



**PROPOSAL FOR CERTIFICATION
AS A**

SEA GRANT COLLEGE

SUBMITTED BY

THE PENNSYLVANIA STATE UNIVERSITY

19 September 2014

LIST OF ABBREVIATIONS

ABBREVIATION	FULL NAME
AIS	Aquatic Invasive Species
AOC	Area of Concern
BMP	Best Management Practice
BUI	Beneficial-Use Impairment
BWET	Bay Watershed Education and Training
CCCAI	Coastal Climate Change Adaptation Initiative
CGLL	Center for Great Lakes Literacy
COSEE	Centers for Ocean Sciences Educational Excellence
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Area
CZMP	Coastal Zone Management Program
DCNR	Pennsylvania Department of Conservation and Natural Resources
DEP	Pennsylvania Department of Environmental Protection
DNA	Deoxyribonucleic Acid
Esri	Environmental Systems Research Institute
GIS	Geographic Information System
FTE	Full-Time Equivalent
GLNPO	USEPA Great Lakes National Program Office
GLRI	Great Lakes Restoration Initiative
HAB	Harmful Algal Bloom
IAGLR	International Association of Great Lakes Research
LECOM	Lake Erie College of Osteopathic Medicine
LEW-CWMA	Lake Erie Watershed Cooperative Weed Management Area
NIE	Newspapers in Education
NOAA	National Oceanic and Atmospheric Administration
NSF	National Science Foundation
PAH	Polycyclic Aromatic Hydrocarbons
PASG	Pennsylvania Sea Grant
PCP	Polychlorinated Biphenyl
PIB	Presque Isle Bay
PISC	Pennsylvania Invasive Species Council
PFBC	Pennsylvania Fish & Boat Commission
PPCP	Pharmaceuticals and Personal Care Products
Project FLY	Project Fishing and Learning Youth
PSIEE	Penn State Institutes of Energy and the Environment
RFP	Request for Proposal
RNA	Ribonucleic Acid
RSC	Regional Science Consortium at the Tom Ridge Environmental Center
SARP	Sectoral Applications Research Program
SONS	Save Our Native Species
STEM	Science, Technology, Engineering, and Math
SUNY	State University of New York
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
VHS	Viral Hemorrhagic Septicemia

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INTRODUCTION/CONTEXT

Brief History

In March 1998, NOAA provided funding to Penn State Behrend, on behalf of The Commonwealth of Pennsylvania and The Pennsylvania State University, to initiate a highly focused Sea Grant outreach project related to the Lake Erie watershed and coastline of Pennsylvania.

In response, Penn State established the Pennsylvania Sea Grant Program (PASG) to promote the ecological and economic sustainability of Pennsylvania's coastal resources through science-based research, education, and outreach.

Based on PASG's performance over its initial six years as an outreach project and the University's reputation, in March 2004, National Sea Grant Office leadership determined that:

- Penn State should lead the Sea Grant effort for Pennsylvania;
- Pennsylvania's outreach project should be designated a Coherent Area Program, which included extension, education, and a modest applied research program.

As the program grew, PASG expanded its influence statewide to three diverse coastal-related regions: the Lake Erie, Delaware River, and Susquehanna River watersheds. In summer 2009, again based on performance, National Office leadership designated PASG an Institutional Program, which included a broader statewide mandate and an expanded research program.

Using the National Sea Grant Program's Strategic Plan as a guide, PASG's current strategic plan supports three critical program areas for 2014-2017: Healthy Coastal Ecosystems, Resilient Communities and Economies, and Education and Workforce Development.

Since 1998, PASG has grown from two to thirteen staff members, one to three major watersheds, and annual NOAA base funding of \$160,000 to \$1,216,475. Pennsylvania's research funding has included, as of March 2014, 106 projects, with thirty-seven distinct organizations, for a total of \$1,659,394; including competitive grants solicited via request for proposal (RFP) totaling nearly \$600,000 since 2012. In addition, per recommendation of the last two site visit teams, major categories of program investment over the years have evolved from 100 percent extension to extension/research parity.

In recognition of the program's continuous growth and maturity, PASG, its host institution Penn State University, and its supporters and stakeholders are making this formal request to the National Sea Grant Office to certify PASG a Sea Grant College.

PASG Mandates/Recommendations from 2008 and 2011 Panels

MANDATES FROM 2008 NOAA REVIEW PANEL	
RECOMMENDATION	RESPONSE
Complete statewide expansion	Established an office in the Susquehanna River watershed in October 2008 in cooperation the PA Fish and Boat Commission (PFBC); created advisory council in 2010.
Create statewide advisory board	Initiated discussions with stakeholders regarding strategy for board development; identified and confirmed appointments in July 2010.
Increase research funding	Increased NOAA research funds from \$0 in 2008 to \$149,000 in 2012-14 and to \$545,767 per year for 2014-2018.
	Increased research support from Penn State from \$0 in 2008 to \$60,000 per year for 2012-14 and to \$160,000 per year for 2014-18.
	Coordinated research RFPs in 2012-14 with twenty-five competitively funded projects totaling nearly \$600,000.

MANDATES/RECOMMENDATIONS FROM 2011 NOAA REVIEW PANEL	
RECOMMENDATION	RESPONSE
Adapt performance measures	PASG has developed an MS Access database tool based on the PIER reporting structure which captures program goals, performance measures, and targets.
Locate DE Office with related organization	Currently in conversation with several groups.
Develop communication plan.	Staff began implementing various communication efforts immediately after the 2011 review; PASG's communication strategy in draft form.
Find more ways to engage with the estuarine programs into which Susquehanna and Delaware watersheds drain.	<p>PASG's watershed coordination extends linkages beyond the Commonwealth's boundaries to form a continuum from the headwaters to the bays.</p> <p>Specific initiatives for the Delaware estuary include:</p> <ul style="list-style-type: none"> • streamlining administration of the Estuary Program; • developing estuary "health" indicators; • completing the Delaware Estuary Fish Consumption Survey; • serving on local boards to address estuary priorities efficiently; • collaborating on numerous climate adaptation projects. <p>Specific initiatives for the Susquehanna River watershed include:</p> <ul style="list-style-type: none"> • participating in regional efforts to improve water quality such as the Penn State Lower Susquehanna Initiative and the Susquehanna River Heartland Coalition for Environmental Studies; • participating in state efforts through Pennsylvania's Department of Environmental Protection (DEP) Chesapeake Bay Program to improve water quality in the Susquehanna River; • collaborating with several county conservation districts to develop and distribute aquatic invasive species (AIS) prevention information to boaters and anglers; • seeking ways to partner with New York and Maryland Sea Grant on regional initiatives.

CRITERIA

1. LEADERSHIP

Be a recognized leader in the ecological and economic sustainability of coastal resources through science-based research, education, and advisory services throughout the state and Sea Grant regions.

PASG is a recognized leader in coastal-related research and extension in Pennsylvania and throughout the Great Lakes and Mid-Atlantic regions. Pennsylvania's central location affords PASG the opportunity to coordinate activities with the Mid-Atlantic and Great Lakes Sea Grant regions, as well as several U.S. Environmental Protection Agency (USEPA) and NOAA regions. PASG has placed an emphasis on leveraging federal expertise, developing its own expertise in extension and research, and leading regional efforts.

PASG Leverages Federal Support

PASG has been a catalyst for augmenting federal support and resources to increase and diversify the collective NOAA-related impacts in Pennsylvania:

- Leveraging federal funds with private and state funds;
- Promoting statewide collaboration among local, state, and private sector organizations;
- Promoting incorporation of Pennsylvania experts (thirty-seven organizations to date) to support PASG's research effort;
- Leading efforts to address NOAA region-wide issues with other Sea Grant states;
- Bringing NOAA and the National Sea Grant Program's nationwide expertise and resources to bear in the Commonwealth.

PASG Takes Lead on Selected Extension Efforts

PASG has taken a local, state, or regional lead in selected areas:

- Led the development of the Pennsylvania AIS Management Plan, which the National Aquatic Nuisance Species Task Force approved in 2007.
- Taken a lead role in addressing Pharmaceuticals and Personal Care Product (PPCP) chemicals in coastal waters, especially in Great Lakes waters.
- Led the effort to assist partner organizations and municipalities in the Lake Erie watershed to preserve open space, provide recreational access to area waterways, and protect environmentally sensitive areas.
- Drafted climate adaptation and other sustainability objectives for the City of Chester's *Vision 2020 Comprehensive Plan*.

- Will assume leadership of the Center for Great Lakes Literacy (CGLL), a partnership between the USEPA and the Great Lakes Sea Grant Network that provides professional development for basin educators.

PASG Builds Expertise in Selected Research Areas

- Increasing understanding of the nature of future flooding risk in the Delaware River watershed in light of projected sea level rise and climate change.
- Impact of AIS on Pennsylvania waters – prevention, early detection, and rapid response.
- Determining the causes, impacts, and implications of the smallmouth bass virus in the Susquehanna River watershed.
- Factors that influence high *E. coli* levels on Lake Erie and Presque Isle State Park beaches, including tracking sources of contamination.
- Understanding the sources, effects, and remediation of contaminants such as PPCP.
- Evaluating the ecological integrity of Lake Erie and Presque Isle Bay using fish communities, sediment contamination, and tumor occurrence to address species-specific bio-indicators.

PASG Takes Leadership Role in Organizing Regional and National Meetings

- PASG worked with Delaware and Minnesota Sea Grant to host to the 2013 Sea Grant Extension Assembly and Communicator Conference.
- PASG staff organized the 2014 Great Lakes Sea Grant Great Lakes Network Meeting.

