fostering environmental literacy.

Applying science research and increasing environmental literacy are hallmarks of DESG. With our UD CEOE faculty and graduate students, we are able to provide two-way communications with Delaware stakeholders about ongoing research and community concerns and needs. Through public presentations—such as our Ocean Currents lectures, Focus on the Coast workshops, and Coast Day open house—DESG provides university faculty and students with opportunities to conduct public outreach. DESG-funded faculty and students also gain experience with smaller stakeholder groups, allowing for more in-depth outreach with more personal attention, such as Taking an Interest in Delaware's Estuary (TIDE) Camp, group lab tours, and educator professional development workshops. These experiences provide our researchers and students with outreach training while enhancing environmental literacy among a broad range of educators, students, and the general public.

Collaborative Network/ NOAA Activities

As with all coastal environments, Delaware faces many complex, interrelated issues that cannot be neatly parsed by political boundaries. As part of the Delmarva Peninsula, our interdependency with Maryland and Virginia is always top of mind for DESG, and when we consider that it is the Delaware and Chesapeake Bays that frame our land, it's clear that Pennsylvania and New Jersey are vital partners as well. For those issues crossing any or all of these state lines, DESG works to maintain close and productive ties with the other four local Sea Grant programs, regional and national NOAA offices and programs, and peers at other related institutions, like the University of Maryland.

Along with sharing expertise across the Sea Grant network, DESG makes a difference locally by working closely with municipal, county and state leaders and agencies, both within government and in the state's academic, business, and nonprofit sectors. To achieve this, DESG fosters close relationships with fellow experts, stakeholders affected by our work, and collaborators in both of those groups with whom the program can achieve more substantive impacts. As evidence of our collaborative relationships, DESG secured more than $7 million in non-Sea Grant funding during the site review period that was either directly related to Sea Grant efforts or catalyzed by past DESG-funded projects.

The close work with the Center for the Inland Bays and DNREC mentioned in the preceding section are good examples of long-standing relationships that have been mutually beneficial while enhancing our commitment to serve our local communities. CIB and DNREC staff are valued members of our SGAC and have provided their expertise on a number of topics affecting our state. We have collaborated on water monitoring and education projects, on coastal research and aquaculture development. The CIB is also closely integrated in aquaculture efforts, taking the lead on oyster gardening, while DNREC developed aquaculture regulations, both with strong support from DESG.

DESG nurtured other, less well-established relationships within our collaborative network during 2014–2017 in order to ensure that our program continues to be relevant to a broad cross section of stakeholders. For the past several years, DESG has invested in deepening its partnership with Delaware State University (DSU) in a number of ways. The dean of the university's College of Agriculture, Science & Technology has been a valuable member of the SGAC for a number of years and was preceded by DSU's president. In an effort to assist DSU in developing research competence and to broaden participation in our research program, DESG has encouraged DSU faculty to participate in the biennial research process, resulting in successful collaborations between faculty at DSU and UD. A DSU graduate student's research with DESG support also produced important baseline data on oysters in the Inland Bays before large-scale aquaculture and restoration work took place. The same DSU graduate student submitted a strong application for the Knauss Fellowship and was one of three applicants recommended by DESG to this program. In 2017, the ongoing effort to cultivate relationships with DSU paid off in other ways. A mini-grant awarded to DSU faculty member Dennis McIntosh produced useful proof-of-concept for new depuration techniques for oysters and led to McIntosh's hiring as a part-time Marine Advisory Service specialist, DESG's first outside of UD.

The experience at DSU is a good example of how the relationships that DESG invests in benefit both partners and Sea Grant. DSU expanded its resources for faculty and student research, education and extension, while DESG gained additional expertise with McIntosh and a deeper talent pool for fellowships. Other relationships have yielded these same win-win scenarios, whether with educational institutions or local business and tourism agencies.

As detailed in the examples below, DESG partners with agencies at all levels—local, state and federal—in order to provide assistance to a broader audience and draw from a pool of talent that extends beyond our own areas of expertise. This approach to collaborative networking is reflected in the following pages and include projects like working with federal partners at the NWS to strengthen communication strategies and helping local oyster growers understand regulations affecting our budding shellfish aquaculture industry.

EXAMPLES OF COLLABORATIVE NETWORK ACTIVITIES

DESG provides expertise on education and environmental literacy for MADE CLEAR project.

Anticipated impacts from climate change are arguably the most pressing environmental issue for our region, requiring a coordinated, region-wide education and outreach effort to provide clear and consistent information to stakeholders. To achieve these goals, DESG partnered with UD and University of Maryland Center for Environmental Science staff and faculty for our NSF-funded Maryland and Delaware Climate Change Education, Assessment and Research (MADE CLEAR) project. DESG developed and provided educational activities, professional development, and project management for this program. In addition to reaching

students and teachers across Maryland and Delaware, our efforts on this project resulted in a number of high-profile climate education activities including draft recommendations for Governors Markell (Delaware) and O'Malley (Maryland) to consider as members of the White House Task Force on Climate Resilience. DESG also took part in the White House Roundtable on Climate Change Education and was a panel member at the 2015 National Council for Science and the Environment focused on climate change education. The results of DESG's work on this project were presented at national science and education conferences, providing additional opportunities to share our work with a broader audience. Through MADE CLEAR, DESG collaborated with Delaware and Maryland State Parks to train park interpreters in climate change science and education and guided them through developing climate change lessons specific to the parks in which they worked. More than 3,000 Delaware students were brought to state parks for the programming, and the lesson plans developed for the MADE CLEAR project continue to be used by interpreters in the parks. The MADE CLEAR efforts in education, developed by DESG, influenced changes to the fifth- and eighth-grade science curricula in Delaware, ensuring the project's impact will continue to be felt long after direct DESG involvement.

DESG works with partners at NSGO and the Sea Grant Network to develop effective communication strategies.

Effective communication is an essential component of stakeholder engagement for Sea Grant programs. During the 2014–2017 time period, the DESG communications team worked closely with the Sea Grant Network and our counterparts in the National Sea Grant Office on a range of projects to strengthen our collective ability to communicate across a range of platforms. DESG assisted in a webinar on social media use and digital analytics and coordinated a Story Map of community resilience projects throughout the Sea Grant Network for the 50th Anniversary of Sea Grant. DESG also collaborated with the NSGO communications team to develop the *Delaware Fact Sheet* and to promote projects for Seafood Month 2017 to advance the Sustainable Seafood and Aquaculture initiative of our program. Also in 2017, DESG researchers and staff hosted Knauss Fellow Christopher Katalinas at the CEOE Lewes campus so he could conduct interviews for the Meet the Experts section of the redesigned seagrant.noaa.gov and attend an Under the Scope teacher development workshop, which he filmed for a video on stakeholder impact. Together, these collaborative interactions promoted the effective use of a range of communication strategies to support our stakeholder engagement efforts.

DESG develops educational material and programming with regional partners at NOAA, NERR and other Sea Grant programs.

