

PROGRESS REPORT
Jacques Cousteau National Estuarine Research Reserve Operations Grant
Award Period 10/1/15 – 3/31/17
NOAA Award NA15NOS4200139
Performance Report Period Oct 1, 2015 – Mar 31, 2016

Tasks outlined by the budget narrative below describe the program activities for the JC NERR during the reporting period from Oct 1, 2015 – Mar 31, 2017. Funds supported ongoing Reserve operations including program administration, coastal training programs, stewardship, education, research, and monitoring programs.. The JC NERR match for this program included waived indirect, salary and fringe costs.

Task OM1: Support General Office Operation

Task Outcome OM1.1 Operating Support and Management of JC NERR Coastal Education

Funds allocated to this task were used to support overall program administration and coordination for the JC NERR including phone, fax, computer maintenance, office and workshop supplies, and grant and contract administration. Rutgers, the State University of New Jersey provided the required matching funds (in-kind services) for grant management, financial reports, overhead and administrative/janitorial support.

Outcome End Date: September 2016

Task Outcome OM1.2 Maintain Basic Reserve Operations and Facilities

Funds were used to maintain basic reserve operations and all lab, education, field and training facilities associated with the JC NERR.

Outcome End Date: March 2017

Task Outcome OM1.3 Provide State Services to Assist Reserve Operations

Rutgers University continued to provide facility support, utilities, access to field equipment and research platforms on behalf of the research operations conducted by the JC NERR.

Outcome End Date: September 2016

Task Outcome OM1.4 Management Plan

An updated Management plan will be developed and approved for the JC NERR.

Outcome End Date: September 2016

Task Outcome OM1.5 Reserve Evaluation

Performance and accomplishments of the JC NERR will be evaluated by NOAA.

Outcome End Date: September 2016

Task OM2: Support General In-state and Out of State Travel and Conference Registrations

Traveler Name	Date	Destination	Purpose
Lisa Auermuller	10/1/15	Ventnor, NJ	Coastal Collation Monthly meeting presentation
Lisa Auermuller	10/8/15	Pennington, NJ	The Watershed Institute for a grant review panel
Lisa Auermuller	10/9/15	Loveladies, NJ	Panel Presentation on JC NERR
Lisa Auermuller	10/15/15	Mays Landing, NJ	Resilience Café Facilitation
Lisa Auermuller	10/21-22/15	Atlantic City, NJ	NJ Association of Floodplain Managers Conference
Lisa Auermuller	10/23/15	Rutgers Bloustein School	Professional Photos for Work Bios
Lisa Auermuller	10/24-30/15	Mobile, AL	2015 NERRS/NERRA Annual Meeting
Lisa Auermuller	11/5/2015	Ventnor, NJ	Coastal Collation Monthly meeting presentation
Lisa Auermuller	11/10/15	Tuckerton and Little Egg Harbor Tour	Local Tour for the NOAA NCOSS group
Lisa Auermuller	11/16/15	Rutgers Bloustein School	GIS/Resilience Practitioners meeting
Lisa Auermuller	11/30/15	New Brunswick, NJ	Climate Adaptation Alliance Advisory Committee Meeting
Lisa Auermuller	11/19-20/15	Washington, DC	Capitol Hill Briefing for NERRS
Lisa Auermuller	12/16-12/18/2015	San Francisco, CA	Panel presentation at the AGU meeting
Lisa Auermuller	12/22/15	New Brunswick, NJ	Meeting with the Inst for Emergency Preparedness and Homeland Security
Lisa Auermuller	1/15/16	Plumbstead, NJ	Partner Meeting with Climate Central
Lisa Auermuller	1/19/16	Ocean County College	Barneгат Bay Partnership Advisory Committee Meeting
Lisa Auermuller	1/28/16	New Brunswick, NJ	Panel presentation at the NJ American Planning Association annual conference

Lisa Auermuller	1/29/16	New Brunswick, NJ	Climate Adaptation Alliance Advisory Committee Meeting
Lisa Auermuller	2/8/16	Rutgers Bloustein School	Climate Adaptation Alliance Advisory Committee Meeting
Lisa Auermuller	2/11/2016	Toms River, NJ	Implementation meeting for the NOAA FRAMES project
Lisa Auermuller	2/22-26/2016	Washington, DC	NERRA and NOAA Coastal Program Managers Meeting
Lisa Auermuller	3/1/16	Trenton and Mays Landing, NJ	Implementation meeting for the NOAA FRAMES project and South Jersey Dredging Forum
Lisa Auermuller	3/3/16	Rutgers Bloustein School	Meeting with Dr Susan Cutter
Lisa Auermuller	3/8/16	Toms River, NJ	Barneгат Bay Partnership Advisory Committee Meeting
Lisa Auermuller	3/9/16	Trenton, NJ	Implementation meeting for the NOAA FRAMES project
Lisa Auermuller	3/10/16	Philadelphia, PA	Panel presentation on Decision Makers and utilization of science
Lisa Auermuller	3/17/16	Berkeley, NJ	Ocean County CRS Users Group Meeting
Lisa Auermuller	3/22/16	Newark, NJ	Modified Getting to Resilience Process with the Iron Bound Community Cooperation
Lisa Auermuller	3/24/16	Trenton, NJ	FEMA Hazard Mitigation 10 Year Planning Meeting
Mike De Luca	2/19/16	Tuckerton	Update mgmt. plan with Lucy Halse
Mike De Luca	2/22-26/16	Washington DC	NERRS executive committee, Prog Mgrs mtg
Mike De Luca	3/4/16	Tuckerton	JC NERR staff meeting
Mike De Luca	3/13/16	Manahawkin	JC NERR fund raiser
Mike De Luca	3/19/16	Tuckerton	NERRS staff meet w/ Lucy Halse (Mgmt Plan)
Mike De Luca	3/30/16	Tuckerton	NERRS staff CPR training
Mike Kennish	10/24-29/15	Mobile, Alabama	NERRS Annual mtg

Melanie Reding	10/24-30/16	Mobile Alabama	NERRS Annual mtg
Melanie Reding	1/22/16	Plainsboro, NJ	ANJEE Conference
Melanie Reding	2/3/16	Wilmington, DE	DE Wetlands Conference
Gregg Sakowicz	03/14-17/16	Atlantic City Airport	SWMP technician training workshop
Ida Scott	11/10-14/15	Virginia Beach, VA	NAI, National Assoc. of Interpreters - Interpreter's roadshow
Andrea Spahn	10/9/2015	Tuckerton, NJ	JC NERR Staff Meeting
Andrea Spahn	10/23/2015 – 10/30/2015	NERRS Annual Meeting	NERRS Annual Meeting
Andrea Spahn	11/4/2015	Tuckerton, NJ	JC NERR Staff Meeting/RIAS Training
Andrea Spahn	11/11/2015	Tuckerton, NJ	Meeting with NOAA ESV Project Team
Andrea Spahn	11/16/2015	Tuckerton, NJ	SET/Sentinel Site Installation
Andrea Spahn	11/17/2015	Tuckerton, NJ	SET/Sentinel Site Installation
Andrea Spahn	12/9/2015	Tuckerton, NJ	SET/Sentinel Site Installation
Andrea Spahn	1/8/2016	Tuckerton, NJ	JC NERR Staff Meeting
Andrea Spahn	2/12/2016	Tuckerton, NJ	JC NERR Staff Meeting
Andrea Spahn	3/18/2016	Tuckerton, NJ	JC NERR Management Plan Meeting

Outcome End Date: September 2016

Task OM3: JC NERR Communications

Task Outcome OM3.1 JC NERR Communications

Products

Newsletter

Andrea Spahn is working on the next newsletter for the reserve: Life on the Edge: Quarterly Jacques Cousteau National Estuarine Research Reserve Newsletter: Spring 2016. The newsletter will be distributed in May 2016.

JC NERR Website

Andrea Spahn updates and keeps the JC NERR website current. CTP and Education programs use the website to advertise the events and aid in registration. Current events and newsletters are also added to the website. Currently, Andrea Spahn has been actively on reorganizing and overhauling the file structure of the website so that some major changes can be made in the near futures. JC NERR is considering adding a blog type form where our researchers can write responses to specific topics. The CTP and Education pages have had complete revisions. Andrea is currently working with the Research Coordinator, Mike Kennish, to revise the Research Page.

Assistance & collaborative Projects

Coordination and Communication with NERRS, FWS, and NPS

Andrea Spahn continued to work with the U.S. Fish and Wildlife Service and the National Park Service to expand shoreline and coastal topography monitoring protocols. She served as the point of contact for the wildlife refuges in the northeast region for surveying assistance. She worked closely with the Back Bay, Eastern Shore, and Fisherman Island Wildlife Refuges to train staff to conduct shoreline monitoring. She worked with the Edwin B. Forsythe Wildlife Refuge to establish the site as a sentinel refuge for coastal topographic monitoring. Shoreline reports were completed for each refuge. The project was expanded to include the effects of Superstorm Sandy in the analysis. Each of the 11 technical reports were completed and submitted to FWS for review. The current phase of the project is to provide updated 1 year reports in the form of appendices for FWS.

Upcoming-

Completion of the third protocol in the Northeast Coastal Barrier Network Coastal Monitoring Protocols: Landform Elevation Models (June 2016)

Outcome End Date September 2016

Task Outcome OM3.2 JC NERR Website

Web-based materials, online courses, curricula, announcements, and surveys engage key audiences in reserve programs.

Reserve data and interactive, on-line activities provide a repository of science based information easily accessed by coastal stakeholders.

Outcome End Date: March 2017

Task: CTP-Continued Development and Implementation of the Coastal Training Program

Task Outcome: ED1.1 Improve Coastal Community Through implementation of Municipal Planning

Workshops Hosted During Reporting Period

The following workshop was hosted during this report period. More details about partners, attendees and workshop objectives can be found in the CTP performance measures database. This workshop was offered after being identified by the CTP audience as important in their ongoing post-Sandy recovery and resilience planning:

- Introducing Green Infrastructure for Coastal Resilience – November 17, 2015

FEMA Region 2 Risk Map - Academic Partnership

L. Auermuller continued a partnership with FEMA and served as the lead on their Region 2 Coastal Outreach Advisory Team (COAT). In this role she facilitated a dialogue between coastal outreach professionals and FEMA on behalf of their map update process. Lisa encouraged members of the COAT to provide feedback on FEMA's progress, messaging and outreach tactics and, in turn, she transferred information from FEMA to the COAT partners.

One FEMA Region 2 COAT conference call was hosted during this reporting period on November 6, 2015 and included 27 COAT representatives. Agenda items included:

- NYC appeal - brief on progress, likely/possible timeline, and how this will impact other studies on the shore.
- Key takeaways for messaging/communication
- Coastal flood risk reduction projects & FEMA flood hazard mapping
- Recent storm shoreline impact and response
- FFRMS - quick summary review and implementation update
- Flood insurance brief:
 - Changes to business policies go into effect November 1
 - Other November 1 changes
 - Changes that will go into effect April 1, 2016
- Technical Mapping Advisory Committee (TMAC)
 - Purpose, topics, and developments thus far
- Sandy claims review. October 15 is the last day to request re-opening of claims.
 - Number of claims, results to date, and what FEMA is doing to ensure things are done better in the future

The FEMA Region 2 Risk Map – the Academic Partnership with the JC NERR received an extension, reprogrammed and supplemental funds were added to the agreement. These funds enabled continued oversight of COAT and engaged the two JC NERR Coastal Resilience Specialists (Jenna Gatto and Chris Huch) to help the NJ DEP coordinate with local officials with adoption of Local Flood Damage Prevention Ordinance. C. Huch and J. Gatto became the NJ DEP points of contact for the counties of Cumberland, Salem, Mercer,

Camden and Gloucester to update their flood hazard prevention ordinance and adopt those ordinances, thereby making their new FIRMS effective.

Outcome End Date: September 2016

Task Outcome ED1.2 Promoting Coastal Flood Awareness, Mitigation & Adaptation

New Jersey Climate Adaptation Alliance - Scientific and Technical Advisory Panel

L. Auermuller has been working with the NJ Climate Adaptation Alliance (NJCAA) to help plan, convene, and distill scientific and practitioner information to inform a Sea Level Rise and Coastal Storms Science and Technical Advisory Panel. Between 2012 and 2014, the New Jersey Climate Adaptation Alliance (NJCAA) engaged a broad network of stakeholders to assess knowledge gaps to guide resilience and climate adaptation planning in New Jersey. The stakeholders sought to understand the future projections of sea level rise and coastal storms more fully in order to plan for the resulting impacts in a comprehensive manner. The NJCAA convened a group of scientists and technical experts to identify and evaluate the most current science on SLR projections and changing coastal storms, consider the implications for the practices and policies of local and regional stakeholders, and provide practical options for stakeholders to incorporate science into risk-based decision processes. The NJCAA also convened a meeting to discuss initial scientific recommendations in planning and decision-making.

L. Auermuller worked with the NJCAA as a steering committee member to oversee implementation of the STAP. She also interviewed local municipal staff and elected and appointed officials who elected to exceed minimum standards set for municipal freeboard, and understand the scientific information currently used in their decision making. This research, along with research collected in previous progress reports, will be summarized in a document which will supplement the STAP final report.