PASG Staff Assume Leadership Roles	
NATIONAL/INTERNATIONAL	LOCAL
• Great Lakes Commission, PA Commissioner	• Chester Climate Adaptation Task Force, Co-Chair
• Lake Erie Percid Mgmt Adv Group for GLFC, Member	• DE County Coastal Zone Management Task Force, Member
• National Assembly of Sea Grant (SG) Ext Dir, Member	• DE River Urban Waters, Partner
• PA Advisor Great Lakes Fishery Commission, Member	• <i>E. coli</i> Taskforce, Chair
• SG Association, Member	• Environment Erie, Vice Chair
• SG Education Network, Member	• Erie Community Foundation’s Environment Committee, Member
• SG Extension & Communications Network, 2013	• Erie Times-News in Education Advisory Board, Member
• SG PPCP Working Group, Member	• Erie-Western Port Authority Advisory Board, Member
• SG Superstorm Sandy Coordination Team, Co-Chairs	• Friends of the Tom Ridge Environmental Center, Member
• Sustainable Coastal Community Dev Network, Member	• Harmful Algal Bloom Task Force, Education & Outreach Cmte
REGIONAL	• Lake Erie Coastal Zone Advisory Committee, Member
• Center for Great Lakes Literacy, Project Coordinator	• Lake Erie Region Conservancy Board, Member
• Chesapeake Bay Prog Education Workgroup, Member	• Millcreek Township Planning, Commissioner
• Great Lakes Observing Systems, Member	• PA Archeological Shipwreck Survey Team, Co-Chair/Organizer
• Great Lakes SG Directors Network, Member	• PA Lake Erie Watershed Association, Member
• Great Lakes SG Network, Member	• Partnership for the Delaware Estuary, Board Member
• Mid-Atlantic Panel on AIS, Member	• Penn State Behrend School of Science Board of Visitors, Member
• Mid-Atlantic Regional Ocean Council, Member	• Preservation Erie Board, Member
• Mid Atlantic SG Network, Member	• Presque Isle Bay Public Advisory Board, Executive Committee
STATE	• Presque Isle State Park Advisory Board, Member
• PA Invasive Species Council, Member	• Regional Science Consortium, Past President
	• Seaway Trail PA Committee, Member
	• Tick Taskforce, Chair/Organizer

2. ORGANIZATION

Have created the management organization to carry on a viable and productive Sea Grant Program and have the backing of its administration at a sufficiently high level to fulfill its multidisciplinary and multifaceted mandate.

Institutional Setting and University Engagement with PASG

Since 1998, Penn State Behrend, an undergraduate and graduate university campus of The Pennsylvania State University, has led the implementation of the statewide program with the support and guidance of the Penn State University system and the Commonwealth. Within the University, Penn State's Institutes of Energy and the Environment (PSIEE), an organization that coordinates the entirety of the University's energy and environmental resources, provides oversight for the program. In addition, the program works closely with the University's Senior Vice President for Research and Penn State Behrend's Chancellor. Based on these connections, PASG was able to obtain nearly \$420,000 annually in cash and in-kind matching funds from the University.

In addition to its affiliation with PSIEE and the cooperation of University researchers, the University's Provost has initiated an effort to garner the collective water resources of the University to address water-related issues. To this end, the University has developed the initiative, *Water at Penn State: A Strategic Plan for Enhancing Science, Education, and Outreach*. The program focuses on investment in four research areas of excellence, with acute societal relevance, and in which Penn State is poised to become a global leader: Water Quality, Quantity, and Human Health; Watershed Dynamics: Fluxes from Continent to Ocean; Water and Ecosystems; and Water and Global Environmental Change. PASG will be a partner in this expanding area of expertise. This plan has internal (college deans) and external (national experts) advisory groups. Recently, along with several other longstanding water-related research and extension centers at the University, PASG was invited to make a presentation to the combined advisory groups about its programs.

Management Leadership

PASG director (since March 1998), Dr. Robert Light, also serves as Penn State Behrend's Senior Associate Dean for Research and Outreach & Chief Operating Officer. He holds a doctorate in Ecology from Penn State and has thirty years of administrative experience in a higher education setting. This position affords PASG a close and high-level connection to college and University leadership, especially in areas related to marketing and communication, general outreach/extension, sponsored research, community and workforce programs, K-12 Science, Technology, Engineering, and Math (STEM) initiatives, and academic programs. He spends at least 55 percent of his time on PASG duties.

A PASG organizational chart has been included (Figure 2A) which includes further detail on staffing and institutional setting. Staff résumés are included in Appendix 1.

Geographic Influence

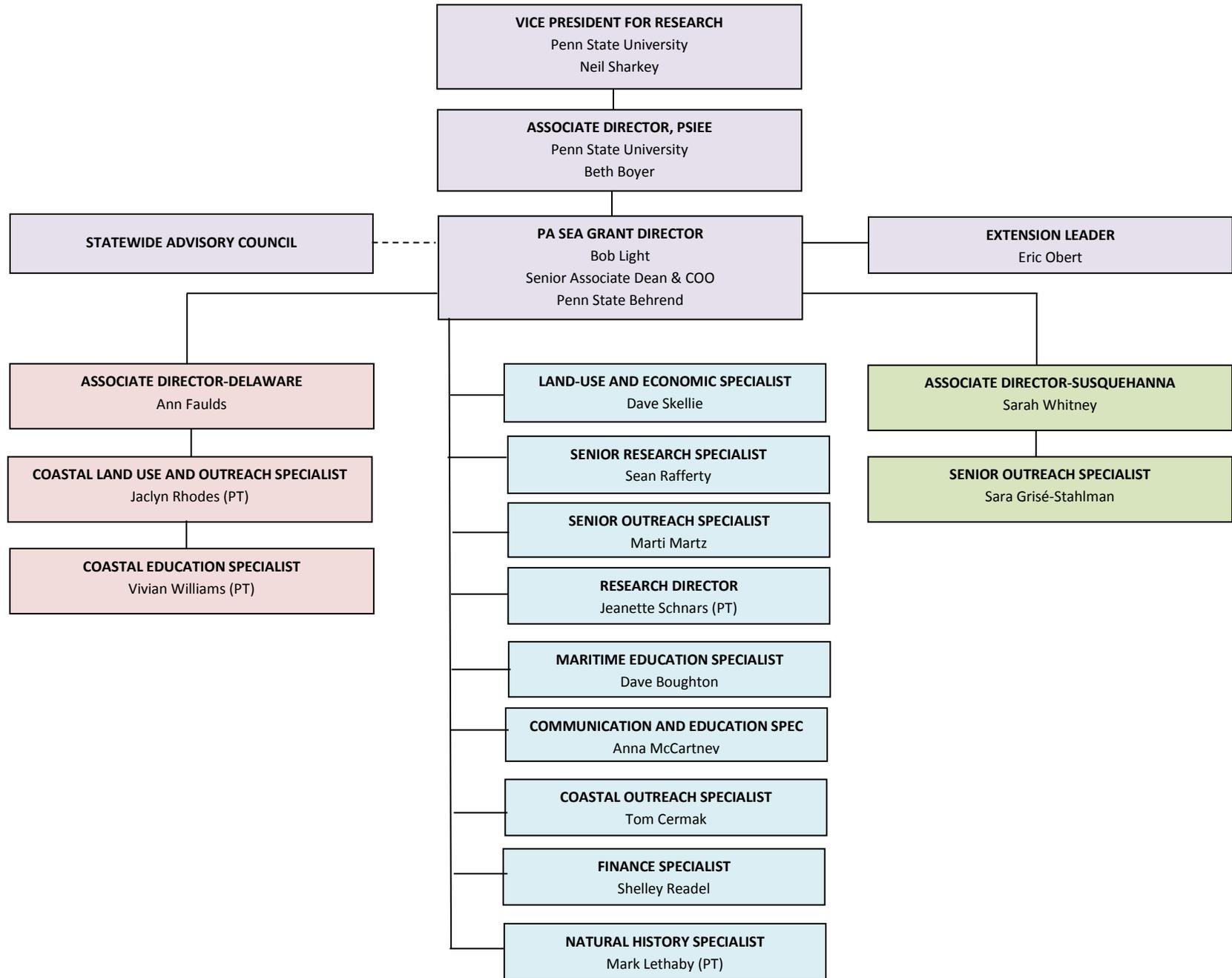
PASG influences coastal watersheds across the state, including the Lake Erie, Delaware River, and Susquehanna River watersheds.

- The Lake Erie watershed consists of the northern half of Erie County and the northwestern corner of Crawford County. Overall, the watershed land area is 511 square miles. The dominant topographic feature of the watershed is the 76.6-mile shoreline of Lake Erie that includes the Presque Isle ecosystem.
- The Delaware is the longest un-dammed river east of the Mississippi. The Pennsylvania portion of the Delaware River watershed is home to approximately 5.25 million residents and in total, 8 million people rely on the Delaware for drinking water. The Pennsylvania Coastal Zone Management Area (CZMA) includes a 112-mile stretch of tidal Delaware River coastline within Bucks, Philadelphia, and Delaware counties. The CZMA is PASG's primary geographic focus. Because of its importance to Philadelphia and the Delaware Estuary, the Schuylkill River watershed is also a target area for PASG.
- The Susquehanna River basin is the largest watershed in the Atlantic Slope of North America. In Pennsylvania, the Susquehanna River watershed covers approximately half of the land area of the Commonwealth and touches 43 of the 67 counties. The river is only a couple meters wide at its northernmost point in New York but expands to nearly a mile wide in Harrisburg.

Strategic Direction

PASG coordinates statewide issues with its Statewide Advisory Council and locally with councils for each of the three coastal watersheds (Tables 2A-D). The councils represent many of PASG's key stakeholder groups such as government agencies, private sector, and higher education. Refer to Relevance Section for more detail on the council involvement. PASG incorporates feedback from the councils into PASG's strategic planning. In addition, PASG also bases its planning and direction on NOAA's and the National Sea Grant Programs strategic plans, including the National Sea Grant Program's four critical program areas: Healthy Coastal Ecosystems, Resilient Communities and Economies, Sustainable Fisheries and Aquaculture, and Environmental Literacy and Workforce Development. Based on feedback from stakeholders and advisors, PASG does not consider Sustainable Fisheries and Aquaculture a high-priority issue for Pennsylvania; therefore, PASG focuses its efforts on the other three critical areas. Since stakeholder, advisor, and staff feedback are gathered on an ongoing basis, PASG considers its strategic plan as a draft document, maintaining flexibility to incorporate emerging coastal issues and changing directions of NOAA, the National Sea Grant Program, Pennsylvania, and other collaborators.

FIGURE 2A. PASG ORGANIZATION CHART



PASG Statewide and Regional Boards

The boards meet at least once per year, are provided an update on activities, and are asked for input on research focus areas and extension issues to address.