Collaborations among DESG and regional partners have played a key role in supporting our efforts to advance environmental literacy. During the 2014–2017 review period, DESG participated in several joint efforts with a range of partners from NOAA, NERR, and other Sea Grant programs to develop and evaluate educational material and programming. Since 2012, for example, our Education Specialist has served as Delaware's university partner for the NOAA Chesapeake Bay Office/Chesapeake Bay Program Mid-Atlantic Environmental Literacy Workgroup, which is tasked with evaluating and recommending policies related to PK–12 bay education in the Chesapeake Bay states. Through MADE CLEAR, DESG also worked collaboratively with both the Chesapeake Bay National Estuarine Research Reserve (CBNERR)-Maryland and the Delaware National Estuarine Research Reserve to provide climate change education for teachers. In another example, DESG professionals provided resources, hands-on activity ideas, and a presentation at the June 2014 CBNERR-Virginia Horseshoe Crab Discovery Lab. DESG also partnered with other state Sea Grant programs to provide educational programming. As part of a NOAA Bay Watershed Education and Training (B-WET) *Bay to Bay* project, for example, DESG worked collaboratively with the DNERR Education Coordinator, along with Maryland Sea Grant's Watershed Restoration Specialist, NOAA Environmental Science Training Center Education Coordinator, and Connecticut Sea Grant's Education Coordinator, to conduct six-day *Bay to Bay* Delmarva transects in July 2014 and 2016. While not an exhaustive list of our collaborative interactions to advance environmental literacy over the four-year review period, these examples illustrate the diversity of topics, activities, and collaborations involved in our educational programming and implementation.

DESG collaborates with local and national partners to advance aquaculture and seafood safety.

Both locally and nationally, DESG demonstrated leadership in aquaculture and seafood safety through collaboration with other Sea Grant programs, regulators, legislators, nongovernmental organizations, and the community. Significant progress in aquaculture has been made in our own state, with DESG playing a pivotal role in collaborative

interactions leading to the successful reopening of Delaware's Inland Bays to shellfish aquaculture. The four-year review period began just after Delaware's General Assembly approved the legislation in 2013, with DESG input, to restart shellfish aquaculture in the Inland Bays and ended just after the first bottom leases were awarded to farmers. Considerable support, expertise and coordination was provided by DESG during this time to help regulators put into practice the legislation and to help stakeholders—from prospective shellfish farmers to water quality organizations—achieve their goals of planting oysters and clams.

At the same time, the DESG aquaculture and seafood specialists were working regionally and nationally to advance the industry outside of our state. In coordination with Oregon Sea Grant/Extension, Louisiana Sea Grant, and Wisconsin Sea Grant, DESG developed and coordinated regional "Aquaculture and Fish Tech 101" educational programs for industry professionals and educators. This programming covered important global, national, regional, and local issues related to seafood quality, safety, and human health, with a goal of informing consumers about the importance of seafood in their diets. More than 100 seafood-affiliated representatives from extension, research, industry, and NGOs participated in the workshops and received the training materials and online resources that were developed.

DESG strengthens partnerships that support community resilience and disaster preparedness.

Adaptation strategies to enhance community resilience to climate change is a shared concern across Sea Grant programs. During the 2014–2017 time period, DESG strengthened its collaborative network to support community resilience and adaptation by working with Sea Grant programs on both regional and national scales. DESG professionals collaborated with NWS and Sea Grant partners in NOAA's North Atlantic Region to design and host a regional workshop to build capacity for NWS outreach and associated impacts. The workshops also provided feedback on NWS products related to forecasting, communicating about weather- and climate-related hazards, and emergency preparedness. This effort helped to achieve Weather-Ready Nation goals that not only enhance climate services to help communities, businesses, and governments understand and adapt to climate-related risks, but also improve weather decision services for events that threaten lives and livelihoods. DESG professionals also collaborated with New Jersey Sea Grant colleagues to extend resources and information on climate adaptation planning to New Jersey communities. As part of this collaboration, we provided NJSG with the "Delaware Homeowners Handbook to Prepare for Natural Hazards" text and template produced by DESG to use in preparation of the NJ Homeowners Handbook. DESG also demonstrated leadership and expertise on disaster preparedness by coordinating with colleagues at Hawaii Sea Grant for delivery of a National Disaster Preparedness Training Center course on coastal community resiliency. In addition to regional and national partnerships, DESG worked extensively within our own state, coordinating with DNREC, DNERR and NOAA's Coastal Services Center on workshops related to climate adaptation and resiliency specifically for Delaware communities. These collaborative interactions between DNREC and DESG professionals contributed to the formation of the Delaware Resilient and Sustainable Communities League (RASCL), which now holds yearly summits to bring the latest climate preparedness resources to stakeholders in the state of Delaware and beyond.

REGIONAL/MULTI-PROGRAM PROJECTS

As reflected in the preceding stories and list of collaborations, DESG was involved in many varied projects throughout the region involving multiple programs, whether within the Sea Grant or NOAA networks, the civil society and government of the state, or with partners who fit in neither category, but increased the quality and impact of a project. Another way to consider the breadth of collaboration and impact represented by the projects described in this book is in the table below, which shows how many projects involved partners outside DESG (columns) and states beyond Delaware (rows):

Table 4. DESG Collaborators and Projects.

Collaborators by State	Sea Grant	Federal	Delaware Agencies	University Partnerships
Delaware		11	9	7
Maryland	6	3	3	4
Virginia	3	2		2
North Carolina	3	1	1	
Pennsylvania	3	1		1
New Jersey	5	1	1	
New York	2	1	1	
Outside Mid-Atlantic Region	8			

SUCCESS IN SEA GRANT NATIONAL COMPETITIONS

DESG highly values its place in the National Sea Grant Program and strives to contribute to the nationwide vision in many ways, including by supporting research through National Strategic Investment (NSI) awards.

Table 5. 2014–2017 National Strategic Investments.

2014–2017 National Strategic Investments	Award Amount
Climate Initiative	$60,000
Economics of Ecosystem Services from Oyster Aquaculture	$317,216
Aquaculture and Fisheries Technologies for Food and Health Educators, Seafood Professionals, and Communicators: Phase II Continuation of Aquaculture and Fish Tech 101	$131,687
Surf Zone Injury and Beach Safety Awareness Campaign: Enhancing the Delaware Surf Zone Injury Study	$14,976
Network Visioning Initiative	$30,000
Social Dimensions of Offshore Wind Power Development off the Delmarva Peninsula	$119,269
A Bioeconomic Analysis of Ecosystem-Based Horseshoe Crab Fishery Management	$52,915
	$726,063

Graduate Student Fellowships

DESG administered a number of graduate student fellowships during the 2014–2017 time period, including seven prestigious Knauss Marine Policy Fellowships. It should be noted that residents of Washington, D.C., find themselves without a home Sea Grant program when applying for the Knauss Fellowship, so applications are rotated among several state programs. During this time, Delaware administered a 2014 and 2017 Knauss Fellow from Washington, D.C.