NOAA's NCOSS Ecosystem Services Valuation Project at the JC NERR

The staff at the JC NERR has been working closely with a NOAA NCCOS group to conduct an ecosystem services valuation project at the JC NERR. The reserve was selected because of the strong relevance of this topic to its management goal, the role of coastal marshes in providing ecosystem services during Superstorm Sandy, the presence of coastal development in the area (ie Little Egg Harbor Township), the data available to enhance the research models, and the strong relationship with Rutgers University and other regional partners.

In November, the NCCOS team visited the reserve to introduce project and ecosystem service valuation concepts to stakeholders and partners, to discuss InVEST scenarios and to identify relevant deliverables. The research team conducted a local tour of the reserve and surrounding area so they could become more familiar with the social and geographical aspects of the study area. JC NERR staff worked closely with the NCCOS team to refine the research scope, identify data sets and ensure that the final product is meets the needs of the reserve and NCCOS.

NOAA's Mid Atlantic Coastal Storms Program

In anticipation of the startup of NOAA's Mid-Atlantic Coastal Storms program, the JC NERR was awarded \$50K to identify needs of the management community in the NY and NJ region. When funding eliminated the Coastal Storms program, the reserve had an opportunity to refine the scope and objectives of this preliminary Mid-Atlantic project. Thus the JC NERR will now conduct three projects to help inform and extend existing coastal storm efforts in the Mid-Atlantic region including:

- Improve Collaboration, Communication and Utility of NOAA's Coastal Flooding Products: This project will improve the utility and delivery of NOAA's coastal flooding products by convening NOAA flooding product developers to understand current products and future directions, and engaging with external users to improve communication about these products.
- Expand Wetlands Watch Flood App into the NY/NJ Region to Advance Municipal Resilience and Improve Community Risk Awareness: This effort will expand the existing Wetlands Flood App (Version 1.0) into the NY/NJ region while enhancing existing, targeted municipal resilience technical assistance and coastal hazard risk awareness.
- Sandy CREST Projects - Share Results and Create a Path Forward Workshop: This workshop will bring together NOAA funded post-Sandy New Jersey CREST projects to share lessons learned from each project and to discuss a framework for future collaboration on community-level resilience engagement.

Risk Communication with NJ DEP and NOAA

The JC NERR worked in collaboration with NOAA and the NJ DEP Coastal Management Program to mentor a Rutgers graduate student working on coastal hazard risk communication products. The student is working with NJ communities focused on building resilience capacity and how this effort can be expanded to meet the needs of risk communication nationally.

Student tasks include development of:

- 1-page municipal-specific coastal hazard summaries
- risk communication training module
- risk communication manual
- NJ-version of the Coastal Hazards Handbook
- Case studies of effective municipal/county resilience risk communication.

Outcome End Date: September 2016

Task Outcome ED1.3 Getting to Resilience Technical Assistance

Coastal Resilience Specialists, J. Gatto and C. Huch, continued to provide technical assistance to NJ communities. The Specialists worked one-on-one with municipalities to identify current and future hazards and vulnerabilities. Additionally they work alongside communities to increase their preparedness by linking planning, mitigation, and adaptation activities. Technical assistance involved face to face review and discussion of risks as illustrated by FEMA flood maps, the NJFloodMapper, NJ Adapt, and the state's Community Vulnerability Index (CVI) and the step-by-step guidance through the GTR community evaluation process.

The GTR questionnaire is broken into five sections: Risk and Vulnerability Assessments, Public Engagement, Planning Integration, Disaster Preparedness and Recovery, and Hazard Mitigation Implementation. In order to efficiently answer all of the questions within the questionnaire, participation from a wide array of municipal officials and staff is encouraged. These can include administrators, floodplain managers, emergency managers, stormwater managers, public works officials, town engineers, and appointed and elected officials. The GTR process requires about three meetings with representatives from the towns. The first two meetings are for a facilitated discussion where the town representatives voice their resilience successes and challenges and where the five sections of the GTR evaluation are reviewed and filled in online at www.PrepareyourCommunityNJ.org.

Upon completion of the GTR questionnaire, JC NERR staff analyze the answers provided by the municipality, linkages provided by the GTR website, notes taken during the discussion of questions, the municipality's Master Plan, and mapping of risks, hazards, and vulnerabilities. After reviewing all of this information, a recommendations report is drafted by the Coastal Resiliency Specialists to help assist municipal decision makers as they recover from Sandy and become more resilient in the future.

During the October 2015 – March 2016 period, informational meetings about GTR took place with Egg Harbor Township and Lacey. The GTR process was started with Monmouth Beach, Lacey, Egg Harbor Township, Surf City, Barnegat Light, and Lavellette. The GTR questionnaire was completed with Commercial, Longport, Harvey Cedars, Neptune, Hazlet, Keansburg, Monmouth Beach, Egg Harbor Township, and Lacey. GTR Recommendations Reports were drafted for Commercial, Longport, Harvey Cedars, Neptune, Hazlet, Keansburg, Monmouth Beach, Egg Harbor Township, and Lacey. Recommendations Reports were completed for Commercial, Longport, Harvey Cedars, Neptune, Hazlet, Keansburg, and Monmouth Beach. GTR Recommendation Reports are in the process of being edited and moved towards finalization for Brick, Keyport, Margate, New Brunswick, Carteret, Ship Bottom, and Longport. The GTR recommendations report presentations meetings were held for Ship Bottom, Margate, Hazlet, Longport, Monmouth Beach, and Neptune.

The Long Beach Township Recommendation Report was finalized, along with Beach Haven, Pleasantville, Keyport, and Carteret.

A similar resilience planning process was started with Newark's Iron Bound Community Corporation.

As resiliency projects continue and collaborative resiliency projects develop, the following additional resiliency outreach and technical assistance has been provided by J. Gatto and C. Huch to municipalities and other resiliency partners:

October

JC NERR staff attended

- the Resilience Cafe,
 - the two day NOAA "Coastal Inundation Mapping" training,
- Staff also presented at the Ventnor Back Bay Flooding Town Hall, the New Jersey Association of Floodplain Managers Conference, and an NJ DEP training session on coastal tools.

November

JC NERR staff attended

- the November Coastal Coalition meeting,
- “The Shore’s Future: Living with Storms and Sea Level Rise” in Toms River,

Staff also facilitated the semi-annual COAT call and met with representatives from the Coastal Coalition for an informal planning meeting to begin the process of creating a multi-jurisdictional program for public information with Atlantic and Cape May communities.

December

JC NERR staff attended

- the Ocean County CRS User Group meeting,

Staff also took part in FEMA webinars which included information on timeline changes to the Flood Insurance Rate Map studies. Webinars were attended for Monmouth, Ocean, Atlantic, Cape May, Middlesex, and Salem counties.

January

JC NERR staff attended

- the Monmouth County CRS User Group meeting,
- the Coastal Coalition meeting,

February

JC NERR staff attended

- CVA meetings in Tuckerton and Little Egg Harbor,
- the Coastal Coalition meeting,
- the Atlantic Cape Program for Public Information Meeting,
- a meeting with Coastal Coalition members and the Army Corps of Engineers,
- a Dredging Forum,
- a training from The Nature Conservancy on the Restoration Explorer,
- the "Fixing Flooding One Community at a Time - Green Infrastructure" workshop,

Staff also attended several webinars and hosted a GTR questionnaire upgrade meeting.

March

JC NERR staff attended

- the Long Beach Island Program for Public Information meeting,
- the Coastal Coalition meeting,
- a meeting with Ventnor on creating a flood warning system,
- a Dredging Forum,
- a Monmouth County Resilience Symposium,

Staff staff presented the GTR process to EPA’s Pollution Prevention Program and, separately, to members of the FRAMES project team at the Louis Berger Group. Staff also gave a guest lecture to a college class at Stockton University regarding resilience work and coastal hazards. The JC NERR Resilience team presented the GTR process at a 10-year FEMA Hazard Mitigation Planning meeting and hosted a staff Retreat in Tuckerton for the State OEM Hazard Mitigation Office.

Additional Grants to Supplement the GTR Technical Assistance

- **NJ Resilient Coastal Communities Initiative with NJ DEP** – With continued support

from a NOAA CREST grant, the Resilient Coastal Communities provided New Jersey communities the appropriate tools, information and technical assistance needed to make informed decisions on coastal hazard mitigation and adaptation measures. Communities have assessed their geographic, environmental and social vulnerabilities to the impacts of current and future coastal hazards. Getting to Resilience was used to assist local governments evaluate the adequacy of their existing municipal hazard preparedness plans and to identify opportunities to plan for the future. Coastal hazard mitigation and adaptation measures enhanced the Getting to Resilience process. The NJ Resilient Coastal Communities Initiative built upon the existing work of the New Jersey Coastal Management Program, the NJ Recovery and Resiliency Network, NJ Future, the New Jersey Sea Grant Consortium and New Jersey's academic institutions (Including the JC NERR).

- **Extension of the Resiliency Outreach to Communities** – With Additional funding from the NJ DEP's Coastal Zone Management Program, the Community Resiliency staff time at the JC NERR will be extended with an additional time of about 8 months each. This funding will allow the GTR process to seamlessly continue and expand beyond what was originally planned. The JC NERR will work closely with the NJ DEP Coastal Zone Management (CZM) Office to ensure the communities served by this scope of work represent a broad diversity in geography and coastal typology. The JC NERR will also ensure consistency between this task and the other associated grant tasks as directed by the NJ DEP CZM Office grants Years 32 and 34. NJ DEP Coastal Management Program will be funding salary time through 2016 for the Community Resilience Staff. This would be supported from their base funding through NOAA.
- **New Jersey Fostering Regional Adaptation through Municipal Economic Scenarios (NJ FRAMES)** – The JC NERR is a project partner on the recently funded NOAA Regional Resilience grants. The lead on the project is the NJ DEP Coastal Management Program. This project will focus on the 15 communities that make up the Two Rivers Council of Mayors in Monmouth County to perform a stakeholder-led scenario planning process, deploy new and enhanced decision-making tools, and develop consistent state- and community-level policy and practices that support resilience and adaptation actions. The GTR process will be provided to all 15 communities through this opportunity.

Outcome End Date: September 2016

Task Outcome ED1.4 Webinars

No webinars have been offered, to date, for this reporting period.

Outcome End Date September 2016

Task Outcome ED1.5 Conduct an Updated Needs Assessment to inform a 2016-2021 CTP Strategic Plan

L. Auermuller has been working with a JC NERRR volunteer to expand and refine the CTP database which will be used for the needs assessment survey that will be administered this summer.

Presentations

Many presentations about the Getting to Resilience process have been requested at state and federal levels. Presentations made by J. Gatto and C. Huch were noted in the GTR section above (1.3). Lisa Auermuller presented the JC NERR resiliency work during the following meetings/conferences:

- 10/1/15 - Coastal Collation Monthly meeting presentation
- 10/9/15 - Long Beach Island Foundation of the Arts and Sciences Panel Presentation on JC NERR
- 10/21-22/2015 - NJ Association of Floodplain Managers Conference presentation
- 11/19-20/15 – GTR presentation at Capitol Hill Briefing for NERRS
- 12/16-12/18/2015 - Panel presentation at the AGU meeting
- 1/28/16 - Panel presentation at the NJ American Planning Association annual conference
- 3/3/16 – Presentation at meeting with Dr Susan Cutter at Rutgers University

3/24/16 GTR presentation at a FEMA Hazard MiResults of reserve programs are communicated to key audiences through publicly accessible media including a quarterly newsletter, scholarly articles, newspaper articles, radio and TV news services. Audiences are better aware of the value of coastal and estuarine systems.

Outcome End Date: September 2016

Task ED2 Education and Public Outreach-Continued Development and Implementation of Public outreach

Task Outcome ED2.1 Onsite Public Programs

Lunch n' Learn Series

- The JC NERR and the Tuckerton Seaport continued to offer the Lunch n' Learn series on the second Wednesday of the month from September to May. This series continued to attract a diverse group of community residents of which a core group of about 25 attended every program building their knowledge content from year to year. Each presentation usually has 40-60 participants. The presenters often remark at how knowledgeable the participants are and how much they enjoy the ability to go deeper into their topic/research than they can for other presentations. Six Lunch n' Learn presentations were offered during this reporting period, the final two presentations of the 2015-2016 season will occur in April and May.

During this reporting period we delivered the 2015-2016 season which included:

- The Jersey Devil- A Political Animal (October)
- Oyster Capital of the World (November)
- ReClam the Bay (December)

- A Party in Your Own Backyard (January)
- Station 119: From Lifesaving to Marine Research (February)
- Jetport (March)
- Stewardship and Protection Go Hand in Hand in Wharton (April)
- Tucker's island (May)

We continue to evaluate our Lunch n' Learn speakers and topics and have received numerous suggestions and requests for the 2016-2017 season.

Out and About the Reserve Programs

The JC NERR continued to offer the "Out and About the Reserve" programs with land management partners to encourage community members to get out into the Reserve. During these programs, participants learn about the partnerships that help to manage lands that comprise the Reserve, how partners work together to manage the Reserve, and why protection of these lands are important. Two programs were offered during the fall, our popular Discover Seven Bridges Van Tour.

During this reporting period a new partnership was developed with Pinelands Adventures, a newly formed adventure company run by the Pinelands Preservation Alliance. This new guide company specializes on getting people out into the Pine Barrens by van, canoe, foot and bike. All tours are guided by their education director, a former environmental education middle school teacher. The JC NERR is kicking off this new partnership by offering two extended adventures in June: Pine Barrens Time Machine Van Tour (5 hours) and Pine Barrens Discovery Tour (3 hours, includes hiking and canoeing). The JC NERR is excited about the potential of this new partnership to enhance our Out and About the Reserve programs.