Table 2A. Statewide Advisory Council (established October 2010)	
NAME	TITLE & AFFILIATION
Steven Threefoot	Senior Consultant, DuPont Company Research and Development Group
John Arway	Executive Director, PFBC
Greg Czarnecki	Executive Director, Wild Resource Conservation Program, PA Dept of Conservation and Natural Resources (DCNR)
Lori Boughton	Program Mgr for the Watershed Mgmt Program in the NW Regional Office, DEP
Brian Hill	Program Officer, Richard King Mellon Foundation
Beth Boyer	Assistant Director, PSIEE

Table 2B. Lake Erie Watershed Advisory Council (established 1998)	
NAME	TITLE & AFFILIATION
Emily Beck	Director of Tourism Development, Visit Erie
Tim Bruno	Chief, Office of the Great Lakes, DEP
Ed Kissell	Vice President, Save Our Native Species of Lake Erie
Mark Kwitowski	Assistant Bureau Chief, Erie Wastewater Treatment Plant
Harry Leslie	Park Manager, Presque Isle State Park, DCNR
Pat Lupo	Program Director, Inner-City Neighborhood Art House
Steve Mauro	Dean, College of Health Professions and Science, Gannon University
Rick Morris	Engineer, Millcreek Township
Chuck Murray	Lake Erie Fisheries Biologist, PFBC
Dave Parker	Owner Operator, Presque Isle Canoe and Boat Livery
Jim Rutkowski	Chair, Presque Isle Bay Public Advisory Committee
Mike Rutter	Associate Professor of Statistics, Penn State Behrend
Bob Wellington	Retired, Aquatic Biologist, Erie County Department of Health

Table 2C. Delaware Watershed Advisory Council (established 2002)	
NAME	TITLE & AFFILIATION
Jason Cruz	Aquatic Biologist, Philadelphia Water Department
Danielle Kreeger	Science Director, The Partnership for the Delaware Estuary
Jeff Dewey	Coastal Resources Prog Analyst & Grant Coor, PA Coastal Zone Mgmt Prog (CZMP)
Ron MacGillivray	Environmental Toxicologist, Delaware River Basin Commission
Jessica Anderson	Communications Manager, PA Environmental Council
Jacqueline Tanaka	Professor of Biology, Temple University

Table 2D. Susquehanna Watershed Advisory Council (established 2010)	
NAME	TITLE & AFFILIATION
Dave Heicher	Manager of Research & Grants, Susquehanna River Basin Commission
Tim Schaeffer	Director of Policy Planning and Communications, PFBC
Geoffrey Smith	Susquehanna River Biologist, PFBC
Andy Zemba	Director, Interstate Waters Office, DEP
Lauren Imgrund	Coordinator, Landscape Conservation Initiative, DCNR
Cathy Curran Myers	Executive Director, Bucknell Environmental Center
Matt Royer	Director, Lower Susquehanna Initiative, Ag and the Env Center, Penn State

3. RELEVANCE

Be relevant to local, state, regional, or national opportunities and problems in the marine/Great Lakes environment, with an emphasis on the need for marine resources, and the extent to which capabilities have been developed to be responsive to that need.

PASG has developed a number of active and passive mechanisms for maintaining its relevance by gathering information from stakeholders of all types (government agencies, industry, public, etc.) and at all levels (local, state, regional, national, and international). Through these exchanges, PASG is able to update its strategic plan to reflect current and emerging issues, modify research focus areas in RFPs, which fill research gaps, and generate collaborative projects and funding.

Maintaining Local Relevance

Each of the three major watersheds in Pennsylvania has established an advisory council. In periodic meetings, PASG staff exchange and solicit input from among the membership, which represents the private sector, government, commissions, and other local leaders and stakeholders. Staff gathers input informally through open discussions or more formally through surveys, which help set priorities. Although the councils only meet one to two times each year, PASG councils include stakeholders, whom staff interact with many times during the year. This enhances the program's ability to receive feedback more often and modify plans with greater agility. In addition, during the course of research, extension, and education activities, PASG staff is in contact with many other constituents, including beneficiaries of programming such as boaters, anglers, marina operators, and environmental professionals. Staff also solicits feedback during these interactions.

Example 1 – Lake Erie Advisory Council: Feedback was solicited via survey using the 2010-2012 Lake Erie Advisory Council priority issues matrix completed by members of the council. Priority issues identified through this process and subsequently addressed by staff included: implementation of the statewide AIS management plan, non-point source pollution, implementation of the Lake Erie watershed plan related to the Presque Isle Bay Area of Concern, *E. coli* impacts and sources on Presque Isle beaches, collaboration with the Great Lakes Observing System, and wetlands delineation and preservation, and stream restoration. More recently, through guided discussion, the council provided a list of eight issues to be addressed including such things as phosphorus input to the watershed, harmful algae blooms (HAB), microplastics in fish.

Example 2 – Susquehanna Advisory Council: PASG developed a priority issues matrix with the Susquehanna Advisory Council in 2011. Issues of highest importance were: Chesapeake Bay TMDL/Watershed implementation plan, implementation of state AIS plan, AIS

monitoring and tracking, clean marinas/smart boating, water quality/quantity and non-point pollution, fish passage in Susquehanna, and Marcellus shale research and extension.

Maintaining Statewide Relevance

PASG uses its Statewide Advisory Council and strong relationships with state agencies to gather feedback regarding program research and extension efforts. Feedback is used to update the program's strategic plan, develop research focus areas for requests for proposals, modify extension priorities, and identify new areas for collaboration and joint funding.

Example 1 – Statewide Advisory Council: At its last meeting, the statewide council was asked to list focus areas for PASG's next RFP. Results, which were incorporated into subsequent solicitations included: brownfields in the Delaware watershed and their potential relationship to flooding and climate change, developing a better understanding of nutrient loading related to the Susquehanna's connection to the Chesapeake Bay watershed and harmful algal blooms in Lake Erie, developing species-specific climate models and range projections for climate vulnerability analysis, and mortality of smallmouth bass in the Susquehanna watershed.

Example 2 – DCNR: PASG staff met with the Deputy Secretary for Conservation and Technical Services and key staff members with DCNR to discuss future areas of collaboration. Results of the meeting included twelve potential areas, such as sharing geospatial data for improving watershed-planning efforts, working on River Access Plan for Susquehanna along with PFBC, school-based watershed education (e.g., PASG's Marcellus Shale E-Forum), implementing recommendations from the Chester Creek River's Conservation Plan, creating new recreational areas and waterfront access for City of Chester, and sharing geospatial data for climate adaptation planning in Delaware County.

Maintaining Regional Relevance

PASG has been fully integrated into the Great Lakes and Mid-Atlantic Sea Grant Networks, including membership and leadership roles on director- and extension-level boards and committees, hosting regional meetings, and forming collaborative teams to address emerging issues.

PASG hosted the Great Lakes Sea Grant Network Meeting in June 2014, with more than eighty attendees from eight programs. During the program, participants had the opportunity to compare notes on extension focus areas and in many cases develop collaborative approaches for solving key issues. Main areas included clean marinas, climate change, emerging contaminants, HABs, and AIS.

Interactions at the regional level help PASG maintain its relevance in a larger geographic setting, often leading to collaborative projects among multiple Sea Grant programs.

- PASG has been most active regionally related to AIS research and outreach to boaters, anglers, aquarium owners, and water gardeners Collaborating Sea Grant Programs include Minnesota and Illinois-Indiana. Great Lakes Restoration Initiative (GLRI) funding provided support for these projects.

- PASG received funding as part of the National Sea Grant office's AIS competition to conduct research and extension on AIS vector management looking at baitfish as a pilot pathway.
- Between 2003 and 2012 PASG collaborated with the Delaware and Maryland Sea Grant programs to provide meaningful watershed experiences for teachers and students from schools in the Chesapeake Bay drainage

Maintaining Research Relevance

PASG began funding applied research mini-grants in 2000 in order to seed relationships with experts from higher education and other institutions. These projects enabled staff to identify relevant research areas, determine which institutions were addressing specific research areas, and begin to develop relationships with individual researchers. From 2000 to 2012, PASG funded seventy-two projects (\$959,533) with thirty institutions.

More recently, 2012-present, PASG has received and disseminated through RFPs, NOAA research and Penn State funds for larger projects. Since 2012, the program has solicited research in focus areas identified in conjunction with advisory councils, the National Sea Grant Office, Sea Grant regional partners (Great Lakes and Mid-Atlantic), and others through a series of four RFPs. The Susquehanna River watershed staff also reviewed draft RFP language and priorities with its council members.

Key focus areas for RFPs solicited since 2012 have included AIS impact in Pennsylvania waters, genetic detection of AIS; mortality of smallmouth bass in the Susquehanna watershed; coastal climate adaptation in the Delaware River watershed; nutrient loading in key watersheds, brownfield sites and potential impact on flooding, assessment of fish barriers in tributaries to Lake Erie, and factors that influence *E. coli* levels on Presque Isle beaches. Based on feedback from councils, constituents, staff members, collaborators, and others, PASG has modified its RFPs to reflect timely research issues to address.

Table 3A provides an overview of the 2012-2014 PASG research competitions which incorporated new research funds earmarked for an RFP process approved by the National Sea Grant Office. Over the next three years, 2015-2018, PASG will have approximate annual funds of \$500,000 and \$160,000 from NOAA and Penn State, respectively. PASG plans include maintaining its relevance through focus area advice from its advisory councils, collaborators, and constituents; gathering feedback from its faculty researcher pool; and using its external proposal reviewer pool and National Sea Grant Office staff to maintain an appropriate focus and scientific rigor.

Year	Pre-Proposals	Full Proposals	# of Institutions	Awarded Projects	Total Funding	Topics
2012	20	10	19	7	\$376,036	Climate change, eDNA, AIS, nutrient loading, smallmouth bass mortality
2013 – 14-16 Omnibus #1	15	8	12	7	\$192,942	Climate change, ecological integrity of Lake Erie, lake levels, PPCP, smallmouth bass mortality, AIS
2014 – 14-16 Omnibus #2	18	11	17	In Process	In Process	Climate change, fish migration barriers, <i>E. coli</i> , AIS, smallmouth bass mortality
Total	53	29	33			

Example 1 – Enhancing the RFP Process: PASG has developed a structured process for maintaining relevance and quality of its research program, including:

- generating relevant focus areas as described above;
- a broad, statewide solicitation of preliminary proposals incorporating a standard format;
- a review of preliminary proposals by PASG staff to determine adherence to the RFP format and likelihood of project success;
- a request for full proposals with a standard format;
- a scientific review of full proposals by out-of-state experts in each of the focus areas;
- selection of finalists and approval by National Sea Grant Office staff;
- award and contract negotiation process through Penn State’s Office of Sponsored Programs;
- project updates and a final report prior to release of phases of funding;
- collection of lists of project deliverables, e.g., scholarly papers, conference presentations, etc.