Table 6. Sea Grant Fellowships.

2014–2017 Fellowships	Award Amount
Knauss Fellowship, 2014	$56,500
Knauss Fellowship, 2015	$56,500
Knauss Fellowships (3), 2016	$169,500
Mid-Atlantic Coastal Storms Graduate Research Fellowship, 2016	$40,000
Knauss Fellowships (2), 2017	$113,000
Coastal Management Fellowship (declined due to accepting full-time position elsewhere)	n/a
	$435,500

Performance

LEADERSHIP

In several areas central to Sea Grant's mission, DESG is recognized as a leader in the state and Mid-Atlantic region. Years of investment in developing standards-based, innovative approaches to both formal and informal education, coupled with significant effort to share those approaches through professional development, has earned DESG a well-deserved reputation for excellence in advancing environmental literacy and workforce development. Similarly, attention to process as well as product and the willingness to share what we have learned has led to recognition as a program with effective and transferable knowledge on how to facilitate community development and other participatory governance discussions. Both of these strengths have not only continued since the 2014–2017 review period, they have gained momentum with new hires.

Whether in research and education, community development or other areas, DESG's leadership derives from its staff members' expertise and their willingness to contribute to regional and national organizations, both to share their knowledge and continuously improve their own capability. *(See Appendix, Leadership by staff on boards and committees.)* Their efforts result in formal recognition from peers and professional organizations.

Selected Awards to DESG Staff

2015 Delaware ACE Women's Network Leadership Award (Targett)

2016 DNREC Volunteer Research Group of the Year Citizen's Monitoring Group (Whereat)

2016 Outstanding Community Partnership Award from Downtown Delaware Program (Lewandowski)

2017 Early Career Achievement Award from Mid-Atlantic Sea Grant Network (Lewandowski)

2017 National Marine Educators Association Johnette D. Bosarge Memorial Award (Petrone)

2017 William Q. Wick Award for Visionary Career Leadership (Falk)

2015, 2016, 2017, 2018 First Place Awards from National Federation of Press Women (8 total) and Delaware Press Association (16 total) (EPE and MAS)

Leadership Amongst Community Members and Peers

- Municipal and academic leaders recognize DESG as a leader in facilitation of public engagement and planning. In response to a request from the Lewes Planning Commission to lead the public participation component for the update of the City of Lewes' Comprehensive Plan, DESG helped organize and facilitated public workshops attended by more than 75 people.
- Faculty from three Sea Grant universities—Dr. Joanna York (UD), Dr. Mark Brush (VIMS), and Dr. Lora Harris (UMD)—also requested assistance from DESG to facilitate workshops that collected stakeholder input from more than 15 community planners, scientists, and environmental managers concerning use of the Delmarva Water Quality Model, which gives communities information about how land use affects the health of coastal bays.
- DESG is also known as a leader in education. To increase member diversity and membership benefits, the Delaware Association for Environmental Education requested that DESG lead efforts to develop a conference scholarship and mini-grant program. DESG developed protocols and leads the recruitment and review of applications.
- Sun Otter Tours Inc. sought assistance from DESG to develop a hands-on "beach science" tour for their new company. DESG connected them with representatives from the Southern Delaware Tourism Office and other local businesses and continues to provide the tour with a one-hour exploration of the lower levels of the marine food web.
- Kids Cottage Inc., a local daycare and preschool provider, also received support from DESG when they requested a science professional development series for their teachers. DESG provided four half-day sessions for more than 40 teachers. With assistance from DESG, Kids Cottage developed a renewable energy summer camp and has filled that camp every year since. Both Sun Otter and Kids Cottage have enjoyed increased financial success by incorporating DESG education.
- Institutions outside of Delaware also recognize DESG as a leader in public engagement. Hawaii Sea Grant, North Carolina Coastal Federation, and Stockton University in New Jersey each received detailed guidance from DESG on implementing large environmental-themed open houses, similar to our annual Delaware Coast Day.
- DESG provided leadership in seafood education to national and international audiences. Health practitioners, seafood technologists, and other seafood professionals from all parts of the United States sought DESG's "Aquaculture and Fish Tech 101" workshops, which provided participants with in-depth sessions on core seafood topics, including safety and regulations, nutritional information, key issues, media communications, and future outlook. DESG's Hazard Analysis Critical Control Point (HACCP) training helped seafood processors and regulators from around the globe identify and prevent hazards that cause foodborne illnesses.

PRODUCTIVITY BY FOCUS AREA

The approach taken by DESG over the 2014–2017 period led to significant achievements in research, extension, and education. From program organization to research competitions, DESG has sought continuous improvement while maintaining its productivity. The ability to do both has grown directly from its dedication to stakeholder engagement and collaborations, as well as a focus on relevance to the community.

Activities undertaken by DESG staff and by our researchers have contributed to progress toward both the national performance measures and the goals laid out by DESG in its 2014–2017 strategic plan. This section follows the format of that plan and highlights our successes by focus area.

Research Productivity

Researchers supported by DESG are producing scholarly publications in high-impact journals and reporting research results that are highly relevant to the broader community. In fact, publications describing DESG-supported research have been cited in more than 780 publications over the past 10 years alone and include several publications that have received recognition as top-cited papers by high-impact journals. The publication rate of our PIs has also increased, with nearly double the number of publications during 2014–2017 compared to the previous four years. Many of these publications are in high-impact journals, including:

Publications Featuring DESG Research

- Nature Communications (IF 12.353)
- Bioresource Technology (IF 5.978)
- Journal of Environmental Management (IF 4.449)
- Biogeosciences (IF 4.373)
- Applied and Environmental Microbiology (IF 4.272)
- Earth Surface Processes and Landforms (IF 4.119)
- Limnology and Oceanography (IF 4.025)
- Oecologia (IF 3.409)
- Journal of Geophysical Research-Oceans (IF 3.207)
- IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (IF 3.156)
- Ecological Engineering (IF 3.139)
- Journal of Applied Meteorology and Climatology (IF 2.991)
- Journal of Applied Phycology (IF 2.826)
- Estuarine Coastal and Shelf Science (IF 2.732)
- Marine Ecology Progress Series (IF 2.682)
- Estuaries and Coasts (IF 2.651)

Healthy Coastal Ecosystems

Population growth, development, sea level rise, and degraded water quality are just a few of the challenges facing Delaware's coastal communities, affecting our local economies, as well as the environment. The 2014–2017 DESG strategic plan for the Healthy Coastal Ecosystems focus area placed emphasis on ecosystem processes, relationships between coastal stressors and long-term human and ecosystem health, and providing educational opportunities to enhance understanding and promote stewardship of our coastal environment. To that end, DESG made substantial investments in innovative research to study impacts of these pressures on the health of Delaware's coastal ecosystems and links between ecosystem dynamics and coastal communities. Outreach and education activities were designed to engage and inform local communities and other end users so that they can prepare for and respond to pressures on ecosystem health.