Family Fun Programs

The Family Fun programs were designed to encourage multi-generational learning. The programs are created for all ages to enjoy the wonders of the natural world and specifically addressed estuary and ocean literacy principles. Exciting topics were selected that usually included hands-on activities and exploration to encourage grandparents, parents and children to attend. Programs offered during this reporting period included:

- Build an Underwater Robot A- October 7, 2015
- Build an Underwater Robot B- October 16, 2015
- Seals: New Jersey's Winter Visitors- February 19, 2016

The programs for Spring and Summer 2015 (called Summer Fun programs) were developed and scheduled during this reporting period and include:

- Getting Nature Crafty with Miss Julie- June
- Getting Nature Crafty with Miss Julie- July
- Cape May Park & Zoo's Animals Around the World- July
- Waterbiotics- September

Creature Features

During this reporting period the 7th year of "summer camp" was planned. The Creature Feature program remains the most popular summer program offered by the JC NERR. It is

held on Tuesdays for an hour and a half in the morning for six weeks through the summer. The program is designed for students entering grades 1 through 5 in the Fall and is taught by a summer part-time educator and former 4th grade teacher. The six sessions planned for this summer include:

- Cantankerous Crabs
- Daredevil Dolphins
- Plankton Palooza
- Deep Sea Surprises
- Sensational Sea Turtles
- Fish Festival

Ecological Evening Programs

Ecological Evening programs were designed as a collection of presentations by scientists and professionals to inform the public of current coastal issues and research, and to inspire appreciation for the natural world. During this reporting period we offered three programs including:

- Ospreys: Meet Your Neighbors (November)
- Removing Ghost Pots from New Jersey's Bays (February)
- Pinelands: New Jersey's Suburban Wilderness (March)

During this reporting period planning and scheduling of the Ecological Evening programs for Spring occurred. Scheduled was The Mighty Kirkwood-Cohansey Aquifer for April and the February program, Removing Ghost Pots from New Jersey's Bays, was snowed out and was rescheduled to be offered in May. These programs were designed for the adult learner but are also appropriate for older children.

Community Action Education/ Behavior Change Education

In partnership with our Coastal Training program the JC NERR will offer an Emergency Preparedness Workshop. Original plans included partnering with the Red Crosses Pillow Project but due to grant limitations on their program we were unable to have them partner. However, JC NERR developed a program for families using Community Based Social Marketing (CBSM) that will encourage and help families to prepare personal and family emergency kits. We are targeting the communities in which our coastal resiliency specialists have been working. This workshop will be piloted in May. The Red Cross is still interested in partnering and JC NERR will be following up in the fall to discuss other potential in the area of emergency preparedness.

Special Opportunities- Macroinvertebrate Training

In partnership with NJ Department of Environmental Protection's (NJDEP) Watershed Ambassador Program, a macro invertebrate training was planned to be offered in June. The training will be led by the Mullica River Watershed's Watershed Ambassador. Participants will be introduced to macro invertebrates and the importance of determining the health of a stream based on stream assessments used by the NJ DEP. Participants will learn to perform both a visual and biological assessment of a local stream.

Outcome End Date: September 2016

Task Outcome ED2.2 K-12 Education Programs

Professional Development

The JC NERR continued to support K-12 education with professional development programs that featured Reserve habitats, research and NOAA/NERRS assets. These include professional development trainings in partnership with the NJ Department of Environmental Protection (NJ DEP), and the Alliance for New Jersey Environmental Education (ANJEE). M. Reding is certified in partnership with NJ DEP to offer Project Wet and WOW! workshops. Planning occurred during this reporting period for the following professional development trainings: Ocean Literacy Through a National Coastal and Estuarine Science Curriculum, Project Wet and WOW! and Talking Trash, a marine debris workshop funded externally by a NOAA Marine Debris grant. Two workshops were offered, Ocean Literacy Through a National Coastal and Estuarine Science Curriculum and Project Wet.

Ocean Literacy Through a National Coastal and Estuarine Science Curriculum – January 22, 2016

M. Reding offered two workshops at the Alliance for New Jersey Environmental Education's (ANJEE) Annual Conference focusing on Environmental Education: The Next Generation. These two sessions focused on presenting the NERRS national curriculum E101 for middle school and high school. Participants explored the E101 online curriculum website, did three activities from the curriculum and were introduced to other NOAA resources and given a list of upcoming TOTE workshops. The sessions reached 22 teachers.

Project Wet Curriculum Guide Workshop- February 27, 2016

The Project WET Curriculum and Activity Guide 2.0 is a collection of 64 science-based, interdisciplinary activities and lesson plans that are teacher-tested and classroom ready for K-12 students. Designed with a commitment to meeting educational standards, Project WET activities use the vital importance of water to cover diverse topics and disciplines. Activities with names such as "The Incredible Journey," "Pass the Jug," "Macro-invertebrate Mayhem," describe lessons that are sure to pique student interest and make learning fun. This guide is only available to educators who participate in a six-hour Project WET Workshop. The lessons in this guide are correlated to the NJ Core Curriculum Content Standards as well as National Science Standards. In addition, workshop participants learn about an amazing array of supplementary educational materials that focus specifically on NJ's water resources. Besides being introduced to Project Wet, participants were introduced to NERRS/NOAA resources including SWMP, and Data in the Classroom.

A total of eight educators were trained in Project Wet including two Italian marine biologists doing a residency in the Washington DC area. They were both with the Green Bubbles Project an EU-funded project dedicated to recreational SCUBA diving as a venue to teach ocean literacy and stewardship. Following the workshop these two instructors spent time with M. Reding discussing how the JC NERR and NERRS teaches ocean literacy. This was a unique opportunity for cross cultural exchange in the area of ocean literacy.

WOW! Wonders of Wetlands Workshop- originally scheduled for March 19th rescheduled to May 14th.

A Wonders of Wetlands (WOW!) workshop is an instructional guide for educators that provides a resourceful and creative collection of wetland activities, information and ideas.

WOW! includes: over 50 hands-on multidisciplinary activities in lesson plan format, extensive background information on wetlands, ideas for student action projects and a wetlands resource guide. Besides being introduced to WOW! curriculum, they will be introduced to NERRS/NOAA resources including SWMP.

Talking Trash: Marine Debris Workshop- July 20-21, 2016

Planning and development took place for this new offering, an exciting two-day workshop focused on marine debris funded through the WeCrab Marine Debris Project, a grant received by the JC NERR from NOAA's Marine Debris Program. The JC NERR will use NOAA's curriculum *Turning the Tide on Trash* and *An Educators Guide to Marine Debris*, to help educators bring these marine debris activities into their classroom and informal settings. The workshop will blend research, STEM, stewardship and art as educators explore the impacts of marine debris and ways that students and communities can raise awareness and help prevent this common problem that impacts our oceans and coasts. The workshop will explore current NJ marine debris removal projects funded by the NOAA Marine Debris Project and the variety of NOAA resources that exist. Attendees will be eligible to receive a stewardship stipend to use for a class marine debris project. The workshop is geared towards middle, high school and informal educators.

World Water Monitoring Day

The JC NERR again participation in World Water Monitoring Day, on October 23, 2015 at Batsto Village in Wharton State Forest, one of our land management partners. Critter tracking was the focus and included current research projects on tagging and tracking thresher sharks, horseshoe crabs, and several fish species. 311 middle and high school students participated.

Home School Group Lesson Development

The JC NERR has continued development on a home school offering due to continued requests. The program has been designed to be a "meaningful education experience". The designed lesson plans were developed to be investigative and project oriented, hands-on, STEAM focused and part of a sustained activity. Home school groups must agree to a three visit series with each visit consisting of two hours. Each lesson plan includes pre and post activities. Sessions are as follows:

1st session - Estuary food pyramid with special focus on plankton

- Review of Estuaries
- Estuary food pyramid (students will design an estuary food pyramid)
- Plankton labs
- Planet Plankton (E101)

2nd session- Importance of estuaries to fish (& other species), fish biology and fish tagging research

- Importance of submerged aquatic vegetation (sea grass) to the estuary
- Dash for Grass (activity to teach about the different animals that use sea grass beds for survival)
- Decode a Fish (activity that looks at fish biology and adaptation)
- Fish Printing aka Gyotaku (fish art activity)

3rd session- Advanced technologies used to study estuaries. Introduction to Remotely Operated Vehicles and Autonomous Underwater Vehicles (ROVs and AUVs). Why and how we use them for research

- Aquabotz – students, in teams, build an underwater remotely operated vehicle (ROV) and test it in the pool
- Intro to REMUS (our AUV) and how it is used by the Reserve for research

Planning for a spring group, World Explorers took place during this reporting period. They will be coming to the Reserve in April, May, and June.

Task Outcome ED2.3 Offsite Programs

The JC NERR continued to provide community education programs through informative outreach programs delivered by reserve staff and volunteers. Presentations were made to community groups and non-profit organizations, and community outreach events were held at fairs and festivals.

Offsite Presentations

- Advanced Technologies and Fish Tracking, Harbor Bay Fishing Club on October 20, 2015

Festivals

Our goal at festivals is to raise the awareness of the JC NERR, estuaries, Reserve research, and the value of protecting watershed and estuarine environments. A hands-on activity is typically developed for each event. Festivals are slow from October to March, however during this time we register for numerous spring and summer festivals. Festivals we have registered to participate in are:

- Atlantic County Utilities Festival- April 23, 2016
- RUMFS Open House- April 30, 2016 (rescheduled from fall due to Nor'Easter)
- Little Egg Harbor Sr. Expo- May 4, 2016
- Ocean Fun Days Island Beach State Park- May 21 & 22, 2016
- Barnegat Bay Festival- June 5, 2016
- National Trails Day- June 4, 2016

JC NERR Marine Field Station Open House

One of the largest public events organized by the JC NERR is the annual Open House at the Marine Field Station at which presentations and hands-on activities offer the public a view into current reserve research. The Open House was cancelled the last two years due to remaining damage from Superstorm Sandy and this year it was timed perfectly with a Nor'Easter and possible hurricane that brought severe flooding. Planning for the open house took place during this reporting period but the open house was rescheduled from October 17th to April 30th.

Additional Education and Public Outreach **Conferences and Workshops Attended**

- 2015 NERRS Annual Meeting: October 26-30, 2015
- DE Wetlands Conference: February 3, 2016. Presented two Communicating Climate Change Workshops through NNOCCI in partnership with Sarah Nuss from VA NERR

National/Local/State Committee Service

- **NJ Marine Education Association, President**
- **Pinelands Education Advisory Committee Board Member**
- **National Marine Education Association, Chapter Rep**
- **National Network of Ocean and Climate Change Interpretation (NNOCCI), Regional Leader Mid-Atlantic**

NERRS/NOAA Workgroups and Committee Service

- **Chair, EC Community Action Education workgroup (formerly Community Education)**
- **EC Coordinating Committee**
- **MA/NA Workgroup**
- **EC Virtual Meeting Planning Committee**
- **NOAA NODE/Data in the Classroom workgroup**
- **Data Management Committee, Education Rep.**

Program Planning and Administration

During this reporting period the JC NERR continued to increase use of our media tools. M. Reding was responsible for maintaining and updating the main JC NERR Facebook page (with help from SWMP tech Gregg Sakowicz) along with the JC NERR Educators Facebook Page. The JC NERR had a strong presence in the I Heart Estuaries Campaign.

During this period M. Reding planned, designed, printed and mailed the Fall/Winter 2015-2016 and Summer 2016 public programs brochures. The brochures are mailed to Reserve mailing list and distributed through our reserve partners, and at the Life on the Edge Exhibit, fairs and festivals and at the JC NERR. Public programs were also advertised on the reserve website, NOAA's education calendar on www.nerrs.noaa.gov, and in local newspapers and in the Reserve newsletter.

M. Reding was asked to participate in the development and review for an exhibit RFP with our partner the Pinelands Commission. M. Reding helped Pinelands Commission staff interview and choose the design and exhibit company.

M. Reding continued to be active in the National Network of Ocean and Climate Change Interpretation (NNOCCI) alumni program, attending monthly webinars and has been asked and continues to serve as one of two Mid-Atlantic Regional Leaders responsible for engaging and networking with NNOCCI Alumni.

Grants- M. Reding

Ongoing

During this reporting period M. Reding continued work on two NPS grants: *Submerged Marine Habitat Mapping: A foundation for Enhancing Resilience to Climate Change and other Stressors at the Gateway National Recreation Area* and *Post Hurricane Sandy- Submerged Marine Habitat Mapping, Gateway National Recreation Area*. M. Reding is leading the

education and outreach components of the grants including the professional development workshop that is partially funding the 2016 TOTE training.

M. Reding continued work on a NOAA Restoration Grant titled: *Derelict Crab Trap Removal and Prevention in Southern New Jersey Coastal Bays*. Work on that grant started September 1, 2015 and is a two year grant. M. Reding is leading the education and outreach components of the grant focused on marina signage and outreach to boaters and crabbers.