Each of these steps in the research process ensures the relevance and quality assurance of PASG’s portfolio.

Example 2 – Mid-Atlantic Regional Research: PASG supported the Delaware Sea Grant led effort to identify research needs in the Mid-Atlantic; was instrumental in editing the Climate Change chapter published in the *Sea Grant Mid-Atlantic Ocean Research Plan*; and provided advisory support and proposal reviews as part of the Virginia Sea Grant Mid-Atlantic Research RFP.

4. PROGRAMMED-TEAM APPROACH

Have a relevant, high quality, multidisciplinary approach to research with associated educational and advisory services capable of producing identifiable results to the solution of marine/Great Lakes problems.

PASG has had great success augmenting its limited resources with multiple organizations and collaborators in many disciplines in order to address complex and far-reaching coastal issues such as standardizing tumor analysis in Areas of Concern (AOC), AIS impact, climate adaptation, and PPCP in the Great Lakes. These programmed-team approaches have led to increased funding from key sponsors, multiple publications, and a much broader view and more timely solution for each issue.

Example 1 – Fish tumors or other deformities beneficial-use impairment (regional): In 1998, PASG began working with DEP and several collaborators to address the fish tumors or other deformities beneficial-use impairment (BUI) associated with the Presque Isle Bay (PIB) AOC. Specifically, staff led and facilitated efforts to standardize criteria for assessing the BUI, assessed the BUI, supported research investigating potential etiologies of fish tumors in brown bullhead, and disseminated the results via workshops, field manuals, and scholarly journals. For a number of years, there was debate over appropriate methodology for monitoring the fish tumors BUI and setting targets for delisting. To provide solutions to these obstacles, PASG co-hosted and facilitated a series of three workshops from 2003-2006. The workshops brought together recognized experts in pathology and fisheries biology from the United States and Canada, and government agency representatives to formulate standardized fish tumor assessment criteria in all AOCs dealing with this BUI. As a result of the conferences, two manuals standardizing criteria for assessing the fish tumor BUI were produced: *Field Manual for Assessing Internal and External Anomalies in Brown Bullhead* and *Manual for the Microscopic Diagnosis of Proliferative Liver and Skin Lesions in the Brown Bullhead*. These manuals are currently being used by other AOCs to monitor the fish tumors BUI. In addition, the workshop participants concluded that brown bullhead tumor data collected throughout Lake Erie by PASG and DEP from 2002 to 2005 should be used to establish reference tumor rates and delisting targets for the fish tumor BUI.

Based on a statistical analysis of the fish tumor data collected from the various sites throughout Lake Erie, our statistician identified Long Point Inner Bay (Ontario, Canada) as the least impacted reference site. In 2007, PASG and DEP partnered to assess the tumor rates at Long Point Inner Bay. A Bayesian Analysis applied to the Long Point data established both liver and skin tumor reference rates. These data were published in Volume 36 (2010) of the *Journal of Great Lakes Research* and used by DEP to support its decision to delist the PIB AOC. In April 2012, PASG co-hosted and facilitated the *Presque Isle Bay Fish Tumors or other Deformities BUI Delisting Workshop and Webinar* in Erie,

Pennsylvania. During the workshop, fish health experts from throughout the United States discussed recent research findings related to tumors in brown bullhead and the process for moving PIB toward delisting. Because of the discussions and decades of research, DEP made the decision to petition USEPA to delist the PIB AOC. In February 2013, the PIB AOC became the second American AOC to be delisted by the U.S. State Department.

PASG staff and collaborators continue to assess the fish tumor issue through research. A Web-based database was created to host Great Lakes and Chesapeake Bay brown bullhead tumor data and sediment chemistry. Efforts are currently underway to assess viruses as a potential etiology of skin tumors, determine whether skin tumors have an anthropogenic etiology, evaluate if liver and external tumors in brown bullhead indicate a greater impact to the PIB fish community, and investigate other indicators that could be used to evaluate the ecological integrity of the PIB fish community. Table 4A includes a list of research grants related to this programmed-team project.

Collaborators included NOAA’s Great Lakes Environmental Research Lab, DEP, PFBC, USEPA’s Great Lakes National Program Office and Gulf Breeze Lab, United States Geological Survey (USGS), United States Fish and Wildlife Service (USFWS), International Joint Commission, Environment Canada, National Cancer Institute’s Registry of Tumors in Lower Animals, George Washington University Medical Center, Erie County Department of Health, PIB Public Advisory Committee, Penn State, Gannon University, and Mercyhurst University.

Multidisciplinary area experts included statisticians, veterinarians, fish pathologists, toxicologists, geneticists, fishery biologists, chemists, ecologists, government regulators, risk assessors, and limnologists.

Year	Source	Institution	Amount	Project
2008-09	PASG	DEP	\$2,000	Brown bullhead whole-sediment exposure study
2009-11	EPA GLNPO	Penn State Behrend	\$52,000	Fish Tumor database development
2010-12	EPA GLNPO	USGS Fish Health Branch	\$18,000	Investigating the possible association of virus with orocutaneous lesions in brown bullhead
2010-12	EPA GLRI	Gannon Univ	\$14,555	An evaluation of human health risks from contaminants in PIB
2010-12	EPA GLRI	Texas A&M University	\$21,535	Detection of PAH-DNA adducts from liver of fish collected from contaminated water in PA
2012-15	EPA GLRI	Gannon Univ	\$18,000	DNA sequencing of tumor and non-tumor tissue of brown bullhead
2012-15	EPA GLRI	USGS Columbia Research Lab	\$137,544	Evaluation of emerging and legacy contaminants in PIB and Long Point Inner Bay sediment and water
2014-16	PASG RFP	Gannon Univ	\$36,425	Genomic application for mutation analysis of skin tumor formation in the brown bullhead fish in PIB
2014-16	PASG RFP	Penn State University	\$45,964	Assessing the ecological integrity of PIB through the comparison of hepatic, orocutaneous, gonadal tumor rates, and intersex within <i>Micropterus dolomieu</i> , <i>Amia calva</i> , <i>Ameiurus natalis</i> , and <i>Ameiurus nebulosus</i>
		TOTAL	\$369,773	

Example 2 – Delaware County Climate Adaptation: The Chester Climate Planning Team (team) is a collaboration of outreach, climate, and planning specialists that relies heavily upon the Chester Climate Task Force for input. In addition to PASG, members of the task force include many City of Chester leaders and staff members, flood-affected residents, and many more (see collaborators list below). The task force contributed to a climate vulnerability assessment and adaptation plan that is detailed in the Chester Climate Adaptation Planning Elements. As an addendum to the Chester comprehensive plan, the elements prioritized needs and offered community-generated strategies that will serve as a roadmap for program and spending priorities for many years to come. The elements were further vetted through public community engagement sessions. The team will continue to call upon active task force members while inviting new members who bring relevance to the implementation of current projects. PASG staff gain additional, routine community engagement through participation with Delaware County CZMP, Delaware Estuary Climate Roundtable, and Delaware River Urban Waters meetings.

This project utilized the best available science, including Penn State climate projections for the Delaware Estuary and team-generated NOAA SLOSH flood projection models, the first such model for Pennsylvania’s eastern coast that utilizes LiDAR elevations.

The team recently received a grant from the Georgetown Climate Center to provide in-kind services to assess the legal feasibility of several adaptive land-use policies proposed as part of the Chester climate adaptation strategy. This legal research will help the city explore the possibility of developing abandoned upland properties (perhaps through collaboration with Habitat for Humanity) and offering land swaps to home or business owners currently located in the floodplain.

During the course of our flood hazard assessment, we found that models of small watersheds that combine the risk from stormwater run-off and storm surge do not exist. This led to the development of an RFP to solicit projects as part of the PASG Omnibus RFP to address this gap in hazard modeling. We also identified the need for more information about the risk of flooding of coastal brownfields in light of future climate.

PASG is also beginning to work with Penn State’s highly recognized climate research community to investigate more ways that PASG extension can work more closely with researchers in new research settings in the Delaware River watershed. This example, in which applied research informed extension and extension in turn identified further research needs, is typical of research-extension interaction for our program.

Collaborators included the NOAA Coastal Services Center, city council and staff members, flood-affected residents, healthcare providers, DEP staff, Chester Economic Development Authority, water and sewage utilities, university faculty members, conservation district staff, legislators, the Delaware Valley Regional Planning Commission, ICF International, the Delaware County Planning Department, the Partnership for the Delaware Estuary, USEPA Region II, SC2 (Strong Cities, Strong Communities), Georgetown Climate Center, and Pennsylvania Spatial Data Access.

Multidisciplinary area experts included academics, architects, aquatic biologists, attorneys, brownfield specialist, climatologists, climate adaptation specialist, communicators, emergency responders, engineers, environmental educators, outreach specialists, and planners.

Example 3 – AIS Management (statewide and regional) Given the significant impact that AIS have on the ecology and economy of Pennsylvania, preventing the introduction and spread of AIS is a key issue that PASG has focused on through both research and extension programs since its start in 1998. The recent discoveries of round goby in inland waters in the Erie region, didymo in multiple locations across the state, and water chestnut in new locations in northwest and southeast Pennsylvania highlight the need for continued action.

On the policy front, PASG was instrumental in establishing the Pennsylvania Invasive Species Council (PISC) in 2004. In 2005, PASG organized a workshop that brought together representatives from state and federal agencies, non-profit organizations, and commercial interests and gathered stakeholder input about AIS management priorities. This information was critical for the development of the Pennsylvania AIS Management Plan, which PASG spearheaded and was approved in 2007. The plan also served as a model for the statewide Invasive Species Management Plan. Because of PASG's work, Pennsylvania now has an approved plan in place and the Commonwealth has been able to receive more than \$3 million from USFWS over the past six years to help implement the plan.

In the fall of 2012, efforts began to formally establish the Lake Erie Watershed – Cooperative Weed Management Area. The Lake Erie Watershed Cooperative Weed Management Area (LEW-CWMA) provides a framework of contacts, planning and guidance to individuals, organizations and agencies engaged in the management of invasive plant species within the Lake Erie Watershed. The work of the LEW-CWMA helps members educate stakeholders, develop common management objectives, set realistic management priorities, and facilitate effective treatment while coordinating efforts over geographical and municipal boundaries with similar land types, use patterns, and problem species. The CWMA provides an opportunity to bring the concepts from the Pennsylvania Invasive Species Management Plan down to a local level. Since the formal establishment in 2012, partners have worked to develop a five-year plan, conduct inventories, develop site-specific management plans, and coordinate the treatment of an additional 86.67 acres that otherwise would have went untreated.