Progress Toward National Performance Measures

National Measure	DESG Achieved
Number of acres of coastal habitat protected, enhanced or restored as a result of Sea Grant activities.	1
Number of resource managers who use ecosystem-based approaches in the management of land, water, and living resources as a result of Sea Grant activities.	59

Water Quality Efforts

DESG partnered with DNREC to support water quality assessments and monitoring efforts of local marine and freshwater environments. Much of this important work was carried out by local volunteers throughout the state, who contributed approximately 40,000 hours of effort as part of the Citizen Monitoring Program with support from DESG. Water quality assessments were then used by a broad range of stakeholders and end users including university researchers, local communities, state agencies, and nongovernmental organizations. The South Bethany Canal Water Quality Committee, for example, used water quality monitoring data to show progress toward their goal of making the South Bethany Canals "fishable and swimmable." DESG also leveraged water quality monitoring efforts to assist the Delaware CIB to produce and implement a water use plan to address water use challenges.

While water quality in our local bays remains degraded, our world-class beaches are a different story. The water quality assessment program supported by DESG was instrumental in Delaware being ranked first in the nation for having the highest water quality at coastal ocean beaches. This important recognition was highlighted by local resort communities and state tourism agencies to promote Delaware's clean beaches and coastal tourism in the state.

In addition to water quality assessments, DESG made significant investments in harmful algal bloom (HAB) research, focused on HAB genetics, ecology, and mitigation strategies for species that plague Delaware's coastal environment. HABs have negative effects on ecosystem health and may also have severe economic impacts on recent efforts to restore oyster populations and commercial shellfish aquaculture. Recreational activities such as fishing or boating may also bring local residents or visitors to our region in contact with toxins produced by HABs or pathogenic bacteria such as *Vibrio* spp. that are associated with harmful algal species. DESG researchers found that nutrient-laden groundwater input stimulated phytoplankton growth and differentially structured algal communities, leading to an increase in abundance of HAB species. Other research funded by DESG showed that several distinct strains of a globally-distributed, fish-killing HAB species reside in Delaware's Inland Bays. Results of this project will advance researchers' ability to identify toxic vs. non-toxic blooms and provide coastal management officials additional information to improve response and remediation efforts. In addition to research on HAB ecology, DESG funded research on HAB mitigation using immobilized bacteria that secrete algicidal compounds. Development of this approach would allow targeted deployment in areas such as commercial aquaculture sites for short periods of time to prevent or mitigate blooms.

DESG Goals Addressed

- A network of trained citizen scientists increases the capacity of coastal Delaware monitoring efforts.
- Development of new research tools and practices to improve water quality monitoring efforts is supported.
- Understanding of the impact of changing land use on water quality is improved through the use of new tools, technology, and information services.
- Improved knowledge of natural oyster recruitment in Indian River Bay is demonstrated.
- Technical support and guidance improve aquaculture practices and enhance opportunities for new efforts.

Ecosystem Processes Studied and Restored or Improved

Salt marshes provide critical refuge and breeding grounds for wildlife in Delaware, while also protecting coastal communities from storm surge and flooding. In spite of their recognized value, salt marshes in Delaware are under significant threat due to rising sea levels, increased coastal storm activity, and marsh alterations as a result of human encroachment and development. DESG-supported research improved a model used for simulations of salt marsh dynamics and addressed key questions about the performance and function of salt marsh ecosystems in a changing climate, investigating inundation patterns, sediment transport and accretion, and carbon sequestration in marsh ecosystems. These efforts were used to support restoration of approximately 4,000 acres of tidal wetlands within the Prime Hook National Wildlife Refuge. Other DESG-funded research investigated the role of carbon cycling in coastal marshes. Carbon sequestration by marshes was a key factor in developing decision-making tools to manage impacts of sea level rise on coastal communities. DESG researchers partnered with other Mid-Atlantic Sea Grant programs to address this issue, bringing together natural and social scientists to investigate factors related to barrier island retreat and develop decision-making management tools. The value of marshes in sequestering carbon informed the development of these management strategies and resulted in a long-term beach management plan that is expected to benefit local communities for many decades to come.

The Broadkill River watershed has undergone increased pressure from both residential and commercial development at the head of a tidal estuary in Milton, a small community with limited resources. Stormwater management has been identified as a key issue in the watershed by the Broadkill Tributary Action Team, and a Pollution Control Strategy Plan was mandated by DNREC. DESG staff worked with community and state partners to apply lessons learned from research to help restore the Broadkill River watershed by reducing stormwater impacts and implementing education programs to support restoration efforts. As part of this work, DESG staff served as project coordinators for the second phase of the Milton Rain Gardens project and led the design and construction of six rain gardens in the community. DESG continues to provide programming to support watershed education and restoration efforts.

DESG Goals Addressed

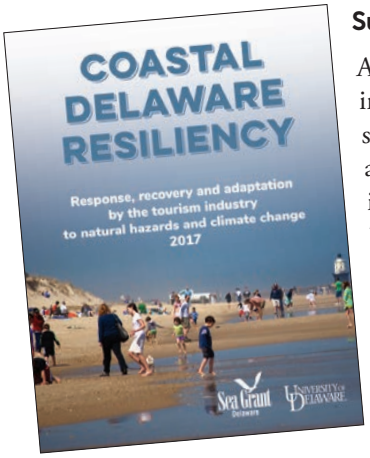
- Improved understanding of ecosystem processes in Delaware and the surrounding region is supported.
- Regional ecosystem sustainability is improved through data developed by DESG researchers.
- Innovative technologies lead to improved assessments of sediment transport, long-term coastal morphology, beach nourishment options, and sea level rise.
- Stakeholders are provided with data to support long-term coastline management, and sea level rise mitigation efforts.
- Low Impact Development (LID) techniques in coastal watersheds are increasingly applied, in collaboration with local partners.

Resilient Communities and Economies

Delaware is the second smallest state in the United States but has the sixth highest population density in the country. In addition, about 15 percent of the U.S. population lives within a 200-mile radius of our world-class beaches in Sussex County, supporting a $3.3 billion tourist industry, the fourth largest private employer in the state. Yet losses in recreational fisheries and commercial fish stocks, along with a shift in commercial activity to the Route 1 corridor leading to our beaches, have led to an economic decline for many of our maritime and rural communities. These losses are compounded by climate change, which puts Delaware coastal communities at risk of coastal hazards like increased flooding and sea level rise. DESG addressed these challenges during the 2014–2017 time frame by funding research and outreach activities to provide local communities with information and support needed to enhance their economies through sustainable activities while increasing resiliency to coastal hazards.