M.Reding continued work on a NOAA Marine Debris Prevention Through Education Grant titled: *WeCrab Marine Debris Project*. Work on the grant started September 1, 2015 and is a two year grant. The grant focuses on preventing ghost pots through education including teacher trainings and recreational crabber workshops. The grant uses Community Based Social Marketing to change behaviors. The Crabber workshops, Community Day Processing Event and teacher trainings were developed and planned during this progress report.

M. Reding continued work on a PAC Grant titled: *Enhancement of Life on the Edge Exhibit*. Work on that grant started July 1, 2015 and ends June 30, 2016. M. Reding is part of the JC NERR team working on content and design.

Submitted

M. Reding was involved in a Science Collaborative Pre-proposal led by Rick Lathrop titled Investigating the Interconnectedness of Climate Change, Nuisance Mosquito Populations, and Long-term Resilience of Coastal Salt Marsh Systems. M. Reding will assist with outreach for the project and develop and implement the educational module for use in TOTE trainings. The pre-proposal was accepted and work is occurring on the development of the full proposal.

Outcome End Date: September 2016

Task ED3: Teachers on the Estuary (TOTE)

Task Outcome 3 Teachers on the Estuary (TOTE)

Teachers on the Estuary 2016: Advanced Technologies and Benthic Habitat Workshop

Planning occurred for the Advanced Technologies and Benthic Habitat Workshop that was rescheduled from July, 2015. This workshop is being partially funded through two National Park Service Grants titled: *Submerged Marine Habitat Mapping: A foundation for Enhancing Resilience to Climate Change and other Stressors at the Gateway National Recreation Area and Post Hurricane Sandy- Submerged Marine Habitat Mapping, Gateway National Recreation* as well as 315 funds. Due to a variety of professional development workshops being offered by the JC NERR this summer the JC NERR decided to develop the benthic mapping training into this year's TOTE training, allowing for a longer workshop with additional elements such as stipends, additional activity resources and STEM expertise.

The Jacques Cousteau Reserve in partnership with the National Park Service, designed a 4-day workshop focused on advanced technologies and benthic habitats. Participants will be immersed in real-world research as they explore a submerged marine habitat mapping project occurring at the Sandy Hook Unit of Gateway National Recreation Area, NJ as they build their ocean and climate literacy. Key topics of the workshop include bathymetry, bedforms and

bottom types, benthic biological communities, sampling techniques and advanced technologies including: multi-beam sonar, remotely operated vehicles (ROVs) and autonomous underwater vehicles (AUVs). Participants will collaborate with other teachers, science educators and scientists as they explore ways to bring STEM and real-world science into their classroom. Participants will:

- increase their confidence in teaching about coastal ecosystems using local real world science and research
- increase their knowledge of current research and benthic habitats, while increasing their ocean and climate literacy
- discover a variety of resources for use in their classrooms
- receive high quality resources and materials to enhance their science teaching (including STEM and NGSS resources)
- receive access to ROV kits and expertise
- receive a stipend for participation, lunch and snacks

During this progress reporting period the program was designed, lessons were created, and the training was advertised on local, regional and national sites.

Outcome End Date: September 2016

Task ED4 Life on the Edge Interpretive Center

Task Outcome ED4 Life on the Edge at the Interpretive Center

The JC NERR continued support for the Life on the Edge exhibit at the Tuckerton Seaport as the gateway to the Reserve. The exhibit offers opportunities to engage audiences to learn about the resource value of estuaries, issues that affect the ecological integrity of their systems and presents information on recreational access and stewardship engagement of the Reserve's habitats. A part-time interpreter continues to be stationed at the exhibit during the peak hours of operation to answer questions and provide inquiry-based engagement strategies. The Interpreter trains docents, who are regularly scheduled to conduct tours and assist visitors during the 362 days per year that the Tuckerton Seaport is open to the public. Funds are requested to support the general operation of the exhibit including needed supplies, maintenance and tech support. Continuing professional development opportunities for the Interpreter and volunteer docents will increase their knowledge of estuaries and how scientific research can inform decisions to best protect the value and beauty of the coastal community. The docents and Interpretation Coordinator meet to collaborate on ideas for conducting tours at the Life on the Edge exhibit and to discuss ideas for exhibit enhancements.

a. Life on the Edge K-12 programs

The interpreter is also for working with the educational staff at the Tuckerton Seaport in continuing to deliver a seamless field trip experience that connects the cultural heritage and natural resources of the Mullica River/Great Bay and Barnegat Bay to school groups from both coastal and inland NJ communities. There is a focus in serving underserved districts through free bus grants and schools and organizations providing services for special needs children.

b. Enhancements to the Exhibit

During this report period, with grant funding from NOAA, the JCNERR continued to work with Night Kitchen Interactive to design, develop and install key interactive components to the Life on the Edge exhibit. A separate agreement was signed with Van Sickle & Rolleri, LTD to design, build and install a family activity corner in the exhibit space. The exhibit steering committee, including the Exhibit/Interpretation coordinator partnered with both studios throughout the initial phases of planning and design process through a series of meetings, conferences calls. The Interpretation Coordinator continued to provide content for the new exhibits.

Engagement with the exhibit has resulted in visitors’:

1. ability to define an estuary and recognize that this one as a special place- let’s protect and preserve it together
2. learning how humans affect the estuary in small and large ways and how we can manage our impact.
3. being able to navigate the Mullica/Great bay/Barnegat watershed and its recreational access through the many images on the map table
4. appreciation of how our lives are intertwined with the benefits of and threats to the estuary
5. taking responsible actions that support local and global environmental and sustainable practices by entering the iPledge station where they can digitally document personal choices.
6. Inspired by a quote from the Cousteau Calypso Log. “The kind of world our children inherit tomorrow depends on how well we care for it today”.

Outcome End Date: September 2016

Task ED-5 Volunteer Program

Task Outcome 5.1 Advancing the Volunteer Program

Volunteers contributed to the Great Bay/Mullica River beach seining project and long-term ichthyoplankton research efforts. Volunteers also contributed largely to public education programs at the JC NERR ‘Life on the Edge’ exhibit, education programs, and coastal training programs at the JC NERR Education Center.

The beach seine project which samples juvenile fish and crabs at areas within the Reserve, uses data collected from sampling to supplement existing long-term data sets on ichthyoplankton, otter trawl, killitrap, and seine sampling. This project was developed to incorporate maximum volunteer involvement in order to better assist JC NERR staff with research within the Reserve, as well as to educate volunteers on the local effects of climate change on the marine environment. Seine sampling was completed in October, which wrapped up a 6 month sampling period. Sampling was expanded to include three additional sites, and with these additional sites, volunteers were more involved with field sampling this past season and also continued to work on this project by entering data collected into long-term databases, making this project a largely volunteer effort. Volunteers also provided integral assistance for long-term ichthyoplankton sampling on the Tuckerton Peninsula in the Reserve.

The 'Life on the Edge' exhibit continues to thrive in part because of dedicated volunteers who provided educational programs to inform the public about the value of estuaries. Volunteers provided feedback and ideas to improve public engagement as part of the renovation project at Life on the Edge. Volunteers also assisted with logistics for a NOAA Green Infrastructure Training workshop and the professional development program: Project WET.

Outcome End Date: September 2016

Task Outcome 5.2 Volunteer Recognition

The Volunteer Coordinator tabulated volunteer hours for volunteer recognition which includes an annual volunteer dinner/recognition event for those with 10 or more volunteer hours, a gift to each volunteer who has 25 or more hours in a given year, and recognition to a chosen 'Volunteer of the Year', as well as those volunteers who have reached 500, 1000, and 2500 hours, respectively, in their term of service with the JC NERR.

Outcome End Date: September 2016

Task Outcome 5.3 Advanced Volunteer Training

With increased volunteer involvement in education programs at the Life on the Edge exhibit, the Interpretive Coordinator (Ida Scott) continued to plan outreach/educational opportunities for volunteers participation. Activities included trips to museums to learn about other interpretive exhibits, docent participation, and how volunteers can incorporate new strategies and content into the Life on the Edge exhibit. Volunteers attend the Barnegat Bay Partnership's Education and Outreach Retreat.

Two volunteers attended the Project WET professional development program.

Outcome End Date: 2016

Task Outcome 5.4 Stewardship Efforts

Volunteer education efforts focused on public education at the Life on the Edge exhibit and assisted with logistics for professional development and coastal training programs. They also Volunteers contributed to collection of long-term ichthyoplankton. One of our long-term volunteers, Helen Zaengle, continued to provide excellent administrative assistance for us with database management, mailing list contacts and addresses for CTP and Education sectors. Helen was indispensable in assisting with building logistics. Our dormitory rooms continue to have a large amount of use, and Helen prepared rooms for guest stays - making beds, keeping track of laundry, and organizing keys for our visitors. Her efforts kept the Reserve office running smoothly and efficiently.

As plans to develop the Grassle Marsh Trail, volunteers have begun to prepare to support interpretive activities associated with this initiative. Over the next few months, volunteers will

focus on ichthyoplankton sampling, new citizen science efforts, public education efforts at the Life on the Edge exhibit, and assistance with construction of the Grassle Nature Trail.

Outcome End Date: September 2016

Task: NERRS System Wide Monitoring

Task Outcomes RM1.1 Estuarine Research and Monitoring Activities

Student Research

Research Coordinator (RC) Mike Kennish is the advisor of a Rutgers University graduate student (Samantha Gilbert) who is conducting a thesis project on the population dynamics of the bay scallop (*Argopecten irradians*) in Little Egg Harbor, New Jersey. Samantha's thesis project is titled "Assessment of the Population Dynamics of Bay Scallops (*Argopecten irradians*) in a Highly Eutrophic Estuary: Field and Laboratory Experimental Approaches." This project is being conducted in Little Egg Harbor, which is a shallow estuarine water body within the boundaries of the JC NERR. The objectives of this study are to identify key habitat characteristics and locations within Little Egg Harbor that may serve as sites for bay scallop source populations and to investigate the dynamics of a planted experimental population of bay scallops for use in developing potential shellfish restoration strategies. In addition, the study aims to more clearly understand the effect of seagrass blade epiphytes and biofilms on larval recruitment and juvenile bay scallop attachment. This work is important because it can inform regulatory decisions regarding seagrass beds and Environmentally Sensitive Area designations in the estuary.

Fieldwork is based out of the Coast Guard station in Beach Haven, New Jersey located on Long Beach Island. In spring 2016, bay scallop seed (50 to 300 individuals) with a shell height (distance from umbo to ventral margin) ranging from 20-30 mm will be planted in cages at multiple seagrass bed sites within Little Egg Harbor. Growth, mortality, and reproductive development will be measured in the cages at each site every three weeks. In addition, during each sampling date, 15 scallops will be collected from an extra cage deployed at each site for reproductive assessment. The gonadal material will be visually assessed for ripeness, and a Gonadal- Somatic Index (GSI) will be calculated to evaluate the population's reproductive status and recruitment period. Simultaneously with cage planting, bay scallop spatbags will be deployed at recruitment sites inspected for bay scallop larvae once every three weeks. Transect surveys will be conducted at these recruitment sites during the first and last month of the field season during each year of the study.

The study output will provide valuable insight into the processes limiting the recovery of bay scallops in Little Egg Harbor. The presence of suitable habitats to support bay scallop populations in the estuary will be evaluated. This work will generate data necessary to inform future bay scallop restoration efforts. Additionally, this study will engage and educate the local community on environmental issues impacting Barnegat Bay and Little Egg Harbor and steps needed to remediate them

Tuckerton Peninsula Salt Marsh System (Sentinel Site Research)

Much of the research conducted by the JC NERR staff and collaborators at Rutgers University during this report period targeted the JCNERR sentinel site (Tuckerton Peninsula salt marsh system). This research is examining the drivers of change that have rendered the salt marsh habitat in the peninsula vulnerable to perimeter shoreline erosion, coastal storm impacts, sea-level rise and inundation. Anthropogenic factors, such as ditching and Open Marsh Water Management that alter hydrology, are also being investigated. Inundation and flooding of marsh habitat associated with storm surge during Superstorm Sandy show how serious impacts of coastal storms can be on salt marsh and other wetlands habitat.

A NOAA COCA project (“Decision-making for Coastal Adaptation: Sustaining Coastal Salt Marshes for Ecosystem Services along the Jersey Shore”) is ongoing. Richard Lathrop (Project PI from Rutgers University’s Ecology and Evolution Department) and staff members from the JCNERR and partner organizations are investigating the efficacy of different management approaches designed to promote the long-term sustainability of this coastal marsh in response to rising sea levels within the context of the constraints imposed by a closely coupled social-ecological system. In connection with this, the costs associated with maintaining this coastal marsh system is being assessed under future sea-level rise scenarios in concert with its ongoing ability to provide highly valued ecosystem services. The broader objective is to provide coastal decision-makers with the information needed to make choices concerning maintenance and/or restoration of green infrastructure within coastal communities in the area. One goal is to develop and pilot-test a process to aid coastal communities and decision-makers in integrating scientific information on the predicted outcomes of ‘green infrastructure’ practices vs. a no intervention alternative (the *status quo*) with an understanding of the value tradeoffs involved into coastal planning. The project is benefiting from the extensive work that the project partners are already engaged in concerning promoting resilient coastal communities that can adapt to the impacts of hazards and climate change.