PASG has partnered with Sea Grant programs in the Great Lakes region to conduct outreach for specific pathways and users with the potential to spread AIS during their recreational and professional activities. By developing materials such as signage at boat ramps, fact sheets and watch cards on specific species, and conducting programs for boaters, anglers, water gardeners, and field staff, PASG has increased understanding and helped change behaviors to reduce the risk of AIS being spread. Over the past three years, PASG has conducted more than 100 programs and educated over 20,000 people on the steps they can take to reduce the risk of AIS spread. A survey in 2013 of almost 100 boaters and anglers

who attended PASG AIS prevention presentations or events found that a majority promised to “always” or “very often” take extra precautions to prevent the spread of AIS. Prior to the event, the majority surveyed indicated they would take precautions “somewhat often” or “never.”

PASG supports AIS early detection and monitoring through both research and extension activities. Since 2000, PASG has funded six research proposals (Table 4B) investigating early detection tools and examining distribution and population assessments of specific species (including zebra mussels, rudd, round goby, and red-eared slider). Since 2007, PASG has coordinated the Pennsylvania Zebra and Quagga Mussel Monitoring Network to help track the spread of invasive mussels in Pennsylvania. The information from volunteer monitors is shared with local stakeholders and state agencies to help prevent further spread and to help with natural resource management decisions. The Pennsylvania Biological Survey used information from the monitoring network in 2010 in their assessment reports for two native mussels (pistolgrip – *Quadrula verrucosa* and round hickorynut – *Obovaria subrotunda*) to recommend that both native mussels be listed as endangered species in Pennsylvania. In 2013, PASG developed *Pennsylvania’s Field Guide to Aquatic Invasive Species*, a waterproof, 5”x 8” identification resource containing profiles for about sixty species of significant concern for invasion in Pennsylvania. The guide, originally developed for water conservation officers, was found to be so useful that DEP and DCNR printed an additional 500 copies of the guide for their field staff and the online .pdf version is now posted on the national Aquatic Nuisance Species Task Force website. PISC is working on a terrestrial version modeled on the guide, and the Mid-Atlantic AIS Panel has requested PASG to develop a broader Mid-Atlantic version.

Additional PASG funding has supported research to study the impacts of specific AIS on native species, as well as graduate education support for what changes in climate will mean for the viability of non-native species in Pennsylvania.

These research results are also useful in the work PASG has done with rapid response planning. PASG led development of Pennsylvania’s AIS rapid response plan, which is an evolving tool for agencies to use when faced with the discovery of a new species or a species in a new location in Pennsylvania. The plan has been used by PFBC at least three times, and each time they provide feedback and suggestions, which PASG has incorporated into the plan.

Collaborators included PISC, PFBC, DEP, DCNR, Pennsylvania Department of Transportation, Great Lakes Sea Grant Network, USFWS, USEPA, county conservation districts, Pennsylvania Lake Management Society, Western Pennsylvania Conservancy, Penn State Behrend, Environment Erie, citizen volunteers, U.S. Forest Service, Pennsylvania Game Commission, RSC, Mercyhurst College, and Cleveland Museum of Natural History.

Multidisciplinary area experts included fisheries biologists, ecologists, law enforcement, aquatic researchers, botanists, GIS experts, extension specialists, and policy makers.

Table 4B. PASG AIS-Related Research			
Year Funded	Organization	Project Title	Funding
2000	PSU	Round goby diet, habitat preference and reproductive strategies in Presque Isle Bay	\$5,000
2000	Gannon Univ	Impact of round goby on tributary streams of Lake Erie	\$5,000
2000	USFWS, SUNY, Buffalo State	Trophic transfer dynamics of PAHs from dreissenid mussels to round gobies	\$7,200
2000	Edinboro Univ	Monitoring zebra mussel invasion of Edinboro Lake, Conneautte Creek, and French Creek	\$7,400
2003	Edinboro Univ	Effect of non-native mollusk species on common map turtles	\$3,532
2005	PSU	Population assessment of rudd in PIB, Lake Erie	\$5,000
2005	PFBC, Drexel Univ	Distribution of the invasive red-eared slider turtle in the Lower Delaware River basin	\$10,000
2010	PSU	The Round Goby Invasion into Erie State Parks: Impacts on Habitat Preference of Native Fishes	\$1,700
2010	SUNY Fredonia	<i>Typha latifolia</i> versus <i>Phragmites australis</i> : Competition to Determine if <i>Typha</i> May be a Good Reintroduction Species in Areas of <i>Phragmites</i> Invasion	\$1,000
2011	PSU	Diet Overlap Between Native Benthic Fishes and Invasive Round Gobies in Two Lake Erie Tributaries	\$7,500
2012/13	PSU	Development of a Field Test Kit for the Presence of Round Gobies	\$41,000
2012/13	DRBC	Nutrient Thresholds for <i>Didymosphenia geminata</i> Blooms and Stalk Formation in the Delaware River	\$18,600
2012-13	Penn State	Evaluation of Round Goby and Tubenose Goby Habitat Disturbance and Impacts to Native Fishes – Phase II	\$18,701
2012-13	Penn State	Evaluation of Round Goby and Tubenose Goby Habitat Disturbance and Impacts to Native Fishes – Phase II	\$2,500
2014-16	Gannon Univ	PCR tracking of predation on non-native species in Lake Erie	\$18,855
2014-16	Temple Univ and DRBC	Development of a real-time PCR method for the early detection of aquatic invasive species in Pennsylvania watersheds	\$32,123
		TOTAL	\$185,111

Example 4 – PPCPs Undo the Great Lakes Chemical Brew: Proper PPCP Disposal (regional)

In 2008, PASG was awarded a small USEPA grant to host the first unwanted medicine collection event in Erie, Pennsylvania. That collection event put the PPCP issue on the radar for researchers, agency staff, and policy makers in northwestern Pennsylvania. In 2009, PASG awarded a mini-grant (\$1,685) to Dr. Steve Mauro from Mercyhurst University to investigate the levels of three chemicals of concern (triclosan, ethinyl estradiol, and fluoxetine) in local waters. These particular chemicals were chosen because existing research showed their presence could impact the health of aquatic wildlife. All three chemicals were found at each stream and open-water site tested. In 2010, having used PASG funds as seed funding, Dr. Mauro applied for and received \$123,604 in GLRI funds to continue this research.

Since 2010, PASG has led a GLRI-funded project that brought together staff from four Great Lakes Sea Grant programs in an effort to reduce the amount of unwanted medicines that

end up in the Great Lakes. Outreach staff from New York, Pennsylvania, Ohio, and Illinois-Indiana have worked together to reach more than 1,200,000 people through education and outreach and to properly dispose 3,600,000 unwanted meds through the award-winning Undo the Great Lakes Chemical Brew: Proper PPCP Disposal project. Unlike five years ago there are now semi-annual drug take backs overseen by the DEA, drop-off boxes in local law enforcement offices in most states, and pending federal policy regarding regular, ongoing returns of unwanted meds at licensed pharmacies.

In 2013, PASG staff partnered with a local university to develop an extension campaign geared toward college students on potentially hazardous chemicals found in personal care products. This campaign, called FreshFaceForward, was rolled out on the Mercyhurst University campus in 2013 and is rolling out on the Penn State Behrend campus in fall 2014. PASG research funds (\$30,000) are being utilized to determine the effectiveness of this campaign on both campuses in a research project titled: Evaluation of Effectiveness of FreshFaceForward: Personal Care Products (PCPs) Social Change Campaign.

PASG leadership was critical in raising the level of importance of this issue in the Great Lakes basin and the collaboration among the four involved Sea Grant programs and their respective partners resulted in project staff being awarded the Great Lakes Sea Grant Network Outstanding Program Award in 2012.

Collaborators included the American Veterinary Medical Association and Lake Erie College of Osteopathic Medicine (LECOM) School of Pharmacy in Erie, Pennsylvania; Drug Enforcement Administration; local police departments and sheriff's offices in all five states; colleges and universities such as Gannon University, State University of New York (SUNY) Fredonia, Purdue University, University of Illinois, University of Milwaukee, and Ball State University; hospitals; pharmacies; local health departments and hospitals; and policy makers.

Multidisciplinary area experts included physicians, pharmacists, veterinarians, law enforcement, aquatic researchers, other health professionals, and policy makers.

Interviews with researchers are located at <http://web.extension.illinois.edu/unusedmeds/upclose/>.

5. EDUCATION AND TRAINING

Be clearly relevant to national, regional, state, and local needs in fields related to marine and Great Lakes resources, including formal and informal programs ranging from pre-college/college/post-graduate to community-based levels.

Through collaboration with federal, state, and local organizations; informal educators, schools, and colleges; PASG is able to reach critical audiences and maximize limited educational resources. Sea Grant emphasizes kinesthetic learning, but utilizes a variety of delivery methods including shipboard programs, workshops, e-forums, distance learning, online and hardcopy publications, social media, website, fact sheets, maps, posters, booklets, and others.

K-16 Programs

- **Lake Erie science field program** introduces K-16 students, teachers, and faculty members to environmental sampling and data collection techniques. During the 2013-14 season, 520 students and educators participated in the program.
- **Distance-learning** technologies were used to broadcast live and archived science educational modules (thirty-two to date) developed by PASG staff, to multiple classrooms.
- **Project FLY** (Fishing and Learning Youth) is a popular program that introduces underserved students in the Erie and Philadelphia area to fisheries science. This program is supported by the Friends of Fish Foundation. *More than 1,200 students were served since 2003.*
- **Great Lakes-Great Stewards**, a NOAA Bay Watershed Education and Training (B-WET) program, provides intensive training and resources for middle and high school teachers and meaningful watershed education experiences for students. These authentic science-learning experiences relate to watershed and water quality issues. B-WET funding wrapped up in May of 2014. This project will be supported by USEPA Great Lakes Sea Grant Network CGLL funding in 2014-15 in an effort to develop a pilot for CGLL education activities for 2015-20.
- **PA Sea Grant's Tall Ship Program** has been underway since 2009 to provide students, teachers, and faculty members with opportunities to experience Great Lakes science aboard Pennsylvania's Flagship, the *US Brig Niagara* and the United Nations Flagship for Environmental Science, *Denis Sullivan*. These ships served as floating classrooms. More than 2,100 students, administrators, and faculty members have participated since its inception in 2008.
- **The Watershed Airshed Education Program** promotes a better understanding of the components of each school's local watershed from the headwaters to the ocean.