Progress Toward National Performance Measures

National Measure	DESG Achieved
Number of communities that implemented sustainable economic and environmental development practices and policies as a result of Sea Grant activities.	34
Number of communities that implemented hazard resiliency practices to prepare for, respond to or minimize coastal hazardous events as a result of Sea Grant activities.	29



Support for Tourism

A warming climate, changes in weather patterns, and rising sea levels will change how and where tourism business is done in coastal Delaware. To address these challenges, DESG contracted with Conservation Community Consulting to explore the potential actions for the coastal tourism industry to undertake in response to changes resulting from climate change and coastal hazard impacts. A technical white paper focusing on this subject matter was translated into a 32-page public-friendly report, "Coastal Delaware Resiliency: Response, recovery and adaptation by the tourism industry to natural hazards and climate change." Outreach efforts, including presentations, press releases, and social media content were then designed to communicate these findings to local tourism entities, chambers of commerce, municipalities, and Southern Delaware Tourism, the convention and visitors' bureau for Sussex County.

DESG also worked directly with local communities to develop sustainable tourism plans. In Laurel, for example, DESG supported development of a nature-based and heritage tourism plan, with recommendations that added value to the sustainable economic development goals of Laurel by attracting paddlers, cyclists, birders, and heritage tourists to the community. More information on support for specific communities is in the next section.

DESG Goals Addressed

- Leadership is provided regionally and nationally on a sustainable coastal tourism initiative.
- Development of a "Sustainable Tourism Framework" for coastal Delaware through collaborations with local tourism and business leaders is supported.

Community Development Activity

During 2014–2017, DESG made substantial investments in local communities to support and enhance economic growth. The maritime community of Leipsic, for example, has been in decline since the 1980s due to the collapse of local recreational fisheries and decreases in commercial fish stocks. This decline has left the community with significant challenges to support economic growth while maintaining its rich cultural heritage and tradition as one of Delaware's premier working waterfronts. DESG worked with the town of Leipsic to produce a set of recommendations and strategies for growth and economic development. DESG then funded development of a new destination image and marketing message for the community—"Leipsic, DE…Built on Water"—and assisted the town of Leipsic in securing funding for an engineering study to determine options for repairs and improvements to a dock and bulkhead along the waterfront. Support from DESG for community events, such as the first annual Oyster Festival in 2017 in Leipsic, helps promote local businesses in this community and its long tradition of oyster harvests in the Delaware Bay.

DESG professionals also worked extensively with the Town of Laurel, a Broad Creek waterfront community, in their revitalization efforts. Similar to Leipsic, DESG assisted

Laurel in creating a new image and rebranding as "Laurel, DE: Great things come naturally." DESG partnered with UD landscape architecture faculty and students to design a phased waterfront redevelopment project, "The Ramble," including mixed-use residential and commercial development, a landscaped river walk, a children's nature-based play area, a kayak launch, and green infrastructure to help prevent stormwater runoff into Broad Creek. DESG also conducted a municipal business infrastructure assessment to build a GIS-based story map of Laurel to help stimulate economic growth. The story map consisted of narrative text, images, and multimedia content that was featured on a Reimagine Laurel website and social media site, created with assistance from DESG. Community events organized by DESG, such as the Delmarva Paddling Weekend in Laurel and the WaterColors community watermelon bus painting event, promote Laurel's rich agricultural heritage, as well as its natural and recreational resources.

DESG Goals Addressed

- Economic growth in coastal communities is stimulated through partnerships with various agencies and organizations.
- Development of marketing/branding strategies to enhance economic development and employment opportunities in waterfront communities is completed.
- Communities engage in economic development initiatives that capitalize on the value of their natural and cultural resources while balancing resource conservation and economic growth.
- Communities have diverse, healthy economies and industries without displacing traditional working waterfronts.

Coastal Hazards and Climate Change Mitigation and Adaptation

Offshore wind has the potential to shift much of the East Coast's electricity needs to renewable power but requires support from the public, local communities, and state governments. DESG conducted a survey of residents in Delaware and Maryland to evaluate public sentiment toward offshore wind, given a range of pricing, project sizes, and visual impacts. Results of the survey demonstrated overwhelming support for offshore wind, providing clarity to state representatives about public perceptions and the level of support for offshore wind power in this region. DESG also partnered with DNREC Division of Energy and Climate to host "Focus on the Coast" seminars to provide local government and community leaders with an overview of climate change issues and mitigation strategies, providing a forum to share results of the offshore wind survey.

DESG made substantial investments in research and outreach to identify and communicate risks to local communities and ecosystems from coastal hazards such as flooding. The Delaware coastline is especially vulnerable to coastal storms due to its low mean elevation, susceptibility to both tropical and extratropical systems, and increased infrastructure development near waterways. DESG-supported research put storms and flooding events into historical context and developed new methods to quantify impacts as they occur in real time. A workshop convened by DESG researchers for state and federal agencies led to development of a network of readily transportable, inexpensive high-water mark sensors for rapid deployment in coastal communities prior to impending storms. Additional workshops conducted by DESG professionals delivered flood risk training for municipal officials along with resources for preparedness and adaptation, as well as Elevation Certificate training for Delaware building professionals and workshops for homeowners about FEMA's flood insurance program and how to reduce their risk of flooding. Working with state and federal partners, DESG created web-based interactive flood risk awareness maps for Sussex County communities, using new mapping technologies that communicate both present and future levels of flood risk. DESG also developed a climate change information portal to provide information on the best climate science, links between hazards and climate, and best practices related to community adaptation planning initiatives.

DESG Goals Addressed

- 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.
- Educational programs are developed—targeted to various coastal audiences—to inform about hazards and risks associated with living along the coast.
- Local officials' knowledge and awareness of flood hazard BMPs are increased.
- Improved communication, collaboration, and resource-sharing among coastal communities, local decision-makers, and coastal resource managers improve planning for long-term resilience.
- Research necessary to aid extension work to improve resiliency in coastal communities is supported.

Environmental Literacy and Workforce Development

DESG is committed to providing lifelong formal and informal learning opportunities to engage and inform the public about environmental issues affecting our coastal communities and environmental health. Whether through teacher training and K–12 student education, social media or outreach events like Coast Day, DESG strives to deliver science-based information that contributes to a well-informed public. During the 2014–2017 time period, DESG also worked to support local businesses and promote sustainable growth, with documented economic gains of over $300K to our state's economy.

Progress Toward National Performance Measures

National Measure	DESG Achieved
Number of Sea Grant products that are used to advance environmental literacy and workforce development.	38
Number of people engaged in Sea Grant-supported informal education programs.	21,253
Number of Sea Grant-supported graduates who become employed in a career related to their degrees within two years of graduation.	28
Number of Sea Grant tools, technologies, and information services that are used by our partners/customers to improve ecosystem-based management.	31
Economic (market and non-market; jobs and businesses created or retained) impacts derived from Sea Grant activities.	13 Businesses retained $324,128 Economic benefit

K–12 Education and Professional Development for Teachers

DESG pursued a multi-faceted approach to engage the public and students in the process of science, including citizen monitoring, hands-on displays, and resources and training for teachers and students. This included annual workshops for citizen monitoring volunteers, as well as developing lesson plans and web-based educational resources for K–12 teachers. In addition, DESG provided over 100 pre-K–12 teachers with hands-on, minds-on professional development in a wide variety of topics, including local weather and climate, water quality, watersheds, ecology, marine biology, wind energy, and the Next Generation Science Standards. With this training, teachers gained valuable content knowledge, skills, and experiences that will allow them to better serve their students.