More specifically, this research project targets NOAA’s Climate and Societal Interactions (CSI)-Coastal and Ocean Climate Application (COCA): Ecosystem Services for a Resilient Coast. With the objective of promoting resilient coastal communities that can adapt to the impacts of hazards and climate change, the project also addresses several of NOAA’s long-term goals as expressed in NOAA’s Next-Generation Strategic Plan, namely 1) *Climate Adaptation and Mitigation*: An informed society anticipating and responding to climate and its impacts; 2) *Weather-Ready Nation*: A society that is prepared for and responds to weather-related events; and 3) *Resilient Coastal Communities and Economies*: Coastal and Great Lakes communities that are environmentally and economically sustainable.

A key component of this research project is to assess the effectiveness of tidal salt marshes and maritime forests in buffering adjacent development from storm-related damage. A part of this effort is determination of the incremental monetary value that a hectare or linear extent of fronting tidal marsh and/or maritime forest has on protecting the built environment. While it is recognized that this research component targets only one major ecosystem service potentially provided by coastal wetlands (i.e., their buffering effect), there are other ecosystem services and societal reasons for maintaining salt marshes and maritime forests within a broader coastal system. This project will add to our larger understanding of coastal resiliency by quantifying the protective ecosystem services provided by salt marsh systems.

During this report period, the following work was conducted on this COCA project by PI Richard Lathrop, Co-PI Michael Kennish, and the team of collaborators. Efforts were focused on assessing marsh vulnerability by generating a Composite Vulnerability Scoring measure. Considering the long-term resiliency of the Tuckerton Peninsula salt marsh system and all the services it provides, one target was to look for indicators of decline or indicators that the marsh is changing. Marsh plants respond to the extent of tidal inundation. For the Tuckerton Peninsula salt marsh, three segments were established based on the presence or absence of mosquito marsh alterations (e.g., grid ditching, OMWM, etc.). Initially, elevation sampling of the three segments was conducted using real-time kinematic surveying methods to transect the marsh platform and capture the marsh features. For vegetation sampling of the marsh, MACWA techniques were employed. The research team looked at the variability of scores for the marshes and compared that to the existing MACWA data set. Variability scores for the marshes were determined and then mapped. When vegetation health was added, changes could be seen in the marsh not based on elevation.

The Digital Shoreline Analysis System (DSAS) was used to determine how much change had occurred along the marsh shoreline between 1977 and 2015. Salt marsh vulnerability maps (i.e., MarshFutures maps) are being generated that will assess seaward edge erosion, platform “elevation capital,” and landward migration and which will predict the fate for selected Areas of Interest (AOIs). Field surveying/sampling and mapping protocols are being followed.

Methods: Estimating Elevation Capital and Developing MarshFutures Maps

Three areas of interest (AOIs) were selected for study within the Tuckerton Peninsula salt marsh system: one in the northern segment, one in the central segment, and one in the southern segment. The AOIs were selected to be representative of different suites of stressors. The Tuckerton Peninsula AOIs were selected by JC NERR staff to correspond with the JC NERR sentinel site and to capture the three major types of marsh management categories (grid-ditching, Open Marsh Water Management, and unaltered). The size and shape of each AOI was tailored to local conditions (marsh shape) and logistics (access, field time). Each AOI encompasses 1-2 hectare areas (i.e., if square in shape, then 100-200 m per side).

Inundation and accretion were examined as well, using the SLAMM model, with a 4 mm accretion out to 2050. The Marsh Equilibrium Model (MEM) is also being considered as a potential marsh model, but we may not have enough data for application of the MEM. There is an interest in finding a way to map the change in elevation capital of the marsh platform along a timeline, until drowned or years until being eroded down.

Another objective is to assess the costs for different techniques of marsh management applied to the Tuckerton Peninsula salt marsh system. What mechanisms are effective in helping decision-makers to integrate scientific projections, economic estimates, and social values into coastal adaptation efforts? This component of the study is ongoing as well. There is a need to be cautious with decision-makers and strategic with recommendations to implement certain restoration techniques.

Other Research and Monitoring Activities

A number of other research and monitoring projects have been ongoing in the JC NERR, being conducted by primarily by JC NERR staff members, Rutgers University scientists, and technical staff of partner organizations. These include

Biofouling

Climate Change Studies

Ecosystem Models

Nekton

Shellfish

Finfish

Sea-Level Rise

Water Quality

During this report period, most of the work conducted on research and monitoring projects in the JC NERR involved data synthesis, with some field work also being conducted. JC NERR and Rutgers University scientists, as well as technical staff of partner organizations are working on a range of abiotic and biotic studies (see list above) within estuarine and coastal marine waters of the JC NERR. A series of technical reports were posted on the website of the New Jersey Department of Environmental Protection, a JC NERR partner which funded a number of research projects on the Barnegat Bay-Little Egg Harbor Estuary from 2011-2013.

Biofouling

Work by Mike Kennish and Gregg Sakowicz has continued on the JC NERR biofouling study. Data analysis of the fouling samples was a primary focus of work on this project during the report period. The macrofouling community in estuarine waters of the JC NERR is being characterized over a 10-year study period. Analysis of polyvinyl chloride (PVC) settling plates deployed at seven sampling sites in Great Bay and Barnegat Bay-Little Egg Harbor systems from spring to fall between 2006 and 2015 reveal relatively consistent species composition of the macrofouling community from year to year, but considerable seasonal variation across sampling stations. The dominant fouling organisms include calcareous bryozoans, calcareous polychaetes, tunicates, barnacles, and macroalgae. Among the most important fauna are the cheilostome bryozoan, *Membranipora* sp.; creeping bryozoan, *Bowerbankia gracilis*; tube-building serpulid polychaete, *Hydroides dianthus*; golden star tunicate, *Botryllus schlosseri*; sea grape tunicate, *Molgula manhattensis*; acorn barnacles, *Balanus* sp.; and the red alga, *Polysiphonia* sp. Other less abundant members of the community include the slipper limpet, *Crepidula fornicata*; orange sheath tunicate, *Botrylloides violaceus*; and sponges. Significant differences are observed between the organisms covering the upper and lower surfaces of the PVC sampling plates. This difference may be due to photonegativity of the larvae setting on the plates, attraction to the same species, and avoidance of interspecific competition for surface area.

Standardized polyvinyl chloride (PVC) plates measuring 25.4 cm x 25.4 cm have been deployed and retrieved at the field sampling stations in this study. Biofouling samples were collected annually over a 10-year period (2006-2015) using PVC settling plates attached to metal racks deployed at seven stations in the Tuckerton Peninsula, Little Egg Harbor, and

Barneгат Bay. PVC fouling plates measuring 25.4 cm x 25.4 cm (10 inches by 10 inches) were used from 2006 to 2013; smaller PVC fouling plates measuring 20.3 cm x 20.3 cm (8 inches by 8 inches) were used in 2014 and 2015. The plates were attached to the four corners of a metal frame measuring and submerged at the sampling stations such that each plate was positioned horizontally in the water column ~0.5 m off the bottom.

The plates were deployed twice each year in the field. The first set of plates was submerged in the spring (May or early June) and removed in the summer (July, August, or September). The second set of plates was submerged in the summer (July or August) and removed in the fall (October or November). All recovered plates were immediately placed in heavy duty zip-lock bags containing ethanol with labels specifying the station ID, date, and plate number. The plates were stored in ice within a cooler for transport back to the RUMFS in Tuckerton. At RUMFS, the zip-lock containing plates were placed in 10 gallon drums of ethanol for storage prior to analysis.

The plates were subsequently analyzed in the laboratory by visual observation, with all fouling organisms identified and their percent areal cover recorded. The plates were carefully inspected for alteration and damage.

Not all stations were sampled throughout the 10-year period because of unusual events (e.g., damage to docks and other structures during coastal storms) and the loss of access to sampling stations at marinas. For example, in 2013 docks at stations 3 and 5 were destroyed by Superstorm Sandy. In 2014, sampling at station 5 was reactivated after dock repairs were completed. However, sampling at station 3 was not reactivated because of severe structural damage. The use of station 7 was suspended in 2006 due to the loss of access to Winter's Yacht Basin Marina.

The retrieved panels have been stored in the JC NERR laboratory at the RUMFS. Laboratory analysis of the panels to determine the composition of epibiotic organisms is ongoing by the research coordinator and will be completed during the next report period. Studies of the biofouling community are being conducted to document the trends in species composition, abundance, and areal distribution of the dominant biofouling species in estuarine waters of the JC NERR and their potential impacts on fouling and functionality of SWMP dataloggers. Observations on species interactions during community development will enable investigators to determine the biotic factors responsible for the source of the community changes. Larval recruitment and settlement patterns of epifaunal species are often strongly correlated with boundary-layer flows. Hence, hydrodynamic processes must also be considered in studies of the species diversity of epibenthic communities.

The biofouling sampling program will continue in 2016 and 2017.

SWMP Water Quality Monitoring

A major focus of the JC NERR is its System-Wide Monitoring Program (SWMP), which focuses on water quality and meteorological monitoring in the Mullica River-Great Bay system. Three primary elements of JC NERR SWMP were covered during this report period including: (1) SWMP water quality monitoring and data submission to Central Data Management Office (CDMO); (2) weather station data acquisition and submission to CDMO;

and (3) real-time telemetry. Gregg Sakowicz collected and processed estuarine water-quality and nutrient data for the JC NERR monitoring sites. In addition, he reviewed JC NERR meteorological data (working in collaboration with technical personnel from the Stockton University Marine Field Station), and determined that they had been collected appropriately.

Gregg also maintained ongoing operation of JC NERR SWMP by conducting periodic maintenance and repairs on field and laboratory instrumentation, sampling platforms, and operation of the JC NERR research vessel, *RV Mullica Explorer*. He ensured successful operation of requisite telemetry equipment. There were several technical problems encountered with SWMP monitoring instrumentation and platform sites during this report period. He handled them effectively.

Gregg completed and submitted the 2014 third quarter SWMP water quality and meteorological data and metadata reports on November 2, 2015. He also completed and submitted the fourth quarter SWMP data and metadata reports on February 1, 2016. In addition, he completed the final review of the 2012 SWMP data in December 2015 with CDMO staff, on schedule, to authenticate the annual dataset. However, several technical issues were encountered with SWMP during this report period. Gregg managed to continue SWMP datasonde calibrations, post-calibrations, and data submissions from January-March despite having no water supply at the Rutgers University Marine Field Station, where SWMP laboratory processing is conducted. This work was accomplished through a number of work-arounds including relocation of some efforts and transport of copious amounts of water to the site.

Task outcome RM1.2 Abiotic and Nutrient Sampling Program

SWMP Nutrient Sampling

The failure of the water supply at the Rutgers University Marine Field Station (RUMFS) impacted nutrient sampling for SWMP during this report period. Discolored water and sediment were discovered in the water supply at RUMFS in late January 2016 resulting in temporary suspension of system use for the latter half of the month. *E. coli* contamination was discovered in the water supply in early February 2016, necessitating a shutdown of the water supply, impacting many laboratory and field operations, including SWMP nutrient work. As a result, it was not possible to continue SWMP nutrient sampling in February and March 2016 due to the lack of a supply of deionized water and, equally important, eyewash and body wash-down safety stations.

SWMP meteorological sampling was successfully completed during this report period. Following the JC NERR SWMP protocols, staff of the Stockton University of New Jersey recorded weather station data, prepared metadata, and submitted the weather station data to the JC NERR for submission to the CDMO. Gregg Sakowicz submitted the 2014 third quarter SWMP meteorological data and metadata report on November 2, 2015. He also submitted the fourth quarter SWMP data and metadata report on February 1, 2016.

Outcome End Date: September 2016

Task Outcome RM1.3 Campbell Weather Station

Staff of the Stockton University of New Jersey will troubleshoot the JC NERR Campbell Weather Station equipment, record weather station data, prepare metadata, and submit the weather station data to the JC NERR for submission to the CDMO. The Campbell Weather Station is located at the Stockton University Marine Field Station on the Nacote Creek. It will be calibrated and maintained in accordance with the Weather Standard Operating Procedure Manual and consistent with other reserves in the NERRS program. Weather station data collected in this program can provide trends in atmospheric processes useful to inform land use/land management strategies and other coastal management applications.

Outcome End Date: September 2016

Task Outcome RM1.4 Habitat Change

Andrea Spahn, with Center for Remote Sensing and Spatial Analysis, continues to produce periodic GIS maps and data for the JC NERR. Updated land use maps have been provided to JC NERR staff and will be uploaded to the JC NERR website.

Outcome End Date: September 2016

Task Outcome RM1.5 Sentinel Site Development

The Tuckerton Peninsula salt marsh system is the designated sentinel site of the JC NERR and a primary target of research and monitoring during the award period. Vertical control and sentinel site plans are in draft form and will be finalized in the summer 2016. In addition, 6 SETs have been installed on the marsh platform, with 3 more SETs being installed in May 2016. Data will be collected on emergent vegetation in the peninsula, habitat trends, and environmental stressors useful for characterizing spatio-temporal structural and marsh composition changes and of value for coastal zone management. Integrating habitat characterization of the Tuckerton Peninsula salt marsh platform with vertical control applications will provide a comprehensive approach enabling the JC NERR to operate effectively as a sentinel site for climate change research and monitoring. This will build additional capacity for the NERRS program.