Included are activities and topics that help to increase understanding of how the land, the water, and the air are interrelated.

- **Drift Buoy Project** was started in May 2011; students construct submersible buoys with satellite transmitters and deployed them in Lake Erie to study lake currents. The Great Lakes Research Lab in Ann Arbor uses the student-collected data to develop current maps of the Great Lakes which aided marine transport, navigation, and search and recovery operations. A total of eight buoys have been deployed in this collaboration with NOAA oceanographers.

Informal Education

- **Presque Isle Summer Field Studies** is a weeklong, activity-based day camp focused on Presque Isle State Park and Lake Erie environmental resources. Students have the opportunity to bike, boat, kayak, and fish as they explore the rich park ecosystems. The camp also utilizes the Tom Ridge Environmental Center Natural History collections and displays and the science labs of the RSC.
- **HAB 101 for Stakeholders** and the resulting HAB Task Force were developed in summer 2013 in response to a harmful algal bloom in PIB. New York Sea Grant funded the workshop, which included several key Ohio Sea Grant and USEPA staff who have been dealing with severe HABs in the western basin of Lake Erie. This workshop resulted in the formation of the HAB Task Force, which has developed the Lake Erie Harmful Algal Bloom Monitoring and Response Strategy for Recreational Waters. This document is being utilized in the 2014 recreational season in waters in northwestern Pennsylvania.
- **Reconnect with Your Environment (Best Practice)**, the award-winning weekly newspaper page in the *Erie Times-News*, began in 2009

Teacher Professional Development

- **CGLL** is a partnership between the USEPA and the Great Lakes Sea Grant Network. This ongoing effort provides outstanding professional development for basin educators including a yearly shipboard science workshop aboard the R/V *Lake Guardian*. These activities build relationships between researchers and educators started through the COSEE Great Lakes project. They highlight quality instructional resources developed by NOAA-supported programs.
- **K-12 teacher in-service days** presented through the Environmental Science Alliance introduce teachers to PASG field activities, resources, and lessons available on Great Lakes Science.
- Five in-service teacher fellows participated in **Chesapeake B-WET** sponsored research with Dr. Brian Mangan of King's College. Teachers contributed to biodiversity, invasive species, and ecotoxicology research projects in the Susquehanna River and Watershed.

Postsecondary Activity

Through internship experiences, part-time jobs, undergraduate and graduate research and education opportunities, PASG-sponsored courses, and fellowships, PASG student engagement and financial support has played a key role in the education and career development of some of the best coastal specialists in the nation. Students are often hired

to assist with special projects while they gain practical experience to augment their education. Some use the experience for college credit. Many of the students we've educated have gone on to join the PASG staff.

- **Recent undergraduate students supported:**

- ✓ 2008-10: Michelle Wunderley (intern); Michelle is now an Environmental Specialist at Enercon Services.
- ✓ 2010: Andrew Lagomarsino worked as an intern. He is now a GIS and environmental specialist for a power company.
- ✓ 2010: Amy Thompson worked as an intern; Amy now works as a biology teacher in New Jersey.
- ✓ 2010-2013: Co-funded twenty-five undergraduate research projects in conjunction with the RSC for total of \$35,675.
- ✓ 2010-14: For the past four summers, PASG interacted with forty-nine DCNR scientific and technical interns engaged in invasive species removal in Presque Isle State Park.
- ✓ 2011: Tom Cermak worked as an intern; Tom now works for PASG.
- ✓ 2012: Eight interns worked under the supervision of PASG staff to conduct a year-round multi-season survey of 2,593 visitors to Presque Isle State Park.
- ✓ 2013: Twenty students were supported through PASG competitive research grants.

- **Recent master's students supported:**

- ✓ 2010: Sara Grise (PASG) started as an intern with PASG, received PASG support during her Shippensburg University thesis research and master's degree related to the interactions between climate change and AIS establishment potential.
- ✓ 2011-12: Jake Lybrook worked as an intern with PASG and received support for his Gannon University thesis project; Jake now works for National Fuel Gas Company.
- ✓ 2012: Matt Pluta worked as an intern for PASG; Matt now works part time for PASG and for Environment Erie.
- ✓ 2012: Shane Kraus worked as an intern.
- ✓ 2013: Seven graduate students were supported through PASG competitive research grants.
- ✓ 2014: Tom Cermak (PASG) is pursuing his master's degree in Community and Economic Development at Penn State University.

- **Recent Ph.D. students supported:**

- ✓ 2008: Supported Jeanette Schnars' (PASG) dissertation research related to maternal transfer of contaminants in the common snapping turtle (Penn State University).
- ✓ 2012: Supported Jim Grazio's (DEP) dissertation research related to PAH-contaminated sediment and neoplasia in brown bullhead (Penn State University).
- ✓ 2012: Supported Casey Bradshaw-Wilson's dissertation (Penn State University).
- ✓ 2013: Six Ph.D. students supported through PASG competitive research grants.
- ✓ 2013: Sean Rafferty (PASG) is currently receiving support for his dissertation research which is assessing the ecological integrity of PIB by comparing hepatic, orocutaneous, and gonadal tumor rates within smallmouth bass, bowfin, yellow bullhead, and brown bullhead (Penn State University).

- ✓ 2013: Currently supporting Cassidy Hahn to assist with Sean Rafferty's dissertation research.
- **Recent Knauss postgraduate fellowships supported:**
 - ✓ Leslie Irwin (University of Pennsylvania) and Shane Hanlon (University of Memphis) received Knauss fellowships via PASG

Other Activities

- **Science-based displays and special events extension** such as the Watershed Congress on the Schuylkill, Pennsylvania Coast Day, the Delaware River Ramble, and the Cradle of Birding Festival, We Love Presque Isle Days, feature messages to increase understanding about a wide range of coastal issues including how to prevent the spread of AIS, climate adaptation planning, safe pharmaceutical disposal, and other topics.
- **Act 167 stormwater management workshops** provide engineers, municipal officials, planners, landscapers, surveyors, landowners, students, and other professionals with timely information about new stormwater regulations. Presentations and field trips address policies, ordinances, and best practices for stormwater mitigation and restoration.

6. ADVISORY SERVICES APPROACH

Have a strong program through which information, techniques, and research results from any reliable source, domestic or international, may be communicated to and utilized by user communities. In addition to the educational and information dissemination role, the advisory service program must aid in the identification and communication of user communities' research and educational needs.

PASG focuses on three of the four National Sea Grant Program critical program areas: Healthy Coastal Ecosystems (4.8 FTE), Resilient Communities and Economies (2.0 FTE), and Environmental Literacy and Workforce Development (2.7 FTE). Based on feedback from stakeholders, advisors, researchers, and staff, PASG does not consider Sustainable Fisheries and Aquaculture a high-priority issue for Pennsylvania.

Key coastal issues addressed by PASG in the Lake Erie, Susquehanna River, and Delaware River regions include AIS detection and prevention; land presentation and public access; climate adaptation; watershed monitoring and stream restoration; pollutants entering the watersheds, especially PPCPs; and stormwater management.

PASG's advisory service (extension program) incorporates the following strategies:

- Support a program that includes scientifically rigorous extension and education.
- Capitalize on the intellectual and physical resources of Pennsylvania's colleges, universities, and collaborating organizations, such as NOAA, USGS, USEPA, and private laboratories.
- Use a broad base of funding including public and private sources that are consistent with the program's mission.
- Maintain a balanced, non-controversial, scientific- and research-based approach to education and extension.
- Effectively disseminate findings and promote resources of NOAA and other collaborating organizations.
- Incorporate quality assurance processes into its programming, especially as it relates to relevance of specific activities and intended outcomes.
- Incorporate extension plans into its research projects.

Healthy Coastal Ecosystems

- PASG continues to be a recognized local, state, and regional leader in **detection, prevention, and response to AIS**. See Programmed-Team Approach Section for a more detailed summary of AIS leadership by PASG.
- In 2013, PASG developed the *Pennsylvania Field Guide to Aquatic Invasive Species* to assist in the early **detection, collection, and reporting of potential new AIS infestations** in Pennsylvania. Based on the usefulness of the guide, PISC requested that PASG assist in the development of a companion terrestrial invasive species field guide and the Mid-Atlantic Panel on AIS requested that PASG develop a regional Mid-Atlantic field guide.
- PASG led the development of the recently completed **AIS Rapid Response** Plan. The rapid response plan is being utilized by state agencies with jurisdictional authority over AIS in Pennsylvania to plan and coordinate response actions to new AIS infestations. Recently, the plan was used to respond to the new water chestnut infestation in Hopewell Lake in Berks and Chester counties, Asian carp found in Washington County, and round gobies found in Lake LeBoeuf in Erie County.
- PASG and its collaborators received more than \$700,000 from the National Wildlife Service to remove terrestrial **invasive species** and restore native plants in the Pennsylvania Lake Erie watershed. Presque Isle Weed Warriors cleared 798 acres of invasive species from Presque Isle State Park to reduce their impact on species diversity and habitat utilization, incorporating 796 volunteers.
- PASG has worked with many local collaborators in six phases of a 10-year **stream restoration** effort along Cascade Creek in Erie, Pennsylvania, and its west branch, which is nearing completion. Projects totaling \$1,783,622 have restored 3,900 linear feet of Cascade Creek leading to an annual projected 463.8-ton decrease in sediment which will no longer enter the stream. PASG prepared grant applications that secured \$1,325,000 from GLRI, the Great Lakes Commission, and the DEP Growing Greener program to support four of the six phases.
- PASG helps with the **Clean Marina Initiative** to recycle boat shrink-wrap and other debris from marinas. Since the PASG Clean Marina initiative began in 2008, Pennsylvania marinas have recycled 121,890 pounds of boat shrink-wrap and 2,200 pounds of marina debris.
- In 2012, PASG staff led an effort to assess the **water chemistry** at 16 locations along Scott Run, Cascade Creek, Mill Creek, and Garrison Run in the Presque Isle watershed. The results of the analysis suggest that water quality in the watershed should support and protect aquatic life and nutrient concentrations should not result in eutrophication. This effort also provided an educational opportunity for PASG interns who assisted with the sampling.
- In January 2013, PASG staff created the *Presque Isle Bay Watershed GIS Web Application* using Esri's open-source ArcGIS Online software. The application provides stakeholders access (<http://pib.psu.edu>) to the geospatial data used in prioritizing **restoration** needs in the watershed. The staff used geospatial data collected as part of the watershed characterization of the *Presque Isle Bay Watershed Restoration, Protection, and Monitoring Plan* to prioritize restoration needs in the watershed.