DESG also planned and implemented programs for students, including those underserved and underrepresented in marine science. Wind energy programs for first- and fifth-graders focused on UD's 2-megawatt wind turbine: how it works and what it means for energy sustainability. Behind-the-scenes tours of UD's Robotic Discovery Laboratories, Global Visualization Lab, and 146-foot research vessel allowed high school students from inner-city Philadelphia and Camden, New Jersey, to learn about technologies that scientists use to study our ocean. With assistance from DESG, high school students from inner-city Baltimore also had an opportunity to learn and grow in Delaware's outdoors through the National Aquarium's "River to the Sea" program, a week-long field-based program that fostered personal and professional growth.

Engaging directly with targeted groups, DESG provided unique learning experiences and an opportunity for students to share their knowledge. With over a decade of experience volunteering for the National Ocean Sciences Bowl (NOSB) regional competitions, the DESG education specialist hosted the Chesapeake Bay Bowl in 2014 and 2017, where 120 high school students from the Mid-Atlantic region demonstrated their knowledge of coastal and marine science by competing for the regional championship and the opportunity to compete at the NOSB finals.

DESG also provided a mix of interactive discussion and hands-on field activities for Boy Scout groups in the Mid-Atlantic region to satisfy requirements for the Oceanography Merit Badge. This long-running program is particularly popular and not only exposes participants to real-life experiences in oceanography, but also serves as an introduction to marine-related careers. Similar programs have been provided to Girl Scout groups, despite the lack of a formal oceanography badge.

DESG Goals Addressed

- Improve the ability and confidence of formal and informal educators to teach about coastal, ocean, and climate change science.
- Provide grade 6–16 students and teachers with information on marine careers, with emphasis on science, technology, engineering, and math.
- Provide opportunities for Delaware students to learn about the coastal and marine environment and demonstrate their knowledge, while supporting teachers' needs to meet state standards.
- Improve awareness of and access to marine and environmental information for targeted audiences, including informal student groups, particularly underserved and underrepresented youth.

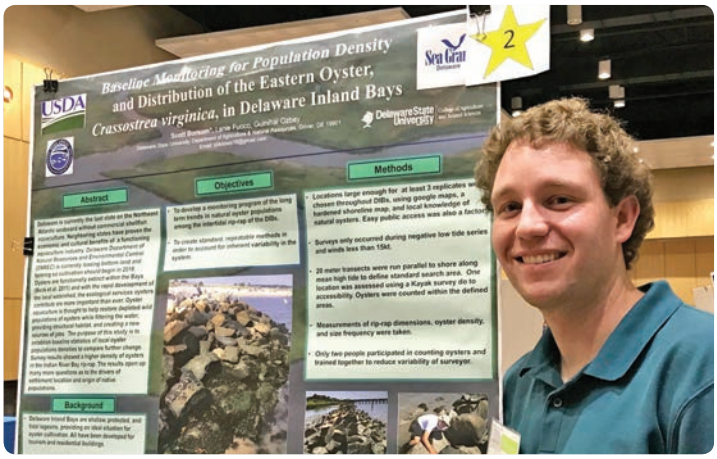
Public Engagement

Recognizing that public engagement requires different approaches for different audiences, DESG hosted several outreach events during the review period designed to promote environmental literacy across a broad spectrum of the public. DESG's annual outreach event, Coast Day, provided unique opportunities to engage thousands of people in marine science-related topics in a single day at UD's campus in Lewes. Prepared by DESG staff, UD faculty and students, and partners from other state and local academic and management programs, Coast Day exhibits were designed to convey scientific information while at the same time building strong interest and understanding of the environment. During the summer months, DESG also hosts an annual summer lecture series, "Ocean Currents," for the purposes of informing interested citizens, coastal community members, and environmental leaders on topics relating to climate change, fisheries, water quality, and global ocean issues. Our "Focus on the Coast" workshops are another example of DESG engaging the public by bringing together coastal decision-makers to discuss pressing local environmental challenges.

Educational material is also produced and distributed by DESG through mass media. DESG's "Sea Talk" radio series was broadcast by radio stations in the Mid-Atlantic region with a listening audience of 8 million. The 30- and 60-second formats covered topics of coastal and environmental interest. Our popular "#15secondscience" series, aired on social media, consists of short blasts of science-related information. In 2017, it had grown to over 30,000 views across four channels (Instagram, Facebook, Twitter and YouTube). The value of this format was recognized by the National Sea Grant Office, who featured #15secondscience on the homepage of their website.

DESG Goals Addressed

- Increase public understanding of role individuals can take to conserve and wisely use coastal, ocean, and environmental resources.



Graduate Student Development

DESG has a strong commitment to graduate student training in marine science, engineering, and policy by providing students with important research experience and opportunities in career development. To that end, DESG has provided graduate student tuition and salary support to work on competitively awarded research projects. Students were also introduced to the DESG mission and operations, provided with communications training, and encouraged to undertake an activity with a DESG staff member. In this program, students were exposed to the activities of the entire DESG program and were provided opportunities to engage in outreach programs with individual staff members.

In addition to DESG support of seven Knauss Fellows and one NOAA Coastal Storm Fellow during 2014–2017, DESG developed additional internship and fellowship opportunities for graduate students. DESG partnered with the Delaware Coastal Programs Office to support a Delaware NERR Fellow and also arranged a graduate student internship with DNREC's Division of Fish and Wildlife. Success of these fellowship and internship programs formed the basis for creation by DESG of three additional graduate student internships in 2018 and expected expansion to include undergraduate students in 2019.

DESG Goals Addressed

- Engage funded graduate students in opportunities to become more knowledgeable and understanding of Sea Grant outreach and extension approaches.

Sustainable Fisheries and Aquaculture

DESG made a substantial investment in 2014–2017 to advance and support Delaware aquaculture, seafood safety, and sustainable fisheries. DESG efforts laid the groundwork for the successful (and long-awaited!) re-opening of our Inland Bays to shellfish aquaculture. An aquaculture extension agent within DESG, along with oyster branding efforts and economic analysis by DESG professional staff and researchers, further supported Delaware's aquaculture industry. DESG also advanced public and professional education in safe seafood handling and processing and enhanced consumer knowledge about the benefits of seafood consumption and sustainable harvesting practices.