Outcome End Date: September 2016

Task: GIS

Task Outcomes RM2.1 GIS Database

Work is on-going with the creation of a shoreline-change analysis map for the sandy shorelines on the Edwin B. Forsythe National Wildlife Refuge. GIS data has been collected on a semi-annual basis, every spring and fall for the past three years, on the Holgate and Little Beach portions of the refuge. The shoreline data are collected using a sub-meter GPS unit and following the Northeast Coastal and Barrier Network Geomorphological Monitoring Protocol: Part I – Ocean Shoreline Position. The analysis was completed using the Digital Shoreline Analysis System from USGS and a Rutgers University code called Shoreline Change Mapper program for ESRI ArcGIS. The analysis shows the rate and direction of change of the shoreline in the refuge over time as well as the immediate effect that Superstorm Sandy had on the shoreline position. Andrea, in partnership with refuge staff, completed the surveys for the spring 2015 and fall 2016 seasons. Analysis of the data results in progress and annual technical reports, which are composed every summer to reflect the previous year. They are available online through the agency websites.

Outcome End Date: September 2016

Task Outcome RM2.2 Habitat Map

JC NERR began updating the 2007 habitat map in FY15. Andrea Spahn began working with NOAA's Office of Coastal Management in October 2014 to look at current data sources and identify data needs to complete a new map. Andrea Spahn will be working with NOAA's Office of Coastal Management to create a final map at the end of September 2016

Outcome End Date: September 2016

Task Outcome 2.3 Vertical Control Plan

JC NERR finished taking inventory of vertical control infrastructure on Tuckerton Peninsula as part of the development of the Sentinel Site Plan for JC NERR. Andrea Spahn has identifying the key elements for a local control network: tide stations, vertical and horizontally accurate geodetic benchmarks, and the identification of locations for SET. All of these elements were put together in draft vertical control plan and submitted to NOAA for review. The review of the plan suggested that JC NERR install a new tidal benchmark in 2 locations and create a detailed survey plan for tying the new infrastructure to the vertical datum NAVD88. In November 2015, JC NERR Staff with help from Nina Garfield, Philippe Hensel, and Chris Mitchell (Hudson River NERR) installed 6 Surface Elevation Tables (SETs) on the Tuckerton Peninsula in the JC NERR Sentinel Site. The installation always coincided with the installation of a NOAA Pressure Tide Gauge at the Cape Horn Marina, located in the middle of the Sentinel Site. 3 additional SETs will be installed in April 2016. The SETs and Tide Gauge will be surveyed for accurate elevation in May 2016. The tide gauge will collected local water level data for 1 year.

Outcome End Date: September 2016

Task: RM3 Sentinel Site Funding

Task Outcome RM3.1 SET Installation

Sentinel Site Installation in JC NERR will be completed May 2016

Outcome End Date: Mar 2017

Task RM4: Research Administration

Task Outcomes RM4.1 Estuarine Research Activities

GRANT PROPOSALS (KENNISH)

The RC was involved in the development and submission of two Science Collaborative pre-proposals during this report period:

Title: Investigating the interconnectedness of climate change, nuisance mosquito populations, and long-term resilience of coastal salt marsh systems

Funding Source – NOAA

Time Frame: November 1, 2016 – October 31, 2019

Grant Amount = \$743,002

Michael J. Kennish, Co-Principal Investigator

Title: Forecasting ecological effects of sea-level rise on tidal wetlands of the National Estuarine Research Reserve System: A collective approach to sentinel site data interpretation and translation

Funding Source – NOAA

Time Frame: November 1, 2016 – October 31, 2019

Grant Amount = \$750,000

Michael J. Kennish, Project Investigator

Title: Cooperative Science Center (CSC) in Resiliency of Coastal Systems

Funding Source: NOAA (Office of Coastal Management)

Time Frame: September 1, 2016 – September 1, 2021

Grant Amount = Maximum \$15 Million

Michael J. Kennish, Project Investigator

(In Preparation)

GRANT FUNDED PROJECTS (KENNISH)

Title: Decision-making for Coastal Adaptation: Sustaining Coastal Salt Marshes for Ecosystem Services along the Jersey Shore

Funding Source: NOAA (COCA)

Time Frame: December 1, 2014 – November 30, 2017

Grant Amount = \$262,578

Michael J. Kennish, Co-Principal Investigator

Title: Life on the Edge Interpretive Trail

Funding Source – NOAA

Time Frame: October 1, 2016 – September 30, 2017

Grant Amount = \$204,561

Michael J. Kennish, Project Match, to assist with the science interpretation of the coastal wetland areas along the trail. He will integrate concepts of the Sentinel Site work taking place just east of the LOE trail on the Tuckerton Peninsula.

PUBLICATIONS (KENNISH)

Journal Articles (Peer Reviewed)

Kennish, M. J., G. P. Sakowicz, and B. Fertig. 2016. Recent trends of *Zostera marina* (Eelgrass) in a highly eutrophic coastal lagoon in the Mid-Atlantic Region (USA). *Open Journal of Ecology*. Manuscript in press.

Meixler, M. S. and M. J. Kennish. 2016. Spatial and temporal effects of forcing mechanisms on coastal marsh plant community characteristics in the Tuckerton Peninsula, New Jersey. *Estuaries and Coasts*. Manuscript in revision.

Kennish, M. J. and E. J. Buskey. 2016. Water quality, habitat, and biotic studies in NERRS estuarine systems. *Estuaries and Coasts*. Manuscript in preparation.

Kennish, M. J. and G. P. Sakowicz. 2016. Biofouling community characteristics in estuarine waters of the JC NERR. *Biofouling*. Manuscript in preparation.

Gandy, L., J. Gumm, B. Fertig, M. J. Kennish, L. Marchionni, X. Xia, S. Chavan, S. Shankrit, A. Thessen, and E. J. Fertig. 2016. Synthesizer: Expediting synthesis studies from context-free data with natural language processing. *Nature Biotech*. Manuscript in preparation.

Journal Special Issue (Peer Reviewed)

Lutz, R. A. and M. J. Kennish (eds). 2015. Exploring New Frontiers in Deep-Sea Research: In Honor and Memory of Peter A. Rona. *Deep-Sea Research II*, Volume 121, 255 pp. ISSN 0967-0645.

Abstracts

Kennish, M. J., B. M. Fertig, G. Petruzzelli, and G. P. Sakowicz. 2015. Tuckerton Peninsula saltmarsh system: development of a sentinel site for long-term climate change research. Rutgers Regional Climate Symposium: Climate Change and Polar Regions, Piscataway, New Jersey. November 20, 2015.

Kennish, M. J., B. M. Fertig, and G. P. Sakowicz. 2015. Tracking fertilizer nitrogen loads and recent trends of *Zostera marina* (eelgrass) in a highly eutrophic coastal lagoon using stable nitrogen isotopic signatures. Abstract, Annual Conference, NOAA and the National Estuarine Research Reserve System Program, Mobile, Alabama, October 26, 2015.

Technical Reports

Kennish, M. J., A. Spahn, and G. P. Sakowicz. 2016. Draft Sentinel Site Plan for the Jacques Cousteau National Estuarine Research Reserve. Technical Report. 15 pp.

PRESENTATIONS (KENNISH)

Kennish, M. J. 2016. JCNERR sentinel site development. Presentation to the County Mosquito Control Agencies, Jacques Cousteau National Estuarine Research Reserve, Tuckerton, New Jersey, January 11, 2016.

Kennish, M. J., B. M. Fertig, G. Petruzzelli, and G. P. Sakowicz. 2015. Tuckerton Peninsula salt marsh system: development of a sentinel site for long-term climate change research. Rutgers Regional Climate Symposium: Climate Change and Polar Regions, Piscataway, New Jersey. November 20, 2015.

Kennish, M. J. 2015. A national integrated network for estuarine research, monitoring, and coastal management. Annual Conference, NOAA and the National Estuarine Research Reserve System, Mobile, Alabama, October 28, 2015.

Kennish, M. J. 2015. Hurricane and nor'easter impacts on New Jersey beaches and bayshore areas. Annual Conference, NOAA and the National Estuarine Research Reserve System, Mobile, Alabama, October 26, 2015.

Kennish, M. J., B. M. Fertig, and G. P. Sakowicz. 2015. Tracking fertilizer nitrogen loads and recent trends of *Zostera marina* (eelgrass) in a highly eutrophic coastal lagoon using stable nitrogen isotopic signatures. Annual Conference, NOAA and the National Estuarine Research Reserve System, Mobile, Alabama, October 26, 2015.

PUBLICATIONS (GROTHUES)

Turnure, J. T., K. W. Able, and T. M. Grothues. 2015. Patterns of intra-estuarine movement in adult weakfish (*Cynoscion regalis*): evidence of site-affinity at seasonal and diel scales. *Fishery Bulletin* 113:167-179.

Grothues, T. M., J. L. Rackovan, and K.W. Able. 2016. Modification of nektonic fish distribution by piers and pile fields in an urban estuary. *Journal of Experimental Marine Biology and Ecology*. Manuscript in review. (Conditionally accepted February 16, 2016).

Newhall, A.E., Y. T. Lin, T. M. Grothues, J. Lynch, and G. G. Gawarkiewicz. 2016. IEEE Journal of Oceanic Engineering. A method of observing acoustic scattering from fish schools using autonomous underwater vehicles. *IEEE Journal of Oceanic Engineering*. Manuscript in review.

Grothues, T. M., E. A. Bochenek, and S. Martin. 2016. Preventing bycatch of Yellowtail Flounder in the sea scallop dredge fishery by dredge pause: video evaluation. *Fishery Bulletin*. Manuscript in review.

Grothues T. M., A. E. Newhall, J. Lynch, G. Gawarkiewicz, and K. Vogal. 2016. High frequency side-scan sonar fish reconnaissance by autonomous underwater vehicle. *Canadian Journal of Fisheries and Aquatic Sciences*. Manuscript submitted.

PRESENTATIONS (GROTHUES)

Grothues, T. M. 2016. Acoustic telemetry of pelagic thresher sharks. Presentation to Society for the Education of American Sailors (SEAS). Monmouth Chapter, Keyport, New Jersey, January 26, 2016.

Grothues, T. M. 2015. Bluefish life history and recent observations. Garden State Seafood Association Fisheries Workshop. Tuckerton, New Jersey, December 11, 2015.

Grothues, T. M., K. W. Able, J. Valenti, and P. Jivoff. 2015. Assessment of fishes and crabs response to human alteration of Barnegat Bay. What Lies Beneath—Barnegat Bay: Barnegat Bay Research Forum, Toms River, New Jersey, November 17, 2015.

Grothues, T., J. Dobarro, M. De Luca, D. Levin, B. Meisinger, G. Twiley, C. Fuller, and R. Petrecca. 2015. Taking advantage of AUV navigation precision for repeated side-scan sonar measures. Coastal Estuarine Research Federation 23rd Biennial Conference, Portland, Oregon, November 11, 2015.

Levin, D., T. Grothues, R. Petrecca, J. Dobarro, M. De Luca, C. Fuller, G. Taghon, N. Psuty, A. Spahn, G. Twiley, and B. Meisinger. 2015. Indirect and direct sampling to evaluate post-Sandy benthic habitat in Sandy Hook Bay, NJ. Coastal Estuarine Research Federation, 23rd Biennial Conference, Portland, Oregon, November 9, 2015.

Grothues, T. M. 2015. Under the keel at Sandy Hook. Presentation to Society for the Education of American Sailors (SEAS). Monmouth Chapter, Keyport, New Jersey, October 27, 2015.

PRESENTATIONS (SAKOWICZ)

Presented a poster on the SWMP data code at the NERRS Technician Training Workshop in Pawleys Island, SC, March 14-19, 2016.

ACTIVITIES (KENNISH)

NERRS Special Issue (*Estuaries and Coasts*)

Mike Kennish conducted extensive work during this report period on the preparation, editing, and submission of material for the NERRS special issue. Fifteen manuscripts have been submitted as part of the special issue for publication in *Estuaries and Coasts* and they are currently in external peer review (see below). Another five manuscripts will be submitted for

publication by April 15, 2016. A brief summary of the editorial work completed by Mike Kennish on the special issue manuscripts is provided below.

**Journal Special Issue (*Estuaries and Coasts*):
“NERRS Estuarine Systems”**

Scheef et al. (*Informing freshwater inflow management decisions for a drought-prone estuary through circulation monitoring*) investigated the circulation patterns in the Mission-Aransas Estuary and its adjoining system, the Guadalupe Estuary, located on the Gulf Coast of Texas. They used numerous tilt current meters deployed throughout the Mission-Aransas National Estuarine Research Reserve (MANERR) to record the direction and speed of water flows. Acquisition of these data is important for determining how water circulates within the estuaries and the exchanges between them. The removal of freshwater from influent systems for human needs by a rapidly increasing coastal population may greatly affect water circulation in these systems by significantly reducing freshwater inflows and altering the salinity structure of the estuaries. Salinity is strongly coupled to current direction in some areas. Tides and wind are important drivers of change, and the relative influence of tides and winds on circulation patterns varies between different parts of the estuary. A salinity model developed for the study shows that flow directions are more accurate in areas that experience strong axial flow than in areas with weaker or more complex flow patterns. The salinity model is useful for informing freshwater inflow management decisions for the estuarine systems.

Smith and Baumann (*Temporal variability in estuarine pH: An analysis of long-term data from 15 National Estuarine Research Reserves*) compared time series data on pH values collected over a decade period at 15 NERRS estuaries. To be submitted.