- In 2011, PASG funded (through a USEPA GLNPO grant) researchers from the USGS Fish Health Branch to investigate the role of **viruses in skin tumor** carcinogenesis in brown bullhead from PIB. Using “next generation” pyrosequencing techniques, the researchers extracted RNA from brown bullhead cancerous tissue and sequenced the RNA. Results of the RNA sequencing indicated that no viral RNA was present in the cancerous tissue; however, gene transcripts associated with cellular responses to viral infection were observed.
- In April 2012, PASG co-hosted and facilitated the Presque Isle Bay Fish Tumors or Other Deformities BUI Delisting Workshop and Webinar in Erie, Pennsylvania. During the workshop, fish health experts from throughout the United States discussed recent research findings related to **tumors in brown bullhead** and the process for moving PIB toward delisting. As a result of the meeting, DEP made the decision to petition USEPA to delist the PIB Area of Concern. See Programmed-Team Approach Section for more detail.
- In 2011, PASG led an effort to assess the fish community of the Pennsylvania portion of the Lake Erie watershed. The ecological integrity of 120 stream locations was evaluated by calculating fish index of biological integrity scores for each site and comparing the data to reference sites. The data are being used to prioritize **restoration and protection needs within the watershed**. In addition, former PASG research assistant Jake Lybrook was able to use the data for his thesis titled, *An Evaluation of Relationships between Physical Stream Habitat Classifications and Corresponding Fishery Data: Does EPA’s Visual-Based Habitat Assessment Protocol Predict the Health of a Fish Community?*

Resilient Communities and Economies

- Together with multiple collaborators and funders, PASG has taken the lead for **preserving coastal lands and enhancing public access to angling areas**, especially streams. PASG staff generally takes the lead on proposal writing and administration, which since 2003, has helped complete twenty-five projects to conserve 1,658 acres of recreational and open space, including 11.2 miles of shoreline (2.6 lake and 8.6 streams). The 2012 acquisitions included 7,538 linear feet of stream frontage. Since 2005, PASG has managed or influenced \$12.2 million in this activity area. There are currently ten additional access easements in process.
- PASG staged a *Managing Municipal Stormwater* workshop in April 2013. Sixty-three attendees, mostly municipal employees and engineers, attended this workshop to understand better how stormwater ordinances are changing in Pennsylvania and what the new requirements will look like. This workshop, funded through DEP, was collaboration among Environment Erie, Penn State Cooperative Extension, and PASG.
- Because Pennsylvania was relatively unaffected by Superstorm Sandy, the staff had the capacity to help other states. PASG provided the leadership to organize monthly conference calls to help provide a coordinated response to Superstorm Sandy damage in Virginia, Delaware, New Jersey, New York, and Connecticut. PASG also established a repository of resources and created a listserv to facilitate effective communication related to **coastal hazards** among responding agencies and organizations. These

activities also became a platform for the southeastern and Gulf Sea Grant programs to share their experience and expertise.

- PASG has been an active contributor to the National Sea Grant Office **Coastal Communities Climate Adaptation Initiative (CCCAI)** Planning Supplemental and Challenge Funding. To date PASG has received three CCCAI awards (\$90,000) and one challenge award (\$100,000). See Programmed-Team Approach Section for a summary of climate adaptation leadership by PASG.
- PASG staff provided on-the-ground project oversight and survey staff for a **User Study of Presque Isle State Park**. Throughout all four seasons, PASG staff worked to collect 2,593 surveys from park visitors. The year-round survey provided experiential and economic data to guide Presque Isle State Park managers and other local stakeholders as they deliver services on a park that hosts approximately four million visitors per year.

Environmental Literacy and Workforce Development

This critical area is covered in the Education and Training Section.

7. RELATIONSHIPS

Have close ties with federal and state agencies and administrations, local authorities, business and industry, and other educational institutions, to ensure the relevance of its programs, give assistance to the broadest possible audience, involve a broad pool of talent, and assist others in developing research and management competence.

PASG has collaborated with more than 190 organizations as of fall 2014 (Table 3A). Of those, 23 are new since the 2011 visit.

Organization Category	Number Per Category
Colleges & Universities	39
Federal	24
International	3
Local	89
PA Government	9
Private Sector	4
Regional Nonprofits	9
Sea Grant	17
Total	194

Maintaining Relationships with Elected Officials

PASG maintains relationships with local and state elected officials in proximity to its offices in Chester, Harrisburg, and Erie to educate members of the legislature about PASG's accomplishments and impacts for Pennsylvania, and to view PASG as a resource for coastal issues. Staff meets with officials at least yearly to provide updates on activities in the region and invite officials to events as appropriate. We have developed strong relationships with local council members, township supervisors, mayors, state elected officials and their staff members. We use these relationships to share information, but to also learn about additional opportunities in the communities and where our services can be best put to use.

More recently, staff engaged legislators in an effort to reinstate a line item in the state budget which was removed in 2008. In doing so, we generated over seventy-five separate letters from constituent groups that have worked with PASG. The letters were welcomed by the legislators, and some responded that it was an especially powerful tool to show PASG's impact in the communities.

Maintaining Relationships with Federal Agencies

PASG has developed and maintained strong collaborative and financial relationships with numerous federal agencies, especially those that support coastal issues. Agencies include

USFWS, USEPA, USGS, and other NOAA-supported programs such as CZMP and Great Lakes Research Lab. The relationships have resulted in collaborative efforts such as a joint RFP with the USGS's Pennsylvania Water Resources Resource Center; joint research such as USEPA's sediment work as part of the PIB AOC project; USFWS funding of much of the AIS extension and research, and USEPA and USFWS funding for several projects as part of GLRI. The strong relationships that have been developed often result in the agencies coming to PASG with potential funding or collaboration activities.

Maintaining Research Relationships

In order to incorporate research expertise from throughout the Commonwealth, PASG has developed relationships with more than sixty educational institutions across the state, funding faculty members at more than thirty schools. These projects partially meet the goals associated with relationships: identified and involved a broad pool of talent, primarily within Pennsylvania institutions, assisted individual institutions and researchers in developing research competence in areas of importance to the Commonwealth and NOAA, and aided researchers in seeking larger sponsored grants

Maintaining State Relationships

Since its establishment in 1998, PASG has had very broad relationships with state agencies, especially DEP, DCNR, and PFBC. These agencies provided earlier base and grant funding for PASG. Prior to the economic downturn of 2002, PASG had an annual DEP non-restrictive line item of \$250,000. Through legislative and DEP connections, PASG could have the line item reinstated at some level for next year. PASG has also developed mutually beneficial relationships with the PA Department of Agriculture, PA Game Commission, and others.

Maintaining Regional Relationships

PASG has developed particularly strong relationships across the Mid-Atlantic and Great Lakes regions, including NOAA regional initiatives and regional offices, other Sea Grant programs, USEPA, and others. This includes leadership roles on director- and extension-level committees and other activities. For example, PASG Director, Bob Light, has been appointed by the Governor as a Great Lakes Commissioner representing Pennsylvania for 2008-2018. This appointment affords PASG the opportunity to interact on a regular basis with coastal representatives from all Great Lakes states and several Canadian Provinces.

Examples of collaborative efforts initiated due to strong relationships include:

Example 1 – Mid-Atlantic Region: PASG received funding as part of the National Sea Grant office's AIS competition to conduct research and extension on AIS vector management looking at baitfish as a pilot pathway. Maryland Sea Grant took the lead, with Delaware, New Jersey, North Carolina, and Virginia Sea Grant as collaborators.

Example 2 – Chesapeake Bay Watershed Education Program: Between 2003 and 2012, PASG collaborated with the Delaware and Maryland Sea Grant programs to provide meaningful watershed experiences for teachers and students from schools in the Chesapeake Bay drainage.

8. PRODUCTIVITY

Demonstrate an appropriate level of productivity (e.g., research results, reports, students employed, service to stakeholders, etc.) commensurate with its length of operation and level of funding.

PASG has been extremely productive in each of the three critical program areas: Healthy Coastal Ecosystems, Resilient Communities and Economies, and Environmental Literacy and Workforce Development. Productivity has also been realized in research, extension, and education. Much of our progress is due to the numerous relationships developed, increasing support from the National Sea Grant Office, and increasing leveraged support. This section highlights PASG's productivity as measured by our program's impacts and accomplishments; research support; student and volunteer support; workshops and presentations; tools, technology, and information services; leveraged funding; publications; and awards.

PASG Student and Volunteer Support

Since 2010, PASG has begun to incorporate more students into its portfolio of services, including support for undergraduate research projects, interns, and graduate students. In addition, PASG has reached nearly 50,000 K-12 students and benefited from more than 16,000 volunteer hours.

PASG-supported Meetings, Workshops, and Presentations

Since 2010, PASG has supported 119 meetings, workshops, and conferences with 9,775 participants, and delivered 156 presentations to 9,922 attendees.

Awards (Table 7A)

Year	Recipient	Award	Awarder
2008	R Light	John C. Oliver Env Leadership Award	Friends of TREC
2011	<i>Erie Times News</i>	PA Newspaper of the Year – First Place	PA News Media Association
2012	E Masteller	John C. Oliver Env Leadership Award	Friends of TREC
2012	M Martz; A McCartney	Outstanding Outreach Programming Award	Great Lakes SG Network
2012	S Grisé-Stahlman	Early Career Individual Achievement Award	Great Lakes SG Network
2012	S Rafferty	Mid-Career Individual Achievement Award	Great Lakes SG Network
2013	<i>Erie Times News</i>	PA Newspaper of the Year – First Place	PA News Media Association
2014	M Martz; A McCartney	Outstanding Outreach Programming Award	Great Lakes SG Network

Tools, Technology, Manuals, Plans, Guides, and Information Services

PASG has translated research findings into sixteen tools, technologies, and information services that are being used to improve the management of coastal, ocean, and Great Lakes ecosystems. Table 7B includes a list of the products.