Progress Toward National Performance Measures

National Measure	DESG Achieved
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.	176

Support for Aquaculture in Delaware

Oysters are considered keystone species for ecosystem health and were once an important fishery in the Mid-Atlantic region. Unfortunately, disease and poor management of oyster stocks contributed to significant declines in the oyster fishery in this region. DESG staff and researchers worked with local and state regulatory agencies, shellfish growers, and local citizens to support redevelopment of a viable commercial shellfish aquaculture industry in Delaware. Substantial support from DESG staff contributed to the passage of a bill in 2013, authorizing DNREC to develop a bottom leasing program for commercial shellfish aquaculture in the Delaware Inland Bays. During the 2014–2017 time period, DESG assisted DNREC with development of this program by serving as a source of technical, science-based information for coastal residents and prospective oyster farmers and by working to address concerns of the general public about aquaculture impacts on our local bays. DESG used several communication methods to provide this information, including public and web-based presentations, seminars, and workshops, along with one-on-one consultations with prospective growers.

At the same time, DESG funded research in support of Delaware's aquaculture industry by examining the role of microbial communities and oyster genotype in disease resistance, examining factors affecting consumer willingness to pay for oysters, and developing innovative post-harvest processing technology to improve consumer safety.

DESG efforts leading to the successful establishment of shellfish aquaculture in Delaware's Inland Bays directly contributed to the recent harvest of the first commercially grown cohort of Inland Bays Oysters in September 2018. A Sea Grant aquaculture grant and a Rural Business Enterprise Grant from the U.S. Department of Agriculture provided funding for the development of the Inland Bays Oysters brand in 2015. The first oyster farmer to bring his product to market credited the brand and DESG's work in sharing it with having prepared consumers to want his oysters once they were available. Looking to the future, DESG hired an additional, part-time aquaculture extension agent at DSU. He now works closely with the DESG fisheries/aquaculture outreach specialist to provide ongoing assistance to growers.

DESG Goals Addressed

- Populations of natural oysters and other epifaunal bivalve species are inventoried and cataloged in Delaware's Inland Bays.
- Awareness of methods and gear choices for growout and culture methods is increased among potential shellfish growers.

Seafood Safety

DESG played a key role in advancing knowledge of safe seafood handling by consumers and industry professionals. The seafood safety specialist at DESG contributed to developing HACCP training materials and worked with several project teams within the National Seafood HACCP Alliance to develop train-the-trainer materials for Sanitation Control Procedures and revise the current Seafood HACCP Models. In partnership with other extension programs in the Northeastern Regional Aquaculture Center, DESG contributed to the development of biosecurity plans with BMPs for commercially important finfish and shellfish species, producing a technical manual to improve operational protocols and risk management strategies.

DESG also engaged directly with consumers to advance knowledge of seafood safety and nutritional benefits of seafood consumption. The Seafood Health Facts website, developed in partnership with Cornell University and maintained by DESG, is increasingly recognized as a reliable and impartial source of science-based information on this topic, with visitors from all 50 states and over 130 countries. DESG also developed and taught classes to consumers on seafood safety and sustainable harvesting at local academic institutions, as well as through the Osher Lifelong Learning Institute program. Together, DESG provided consumers, healthcare professionals, and seafood industry professionals access to new and up-to-date information needed to ensure a safe, secure and sustainable supply of seafood to meet public demand.

DESG Goals Addressed

- Seafood processors are trained and educated in Delaware and the region on FDA Seafood HACCP regulations.
- National Seafood HACCP Alliance Train-the-Trainer materials for the Sanitation Control Procedures (SCP) Course are revised and updated.
- Seafood processors are trained on Sanitation Control Procedures (SCP) allowing them to meet the FDA requirements for the eight key sanitation conditions.

Program Changes from Previous Site Review

While there were no recommendations by the previous Site Review team, we appreciated the thoughtful suggestions that were provided to improve our impact.

1. Suggestion: Vigorously explore avenues for additional outside leveraged funds to grow and strengthen the program.

Response: Leveraged funds (managed and influenced) from our MAS staff and current researchers exceeded the amount reported in the initial response to this suggestion for each of the final two years of the site review period. We will continue to vigorously explore all avenues to maintain or exceed this level of support in the future.

2. Suggestion: Consider starting a State Fellow program modeled after the Knauss Fellowship Program or California Sea Grant State Fellowship Program.

Response: DESG created a joint graduate fellowship program with Delaware National Estuarine Research Reserve and placed an intern with the Delaware Division of Fish and Wildlife during 2014–2017. These pilot efforts led to partnerships with other agencies and organizations to support additional internships within the state in 2018.

3. Suggestion: Think about strategies for maintaining continuity of personal working networks when planning for and responding to retirements or other staff changeovers.

Response: When possible, retiring personnel stayed on to allow for knowledge transfer and continuity with stakeholders as new staff were hired.

4. Suggestion: Modify tracking and use of leveraged funding for increased accuracy and flexibility in matching funds.

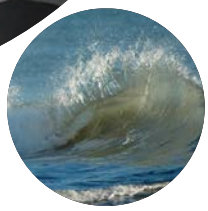
Response: DESG tracks our actual match internally, which is greater than our required match. We have begun to use our match overage to assist Delaware organizations that have shown just cause for lack of matching sources to encourage research proposals from PIs that lack matching funds.

We have started reporting multi-year leveraged funds projects over the award years instead of capturing the entire amount in year one.

5. Suggestion: Identify the needs of retirees arriving from out-of-state, a new stakeholder group.

Response: We established a partnership with the City of Lewes to conduct preparedness workshops "Ready or not: Emergency planning for older adults and people with disabilities." We also continue supporting "Ocean Currents" lectures on the Lewes campus, and we have launched an outreach effort with Sun Otter Tours, both of which are popular with retirees. We are exploring offering content through the Osher Lifelong Learning Institute Program.

Appendix—Leadership By Staff On Boards and Committees (2014–2017)



SERVICE TO SEA GRANT AND NOAA

Chair, SG Extension Assembly (Falk)

Treasurer, Sea Grant Association (SGA) (Targett)

Secretary, SG Education Network Executive Committee (Petrone)

Instructor, SG Academy (Falk)

Member, SGA (Targett, Falk, Lewandowski)

Member and SGA Liaison, Sustainable Coastal Communities Development (SCCD) Network Executive Committee (Falk)

Member and SGA Liaison, Program Mission Committee (Falk)

Member, SGA Communicators Network (O'Connell, Roberts, Jolly-Van Bodegraven)

Member, SGA Strategic Communications Subcommittee (O'Connell)

Member, Sea Grant Week Planning Committee (Falk)

Member, SG Mid-Atlantic Regional Meeting Planning Committee (McCray)

Member, SG Hazard Resilient Coastal Communities Focus Team (Carey)

Member and SGA Representative, Networks Advisory Council (Falk)

Member, SCCD Focus Team (Falk)

Member, NOAA Chesapeake Bay Office B-WET grant program review panel (Petrone)

Member, NOAA PCMHAB (Coyne), Transition Advisory Committee (Whereat)

Member, NOAA/US Lifesaving Association National Rip Current Messaging Team (Carey)