Santana et al. (*Continuous monitoring reveals drivers of dissolved oxygen variability in a small California estuary*) examined dissolved oxygen flux in the Elkhorn Slough, a shallow, well-mixed, eutrophic estuary in central California. A major objective was to identify DO oscillations and their effects in the estuary, as well as their main frequencies and drivers. Time series of DO data collected at two fully tidal sites in the estuary over more than a decade (2001-2012) show that hypoxia events are rare, very short-lived (less than 1 hour), and are not regulated by the diel cycle. When hypoxia occurs, typically during the day, it is largely driven by momentary low turbulent diffusion around slack tides. DO depletion occurs below the photic zone with the cessation of tidal flow, occasionally leading to short periods (15-45 minutes) of hypoxia. Turbidity reduces light penetration in the water column which limits primary production and affects DO levels. In summer, solar radiation is highly correlated with DO concentrations. As tidal currents increase, waters with higher DO concentrations are advected up estuary causing turbulent mixing of DO-poor bottom waters with DO-rich surface waters. During flood tide, advective transport explains up to 47% of the DO daily variability. This work reveals the primary factors controlling DO concentrations in the Elkhorn Slough and informs coastal managers of the key drivers of hypoxia that can be used to develop new remedial applications for improving water quality in this important shallow estuary.

Bernard and Mortazavi (*Nitrate reduction dominated by dissimilatory nitrate reduction to ammonium in a shallow eutrophic estuary*) studied benthic nitrogen processes in Weeks Bay, Alabama, a shallow system characterized by high nitrate loading from the Fish and Magnolia Rivers due to ongoing land use changes in the watershed, including urbanization,

residential development, agriculture, and sod production. Weeks Bay, with a total nitrogen loading of $>140 \text{ g N m}^{-2} \text{ yr}^{-1}$, has one of the highest nitrate inputs of all northern Gulf of Mexico estuaries. The objective of this work was to determine the dominant NO_3^- reduction pathway(s) (denitrification and/or DNRA) in the bay. To this end, the investigators focused on denitrification, dissimilatory nitrate reduction to ammonium (DNRA), anammox, and benthic nitrogen fluxes at two bay sites, a mid-bay site and a bay mouth site. Weeks Bay is generally normoxic, although it experiences periods of hypoxia. Results of this study show that the DNRA pathway predominates over denitrification in Weeks Bay, accounting for 68% of the NO_3^- reduction and contributing to 59% of the benthic ammonium flux that supports primary production in the system. The average DNRA rate in the bay is $50.6 \mu\text{mol N m}^{-2} \text{ hr}^{-1}$, with DNRA values being consistently higher at the bay mouth site than at the mid-bay site. DNRA is an important nutrient pathway that contributes to the high primary production in Weeks Bay.

Dix et al. (*Potential influence of nutrient load on intertidal oyster population structure in a well-flushed subtropical estuary*) compared the population structure of the American oyster (*Crassostrea virginica*) in two regions of the well-mixed Matanzas River Estuary in northeast Florida that are affected by different nutrient loads, notably the St. Augustine and Matanzas regions. Within each region, water quality parameters were collected from 2003-2008 and oyster population structure was examined during the wet and dry seasons of 2008. In the highly urbanized region of the estuary with historically elevated nutrient loads and food availability (i.e., St. Augustine), the oyster population exhibited greater abundance, biomass, and condition index than did the population in the less urbanized region (i.e., Matanzas) bordered by undeveloped watershed consisting mainly of protected forests and wetlands. The Augustine region receives nutrient-enriched inputs from two wastewater treatment plants which discharge directly into the estuary and adversely affect water quality. These preliminary results suggest that oysters respond positively to nutrient enrichment in the Matanzas River Estuary. In addition, oyster metrics collected in such a system as this one with high water turnover rates may provide an early warning of nutrient impairment.

Chang et al. (*Oyster recruitment hotspots linked to estuarine gradient variability in San Francisco Bay, California*) tracked recruitment of the Olympia oyster (*Ostrea lurida*) along the axis of the northern brackish-to-saline region of the San Francisco Bay by sampling at 2-4 week intervals over a five-year period (2010–2015). Temperatures increased at all sampling sites during the study, while winter salinity decreased significantly during a wet year (2011), but otherwise remained high as a result of a drought. A recurring hotspot of recruitment was observed in the mid-upper estuary in conditions corresponding to a salinity range of 20–25 and temperatures $\geq 16^\circ\text{C}$ at the time of recruitment. Higher winter salinities and warmer temperatures corresponded with earlier onset and peak recruitment and were also positively correlated with the magnitude of peak recruitment. Lower winter salinities during 2011 resulted in a downstream shift in the onset of recruitment, and location of peak recruitment. Overall, oyster recruitment varied significantly in space, being well correlated with environmental conditions, especially location along the estuarine salinity gradient. Recruitment also varied greatly from year to year and even in different seasons due to significant interannual and seasonal variation in environmental conditions linked to larger-scale climate patterns and regional hydrological cycles. The Olympia oyster has been the target of conservation efforts in California, but relatively little information exists on larval recruitment across much of its range.

Jeppesen et al. (*Hypoxia increases fish mortality and reduces oyster growth in a highly eutrophic estuary*) assessed the effects of hypoxia in the highly eutrophic Elkhorn Slough Estuary on two stress-tolerant estuarine species, the staghorn sculpin, *Leptocottus armatus* and the Olympia oyster, *Ostrea lurida*. The estuary receives high nutrient loads from an agricultural watershed. The six study sites examined in this study exhibited high variation in dissolved oxygen (DO) levels. A significant inverse relationship was noted between staghorn sculpin survival and number of hours in a day where DO <5 mg/L. Despite low mortality, Olympia oysters showed sub-lethal effects of hypoxia, with their growth rate being lower in areas with extended periods of hypoxia. Tidally restricted areas in the estuary with the longest periods of hypoxia and largest fluctuations in DO were particularly harmful to the organisms. It is concluded that large diurnal fluctuations in DO and extended periods of hypoxia are responsible for lethal and sub-lethal effects on these two indicator species known to be highly tolerant. Decreasing agricultural run-off and restoring more natural tidal exchange could significantly mitigate eutrophic conditions and improve environmental conditions for both species in the estuary.

Fowler et al. (*Relationships between long- and short-term variability in meteorological and waterquality data and fisheries independent white shrimp (*Litopenaeus setiferus*) catch from 2002 to 2014 in the ACE Basin NERR, South Carolina*) analyzed the trends in white shrimp catch-per-unit effort (CPUE) and explained the factors and time frames most influential in explaining the trends. The white shrimp (*Litopenaeus setiferus*) contributes substantially to the largest and most economically valuable fishery in South Carolina, although the landings of the species have significantly declined over the past decade possibly due to multiple factors such as changes in fishing effort, escalating land use changes upland in watersheds, and altered migration exacerbated by warming seas. Environmental conditions directly and indirectly influence white shrimp survival and growth and, ultimately, fisheries-independent and commercial harvests. For example, temperature, salinity, precipitation, and wind-driven currents affect the location of white shrimp juveniles which can significantly affect harvest statistics. The patterns of white shrimp abundance from 2001 to 2014 were compared with water quality and meteorological parameters (e.g., water and air temperature, salinity, pH, dissolved oxygen, rainfall, turbidity, wind speed and direction, relative humidity, barometric pressure, and photosynthetically active radiation) collected in the ACE Basin NERR. The goal was to elucidate which environmental parameters may be useful in predicting white shrimp seasonal abundances in the ACE Basin NERR and will be applicable to others when formulating stock analyses on annual species. Results demonstrate that there is no one abiotic measure that can explain CPUE across all sampling periods. It is a combination of various environmental factors that contribute to the growth and survival of white shrimp throughout the year(s), and the magnitude of the harvest reported on this species.

Long and Wilson (*Citizen science data informs response of migratory songbirds to spring temperature variation in Maine*) synthesized data on the timing of migratory songbird spring arrival in Wells, Maine (USA). More specifically, they used quarterly (February, May, August and November) bird survey data collected by York County Audubon citizen scientists at the Wells National Estuarine Research Reserve (NERR), together with the reserve's System-Wide Monitoring Program data to test whether migratory songbirds arrive earlier in response to warmer spring temperatures and whether the response differs between short- and long-distance migrants and between birds with different foraging modes. Focusing on the abundance of 11 songbird species that arrive in early May in Maine, and correlating this with

mean April temperature on-site from 2004-2014, Long and Wilson found no significant positive trend in April temperatures from 2004-2014 at the Wells NERR and also that May bird abundance was not significantly related to average April air temperature for most species, with the exception of the Chestnut-sided Warbler (*Setophaga pensylvanica*) and the Common Yellowthroat (*Geothlypis trichas*). Not only was there no significant warming trend at the study area, only four years (2006, 2008, 2010, and 2012) had above average April temperatures. In addition, Long and Wilson found no difference in the response to temperature between short-distance and long-distance migrants. Essentially, only a weak correlation was evident between air temperature and songbird spring arrival timing in Maine, with changes only detected during exceptionally warm years.

Garano and Schooler (*Winter algal blooms and hypoxia in coastal embayments of the Lower St. Louis River*) conducted a study to determine if hypoxic conditions exist in the St. Louis River, the largest U.S. river flowing into Lake Superior. To this end, they sampled 21 sites during the winters of 2013-2015 and the summers of 2014-2015 for water quality (dissolved oxygen, temperature, conductivity), algal communities (chlorophyll *a* concentration and algal taxa), light penetration (PAR), ice thickness, and snow cover. Hypoxia was observed in the lower St. Louis River during the winter months under the ice, and during the summer months, particularly near the substrate. Hypoxic conditions occurred during both the winter and summer in the same subset of clay influenced river mouth sites, that is, along the mid and upper sites of clay-influenced river mouth embayments.

Fernald (*Does nitrogen drive Phragmites australis expansion in the Hudson River National Estuarine Research Reserve?*) reported on changes in the distribution of the invasive common reed in tidal marsh habitat of the Hudson River Estuary over a protracted time period. Based on changes in habitat maps created since 1991, there has been an exponential expansion of *P. australis* in all four component study sites examined within the Hudson River NERR: Stockport Flats, Tivoli Bays, Iona Island, and Piermont Marsh. Fernald compared nitrate concentrations from Hudson River Estuary creek and marsh samples to *P. australis* expansion rates obtained from analysis of the series of habitat maps. A major objective was to determine if *P. australis* expansion in the system has been driven by nitrogen fertilization. Data analysis indicated no statistically significant correlations between *P. australis* expansion and nitrogen availability to the study sites. It was determined that *P. australis* expansion was more closely linked to time since invasion of the species than to nitrogen concentrations delivered to the sites.

Meixler and Kennish (*Emergent salt marsh plant community characteristics in three segments of the Tuckerton Peninsula, New Jersey, subjected to different forcing mechanisms*) documented the temporal and spatial changes in a major *Spartina* salt marsh plant community bordering shallow coastal bays in southern Ocean County. The 2,000-ha salt marsh forms a broad platform affected by major storms, shoreline erosion, sea-level rise, coastal subsidence, inundation, mosquito ditching, and Open Marsh Water Management. The effects of different drivers of salt marsh habitat change are evident across the northern, central, and southern segments of the peninsula. Altered marsh habitat results from the following natural processes: (1) perimeter loss due to wave and current erosion, and sea-level rise; and (2) interior marsh loss due to an expanding channel network that dissects the marsh platform and also increases inundation. In this study, key marsh plant parameters were measured in the heavily ditched northern segment, shoreline-altered southern segment,

and the minimally impacted central reference segment in 2011 and 2013; these parameters included the species composition, maximum canopy height, percent areal cover, and shoot density of the salt marsh plants. Data were analyzed for all plant species combined and individual species among segments and across years. Significant differences were found between the ditched northern and central segments for maximum canopy height and percent areal cover in 2011, and maximum canopy height in 2013. Significant differences were found between the shoreline-altered southern and central segments of the Tuckerton Peninsula for shoot density in 2011 and percent areal cover in 2013. Anthropogenic alterations (i.e., grid ditching and Open Marsh Water Management systems) are also considered to be important drivers responsible for the observed differences among segments.

Owen Doherty and Lyndie Hice-Dunton (*Norms and trends in Delaware's estuaries: A 20-year review*). To be submitted.

Patricia Delgado and Philippe Hensel (*Understanding vulnerability to climate change: An analysis of water levels, marsh elevation, and plant species communities in a tidal freshwater marsh*). To be submitted.

William Reay and Scott Lerberg (*Historical evolution of a Late Pleistocene saltmarsh island complex in the Lower York River Estuary*). To be submitted.

Maher et al. (*Does an USEPA wetland assessment method work in the southeastern USA? Testing its efficacy in the marshes of the Sapelo Island NERR and Chatham County, GA*) evaluated the utility of the Gulf of Mexico Coastal Wetlands Condition Assessment protocol which incorporates a three-tiered approach using (1) landscape assessment; (2) rapid assessment method; and (3) collection/sampling of vegetation, water, and sediment. This assessment protocol is used to identify current conditions of a wetland system. In this study, Maher et al. not only evaluated the efficacy of the assessment protocol but also made recommendations for an accurate assessment approach of southeastern marsh health. To this end, they recommended a condensed protocol based solely on parameters of vegetation measurements, porewater nutrient chemistry, and macroinvertebrate densities. This new protocol would provide an accurate evaluation of southeastern salt marsh health at a much reduced cost and with less overall effort than the current USEPA method.