Table 7B. PASG-Supported Technology, Manuals, Plans, Guides, and Information Services: 2006-2013

Year	PASG Staff/Researcher	Manual, Guide, Plan Title
2006	S Rafferty	Field Manual for Assessing Internal and External Anomalies in Brown Bullhead (<i>Ameiurus nebulosus</i>)
2006	S Whitney	Commonwealth of PA Invasive Species Council AIS Management Plan
2007	M Martz	Vegetative Best Management Practices: A Manual for PA/Lake Erie Bluff Landowners
2007	V Blazer	Manual for the Microscopic Diagnosis of Proliferative Liver and Skin Lesions in Brown Bullhead (<i>Ameiurus nebulosus</i>)
2008	S Gris�	Identification of Freshwater Invertebrates
2009	S Whitney	Pennsylvania Invasive Species Management Plan
2010	S Rafferty; K Kaczmarek	Presque Isle Bay Watershed Restoration, Protection, and Monitoring Plan
2011	D Boughton	Shipboard Curriculum Guide, Lake Erie Science-Field Experience
2011	M Rutter	Fish Tumor Database
2012	A Faulds; S Whitney	Pennsylvania Invasive Mussel Monitoring Guide
2012	K Kaczmarek	Zebra and Quagga Mussel Monitoring Network Interactive Map
2012	A Faulds	Marcellus Shale E-Forum
2013	S Rafferty	Presque Isle Bay Watershed Restoration Prioritization Web Tool
2013	S Stahlman	Pennsylvania’s Field Guide to Aquatic Invasive Species
2013	S Whitney; S Stahlman	Rapid Response Plan and Procedures for Responding to AIS in PA
2013	A Faulds	Chester, PA Hazard & Climate Adaptation Planning Website and Interactive Map
2014	B Swistock	H2O Solutions Application (mobile APP device)

Communications

PASG has been successful at media placements and enhancing the effectiveness of its website (Table 7C).

Table 7C. Summary Of Communication Productivity		
Category	Number	Notes
TV Spots	16	For 2013-14 from WICU TV12-Erie and JET 24
Facebook	1,500	Average weekly total reach
Newspaper Articles	43	Published video, photos, blog entries, and news articles for 2013-14
Newspapers in Education	189	187 full NIE pages and two, twelve-page newspaper supplements from January 2009 to June 2014
WPSE Radio Spots	324/year	30- to 90-second spots
Website Visitors	20,665	14,859 new and 5,806 returning from February 2013 to August 2014
Website referrals	4,365	Facebook, fishandboat.com, forecast.weather.gov, seagrant.noaa.gov, psbehrend.psu.edu
Website page views	41,923	
Website unique views	31,537	
Fact Sheets	36	AIS, coastal communities, climate change, others
Peer-Reviewed Pubs	26	

PASG Success in National Competitions

Since 2008, PASG has led or collaborated on twelve national competitions (Table 7D).

Table 7D. PASG Success in National Competitions			
Year(s)	Project	Funding Source	Funding Amount
2008-10	Preparing Coastal Communities for Climate Change	NOAA Sectoral Applications Research Program (SARP)	\$50,000
2006-11	COSEE Great Lakes	NOAA and NSF	\$232,538
2010-11	Pennsylvania Sea Grant Ship Time	NOAA-Sea Grant Ship Time	\$20,000
2012-13	Pennsylvania Sea Grant Ship Time	NOAA-Sea Grant Ship Time	\$20,000
2010-13	Preventing the Spread of AIS by Extending AIS-HACCP and the Stop Aquatic Hitchhikers campaign to anglers and fish tournament organizers	NOAA-Sea Grant (via University of Wisconsin)	\$25,118
2010-14	Preventing AIS through Vector Management: Live Bait Vector in the Mid-Atlantic Region	NOAA-Sea Grant (via University of Maryland)	\$15,216
2008-12	Establishing a Susquehanna Aquatic Biodiversity Network	NOAA Bay Watershed Education and Training (B-WET)	\$263,928
2010-11	Building Capacity to Help Coastal Communities Plan for Present and Future Hazard and Climate Threats	NOAA-Sea Grant CCCAI	\$30,000
2012-14	Chester Climate Adaption Planning	NOAA-Sea Grant CCCAI	\$79,100
2012-14	Building Capacity to Help Coastal Communities Plan for Present and Future Hazard and Climate Threats	NOAA-Sea Grant CCCAI	\$30,000
2012-14	Great Lakes Field Experiences	B-WET	\$43,750
2012-14	Great Lakes-Great Stewards	B-WET	\$62,300

PASG Leveraged Funding

Since 1998, PASG has leveraged more than \$10.5 million in funding from sources outside of Sea Grant's base appropriation.

9. SUPPORT

Have the ability to obtain a diversity of matching funds from non-federal sources, such as state legislatures, university management, state agencies, business, and industry, which is a sign of program vitality.

PASG has had great success generating non-NOAA and non-federal support. Presented in the figures below are data for the last five Penn State fiscal years, ending June 30, 2014. It is clear that PASG through its nearly 200 collaborators has been able to attract a mix of federal and non-federal funds. Refer to Figures 8A-C for more detail. Some highlights of the five years include:

- a 1:1 non-federal match for NOAA funds, exceeding the required 50 percent non-federal match requirement;
- Penn State cash match has increased by 175 percent, including \$160,000 per year for FY 15-18 for research;
- state cash match increase of 397 percent, representing base support and grants;
- 1.1 non-NOAA federal cash for each NOAA dollar through a variety of sources such as USGS, USFWS, and USEPA;
- increased support in areas has reduced NOAA base support by 17 percent;
- NOAA research funds have increased from \$0 to 266,425;
- state support has increased by 12 percent of base;
- other federal support has decreased by 11 percent, indicating increased non-federal support;
- managed or influenced \$7.6 million related to land preservation and open access;
- in-kind match from Penn State, *Erie Times-News* NIE, PFBC space, research projects, etc. totaled nearly \$1.5 million;
- annual cash expenditures have increased by more than \$1 million.

Figure 8A. FY10 - FY14 Support by Source

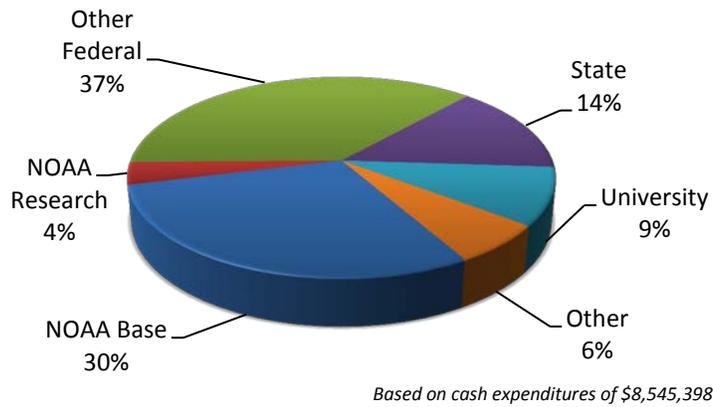


Figure 8B. FY10 Support by Source

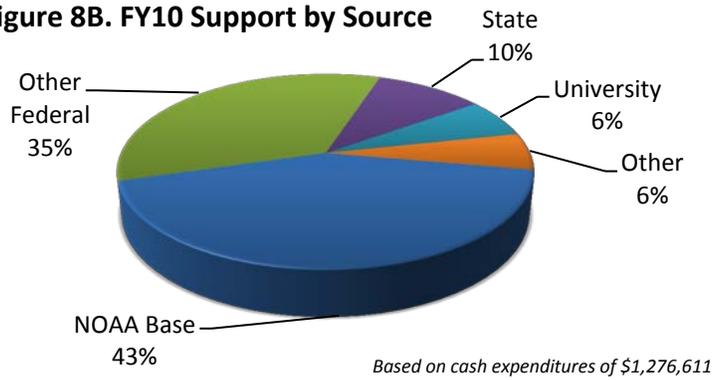
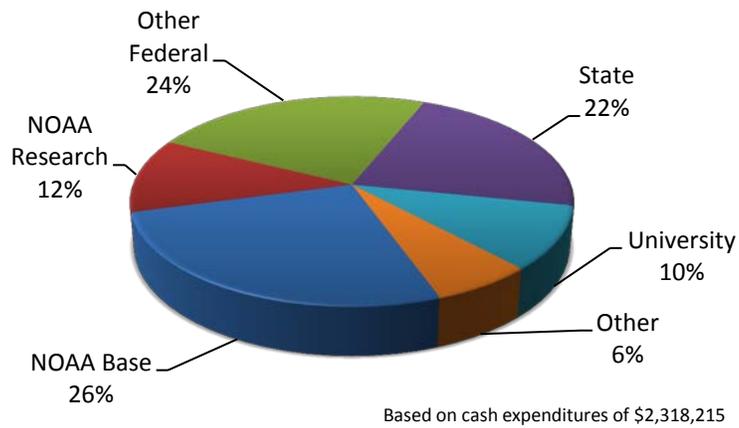


Figure 8C. FY14 Support by Source



10. CONTINUITY OF HIGH PERFORMANCE

Evidence of program growth and maturity.

Since its establishment in March of 1998, PASG has exhibited a continuous increase in program impact and influence: program breadth (research, education, and extension), geography (Lake Erie, Delaware, and Susquehanna watersheds), staffing (2.33 to 13.3 FTE), regional impact (Great Lakes and Mid-Atlantic), support from the University (\$0 to more than \$400,000 annually; cash and in-kind), support from NOAA/Sea Grant (\$160,000 to \$1,216,475 annually), non-federal matching fund support (\$80,000 to \$608,000), program designation (Extension Project - 1998; Coherent Area Program - 2004; Institutional Program -2009), and research administered (\$0 to more than \$650,000 annually, including thirty-seven institutions).

PASG is considered a highly regarded asset by the University, Commonwealth, and National Sea Grant Office; and as a valued collaborator and partner by the thirty-two other Sea Grant programs across the United States.

In order to maintain high performance, PASG incorporates quality assurance measures into its education, extension, and research programs. Feedback from end-users and research selection panels, feedback from the National Office, continuous feedback from supporters and collaborators, and guidance from advisory groups keeps the programs relevant and of high quality.

PASG fully believes that it has met all of the expectations to receive certification as Sea Grant's highest program category, Sea Grant College. According to statute, *Sea Grant Colleges have broad responsibilities for state, regional, and national activities, and engage all of the institutions of higher learning in a state. Only Institutional Programs are eligible for College status, after an appropriate period of time.*