NATIONAL AND INTERNATIONAL SERVICE

Chair, Consortium for Ocean Leadership/Board of Directors (Targett)

Chair, Ocean Future Committee, Education Task Team (Targett)

Coordinator, World Aquaculture Society Employment Service (Ewart)

Seafood Advisor, National Fisheries Institute (Hicks)

Member, National Seafood Hazard Analysis and Critical Control Point (HACCP) Alliance Steering Committee (Hicks)

Member, Seafood HACCP Alliance Executive Committee (Hicks)

Member, Seafood HACCP Alliance Editorial Committee (Hicks)

Member, Seafood HACCP Alliance Training Materials Committee (Hicks)

Member, Internal Advisory Board, NSF ADVANCE (Targett)

Member, Comisión Nacional de Investigación Científica y Tecnológica CONICYT (Chile National Commission for Scientific and Technological Research) Review Panel (Ewart)

Member, Consortium for Ocean Leadership (Targett)

Member, eXtension Community of Practice (CoP) groups: Freshwater Aquaculture, Invasive Species, and Sustainable Marine Fisheries (Ewart)

Member, International Conference on Shellfish Restoration (ICSR) Steering Committee (Ewart)

Member, National Marine Educators Association (NMEA) Annual Conference Committee (Petrone)

Member, NMEA Board of Directors (Petrone)

Member, NMEA Education Research Committee (Petrone)

Member, Search Committee for Consortium President, Ocean Future Committee (Targett)

Member, Society for Research Administrators (Hans)

Member, World Aquaculture Society Industry Committee (Ewart)

Member, National Federation of Press Women (Beeson, Donnelly, Graw, Jolly-Van Bodegraven, O'Connell and Roberts)

Member, National Association of Science Writers (Roberts)

Member, International Rip Current Symposium Organizing Committee (Carey)

Member, International Life Saving Federation RipSafe Committee (Carey)

REGIONAL SERVICE

Chair, Mid-Atlantic Marine Education Association (MAMEA) Action Plan Committee (Petrone)

Chair, MAMEA Social Media Committee (Petrone)

Chair, MAMEA Annual Conference Committee (Petrone)

Chair, Middle States Accreditation Institutional Review for UMCES (Targett)

President, MAMEA (Petrone)

Delaware Representative, MAMEA (Petrone)

Treasurer, East Coast Shellfish Research Institute (Ewart)

Founding Member, Mid-Atlantic Coastal Resilience Institute (Targett)

Member, Industry Advisory Council, Northeastern Regional Aquaculture Center (Ewart)

Member, Mid-Atlantic Environmental Literacy Workgroup (Petrone)

Member, UNH School of Marine Science and Ocean Engineering External Advisory Board (Targett)

Member, Virginia Institute of Marine Science Virginia Fishery Resource Grant Program Review Panel (Ewart)

Member, Maryland Department of Natural Resources, Harmful Algae Task Force (Whereat)

Member, Steering Committee, Resilient and Sustainable Communities League (Swallow)

Delaware Representative, Atlantic States Marine Fisheries Commission Committee on Social Science (Falk)

Member, National Association of State Aquaculture Coordinators (Ewart)

STATE AND LOCAL SERVICE

Chair, Lewes Education Coalition (Petrone)

Vice-Chair, Greater Lewes Foundation Board (Targett)

Interim State Aquaculture Coordinator (Delaware) (Ewart)

Member, Blue Hen Wind/Board of Directors (Targett)

Member, Cape Henlopen State Park REECH Program Steering Committee (Petrone)

Member, Delaware Association for Environmental Education Board of Directors (Petrone)

Member, Delaware Center for the Inland Bays Science and Technology Advisory Committee (Farrell)

Member, Delaware Children in Nature Coalition (Petrone)

Member, Delaware Natural Areas Advisory Council (Lewandowski)

Member, Delaware State Parks Council (Lewandowski)

Member, Delaware Technology Park/Board of Directors (Targett)

Member, Delaware Water Resources Advisory Panel (Lewandowski)

Member, Delaware Waterways Management and Financing Advisory Committee (Lewandowski)

Member, Delaware Small Business Development Center Committee on Delaware Business Resiliency (Carey)

Member, Delaware Association for Environmental Education (O'Connell, Jolly-Van Bodegraven)

Member, Delaware Press Association (Beeson, Donnelly, Graw, Jolly-Van Bodegraven, O'Connell and Roberts)

Member, Delaware Hazard Mitigation Council (Carey, Swallow)

Member, Delaware National Estuarine Research Reserve Coastal Training Program Advisory Board (Carey)

Member, DNREC Community Involvement Advisory Council (Farrell)

Member, DNREC Climate Change Impact Assessment Steering Committee (Carey)

Member, DNREC Coastal Training Program Advisory Committee (Swallow)

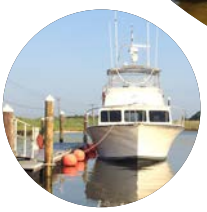
Member, DNREC Beach Regulatory Advisory Committee (Carey)

Member, Sussex County Association of Towns (Lewandowski)

Member, Sussex Economic Development Action Committee/Board of Directors (Lewandowski)

Member, Sussex Habitat for Humanity/Board of Directors (Lewandowski)

Member, Lewes-Rehoboth Canal Improvement Association/Board of Directors (Lewandowski)



Member, Greater Lewes Foundation Board (Swallow)

Member, City of Lewes Hazard Mitigation Committee (Swallow)

Member, City of Lewes Mitigation Planning Team (Carey)

Member, Town of Bridgeville Planning & Zoning Commission (Lewandowski)

Member, Wilmington University Environmental Science and Policy Advisory Board (Lewandowski)

Member, Green Eggs and Sand: Horseshoe Crab/Shorebird Education Project, Board of Directors (O'Connell)

Member, New Road Master Plan Stakeholder Committee (Swallow)

Member, Delaware Interfaith Power and Light Youth Climate Action Planning Committee (McCray)

Member, Inland Bays Oyster Branding Committee (Ewart)

Member, Inland Bays Water Use Plan Implementation Committee (Lewandowski)

Member, First State Marine Wind/Board of Directors (Targett)

SERVICE TO UNIVERSITY OF DELAWARE

Chair, UD Subcommittee for Grand Challenges, Great Debates, and Big Ideas (Targett)

Co-Chair, UD Coordinated Communications Council (O'Connell)

Member, UD Lewes Safety Committee (Petrone)

Member, UD STAR (Science, Technology, and Applied Research) Campus Steering Committee (Targett)

Member, UD Strategic Planning Steering Committee (Targett)

Member, UD Campus-Wide Social Media Group (O'Connell)

Member, UD Steering Committee, Colleges Representative (O'Connell)

Member, UD Web Governance Committee (O'Connell)

Member, UD Creative Services Committee (Beeson)

Member, UD Partnership for Arts and Culture (McCray)

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