Spurrier and Underwood (*Real-time kinematic GPS-derived elevation ranges of marsh vegetation in a northern Gulf of Mexico estuary*) recorded elevations of two dominant emergent salt marsh species (*Spartina alterniflora* and *Juncus roemerianus*) in the Grand Bay National Estuarine Research Reserve (GBNERR) at Moss Point, Mississippi. Using Real-Time Kinematic (RTK) GPS systems in the field, Spurrier and Underwood obtained extensive positional data in marsh habitat of the reserve, with horizontal and vertical accuracies on the scale of centimeters. This effort produced highly accurate elevation ranges for the marsh system. For example, field surveys yielded elevation profiles with a range of -0.260 to 0.887 m and a mean elevation of 0.285 ± 0.130 m, which defines an elevational band of ~1 m wide where marsh habitats occurred. Data analysis revealed a mean horizontal error of 0.8 cm and a mean vertical error of 1.3 cm with a 68% confidence interval. *Spartina alterniflora* occupied an elevation range from -0.244 to 0.512 m, with a mean elevation of 0.196 ± 0.076 m; *Juncus roemerianus* occupied a range from 0.105 to 0.642 m, with a mean elevation of 0.297 ± 0.072 m. Collecting accurate elevation ranges in marsh habitats is important for

restoration, marsh migration modeling, and land acquisition projects to support marsh ecosystem conservation and preservation in the face of sea-level rise and inundation.

Doroff et al. (*Assessing coastal habitat changes in a glacially influenced estuary system: Kachemak Bay, Alaska*) monitored emergent vegetation types and relative marsh elevation at four salt marsh study sites in Kachemak Bay during 2010-2013 to provide site-specific indicators of sea-level rise. Extensive measurements of vegetation plots at each marsh site were used to determine short-term variability in the vegetation community structure. The investigators also generated 20-year projections of relative sea-level change to inform local planning. Land-level uplift (8.6 mm yr^{-1}) exceeds global sea-level rise (3.2 mm yr^{-1}) by 5.4 mm yr^{-1} at Kachemak Bay, reflecting the geologically active nature of the region. Models were applied for regional tectonic and isostatic uplift to address land-level change, to evaluate the relative sea-level change projections for the region, and to assess the potential effects of sea-level rise on marsh habitat. The investigators paired the vertical land-level change model projections with intensive baseline monitoring of the four salt marsh areas to provide a database for understanding and predicting changes from glacier loss or other environmental perturbations to the local community ecology. The data were useful for demonstrating how marsh vegetation cover types change over time and space. Emergent plant species varied considerably in abundance among the study sites and across years which is characteristic of a region experiencing such a large flux in land levels.

Reposa et al. (*The National Estuarine Research Reserve System as a national network of reference sites for assessing tidal marsh restoration project performance*) evaluated the success of 17 salt marsh restoration projects at five National Estuarine Research Reserve System (NERRS) sites (i.e., Wells NERR in Maine, Narragansett NERR in Rhode Island, Chesapeake Bay NERR in Virginia, North Carolina NERR in North Carolina, and South Slough NERR in Oregon). The goals of this study were to: (1) determine the level of restoration achieved at each project using the Restoration Performance Index (RPI), which compares change in indicator variables over time between reference and restoration sites; (2) evaluate the comparative restoration performance of hydrologic and excavation restoration approaches; (3) identify and assess key environmental parameters that drive variations in restoration performance; and (4) evaluate the use of long-term NERRS monitoring sites as reference wetlands for local restoration projects. The RPI was deemed an effective tool for evaluating restoration success in the reserve sites. RPI scores were calculated for each restoration wetland relative to its paired reference wetland using multiple vegetation and hydrologic parameters that were collected across all study years. RPI scores for tidal wetland restoration sites ranged from 0.16 to 0.88. Application of the RPI indicated that most projects surveyed in this study achieved an intermediate level of restoration. Results of this work demonstrate that NERRS reserves can serve as excellent long-term reference sites for assessing local tidal wetland restoration projects. Application of the RPI will advance the science of tidal wetland restoration in general and help guide the planning, design, and evaluation of future restoration projects in estuarine systems.

JCNERR Biofouling Project

Mike Kennish conducted extensive work on the 10-year biofouling database of the JCNERR. Work is continuing on the preparation of a technical report on this project.

Sentinel Site Development

Mike Kennish has been working with Andrea Spahn on a Vertical Control Plan and Sentinel Site Plan for the JC NERR. The final Vertical Control Plan is nearing completion, and a draft Sentinel Site Plan has been prepared. Both of these documents will be completed in 2016.

Mike Kennish, Gregg Sakowicz, and Andrea Spahn were part of a field crew that installed six SETs (surface elevation tables) on the Tuckerton Peninsula salt marsh during this report period as part of the development of the JC NERR Sentinel Site. These SETs were sited at the mid-point of the tidal range along permanent biomonitoring transects located on the salt marsh surface. A tide station was also installed. Three additional SETs will be installed on the salt marsh during 2016. After leveling and completion of infrastructure elements, measurements of the SETs and biomonitoring stations will be conducted on a regular basis.

Mike Kennish is a Co-PI on a NOAA-funded COCA project being conducted in the JC NERR Sentinel Site (Tuckerton Peninsula salt marsh) and two other salt marsh systems in New Jersey (i.e., Barnegat Bay and Delaware Bay). Work has been ongoing over the past year on this project. This project (“Decision-making for Coastal Adaptation: Sustaining Coastal Salt Marshes for Ecosystem Services along the Jersey Shore”), which is led by PI Richard Lathrop of the Center for Remote Sensing and Spatial Analysis at Rutgers, is investigating the efficacy of different management approaches designed to promote the long-term sustainability of coastal marsh habitat under rising sea levels within the context of the constraints imposed by a closely coupled social-ecological system. It is also examining the costs associated with maintaining the coastal marshes under future sea-level rise in concert with their continued ability to provide highly valued ecosystem services. A broader objective is to provide coastal decision-makers with the information needed to make effective choices concerning the maintenance and/or restoration of green infrastructure within coastal communities bordered by the marshes. Work during this report period by the research team was focused on estimating elevation capital and developing MarshFutures maps for the marsh systems. Marsh elevations across each selected area of interest in the JC NERR Sentinel Site were surveyed by Andrea Spahn, Gregg Sakowicz, and Mike Kennish using RTK-GPS (real-time-kinetic global positioning system) survey equipment and contrasted with existing elevation data (e.g. LIDAR data) to produce base-layer elevation maps. This surveying also captured marsh features along marsh surfaces. ArcGIS/ESRI products were used to prepare vulnerability maps by GIS specialists at the Center for Remote Sensing and Spatial Analysis of Rutgers University. The maps were then used to guide detailed marsh vegetation sampling to assess vegetation indicators. DSAS (Digital Shoreline Analysis System) was used to determine how much change has happened on the shoreline of the marshes between 1977 and 2015. The overall goal of the project is to document susceptibility of the marsh platform to ongoing sea-level rise, coastal storms, and other drivers of change.

SWMP Science Transfer Workshop

The research and monitoring staff of the JC NERR (Mike Kennish, Tom Grothues, and Gregg Sakowicz) attended the SWMP Science Transfer Workshop held at the JC NERR Coastal Center on February 17 and 18, 2016. Led by Tom Grothues, this workshop provided the research and monitoring staff from four mid-Atlantic NERR reserves with time series of data and analytical tools to assess SWMP water quality data, along with graphical support and

training to facilitate their use. Workshop participants reviewed plotted trends in water quality parameters for each of the participating reserves, independently using a common methodology for handling very large data sets. Analytical results were formatted and saved for actual application to management issues. The analytical codes, already completed, were transferred and annotated to allow refreshed analysis of growing SWMP data sets in the future or to tailor it for other applications. Participating reserve staff left the workshop with data analyses, computer codes, training materials, updated SWMP figures, and tailored data summaries about their estuary that can be used in outreach programs and in support of independent chemical, biological, and physical research in and across reserves. The workshop provided a number of benefits to participants. It gave staff members of the participating reserves greater skill, confidence, and technical resources to analyze the monitoring data. In addition, the monitoring data of the reserves will be more available for greater use in future research and outreach programs.

Education and Outreach

Mike Kennish supported outreach and education efforts by working with nonprofit environmental organizations in New Jersey, disseminating information on the assessment and condition of coastal ecosystems as well as the impact of climate change on coastal communities. He has continued to interact with environmental organizations (e.g., Save Barnegat Bay, Sierra Club, Environment New Jersey, and other organizations in New Jersey), sharing scientific information and findings on coastal problems. Mike was interviewed by the Press of Atlantic City for three articles published by the newspaper on coastal storm impacts in southern New Jersey. He provided science explanations for these impacts.

New Jersey Academy of Science

Mike Kennish continues to serve as the editor of the *Bulletin of the New Jersey Academy of Science*, a peer-reviewed science journal which is a subsidiary of AAAS. Much of the focus of the New Jersey Academy of Science is to serve as a platform for support of high school science education and research. Planning is underway for the 2016 annual meeting of the New Jersey Academy of Science scheduled for April 2016 at Kean University in Union, New Jersey.

Climate Change Service Activities

JC NERR Sentinel Site development of the Tuckerton Peninsula salt marsh system is important to the Climate Institute of Rutgers University, a partner in climate change research in New Jersey. As a member of the Rutgers Climate Institute, Mike Kennish is working on a series of research and monitoring projects dealing with climate change effects on coastal ecosystems and communities in the state. This work is ongoing. In November 2015, he made an important presentation (“Tuckerton Peninsula salt marsh system: development of a sentinel site for long-term climate change research”) on the JC NERR Sentinel Site at the annual meeting of the Rutgers Climate Institute. Mike is also working with various academic departments at Rutgers, other academic institutions and government bodies, and national and local environmental groups on climate change issues. A major goal of this work is to assess coastal habitat and community sustainability and to strengthen the resiliency of the coastal zone in New Jersey.

Partnerships

Mike Kennish continues to interact and collaborate with JC NERR partners. He has been working with Martha Maxwell-Doyle of the Barnegat Bay Partnership and members of the Partnership of the Delaware Estuary on monitoring environmental conditions of salt marsh systems in New Jersey. Mike has also interacted with members of the U.S. Fish and Wildlife Service, U.S. Geological Survey, and New Jersey Department of Environmental Protection on coastal zone issues. Development of the JC NERR Sentinel Site is a focal point for increased partner interaction with the JC NERR staff.

ACTIVITIES (GROTHUES)

Thomas (Motz) Grothues' activities focused on three principal areas of research and monitoring work during this report period. (1) Fish tracking continues to be pursued through the deployment of telemetry dataloggers in the JC NERR. This program passively collects data from the passage of fish tagged by other researchers through the Mullica River-Great Bay Estuary and does not pursue additional tagging. Acoustic receivers in the lower bay were removed in winter due to an ice threat following an earlier loss, and they will be deployed pending hardening and redesign of the associated SWMP datalogger installation infrastructure. A datalogger in the upper estuary remains in place. (2) Motz assisted in AUV missions as well as benthic sampling for the JC NERR partner National Park Service, and he analyzed benthic infaunal community, sediment, and acoustic data, as well as hydrographic data. Results for that project were presented at the CERF Biennial Conference in Portland, Oregon as well as in reports to the National Park Service. (3) Motz also led the SWMP Science Transfer Workshop held at the JC NERR Coastal Center on February 17 and 18, 2016. He produced an analytical software tool and material for the inspection and trends analysis of long-term SWMP data; this was executed in support of an ongoing Mid-Atlantic Bight-wide SWMP synthesis as well as in peer-reviewed publications using the data. In the workshop, Motz disseminated the code and product to four participating regional NERRs and two additional NERRs sites via cloud sharing. Development of these tools continues for reporting at the national NERRS meeting in November. During this report period, Motz also mentored five Rutgers interns on projects relevant to the NERR's program, and he presented results at outreach events and tours to allow access of teachers to researchers in support of improved STEM teaching projects.

ACTIVITIES (SAKOWICZ)

Gregg Sakowicz's activities largely focused on SWMP water quality monitoring and the JC NERR Sentinel Site. Specific output is as follows:

Assisted with the Installation of 6 surface elevation tables on salt marshes of the JCNERR sentinel site.

Installed a NOAA tide gauge for the JCNERR sentinel site (hardware installation is complete but is yet to be leveled in and transmitted; awaiting contractors and NESDIS ID and transmission window and permission).

Maintained water quality monitoring at all five SWMP stations over the winter months despite occasional winter/ice conditions.

Completed and submitted the 2014 third quarter SWMP water quality and meteorological data and metadata reports on November 2, 2015

Completed and submitted the 2014 fourth quarter SWMP water quality and meteorological data and metadata reports on February 1, 2016.

Completed the final review of the 2012 SWMP data in December 2015 with CDMO staff, on schedule, to authenticate the annual dataset.

Participated in the Barnegat Bay Strategic Action Committee (STAC) as a representative of Rutgers/JCNERR.

Provided guidance to the Barnegat Bay Partnership (our local National Estuary Program partner) regarding the design and operation of water monitoring stations that will be installed and operating in 2016. The goal is to make them SWMP-like so data are comparable within and among our respective programs.

Installed next-generation wiped Conductivity-Temperature (CT) probes on the JCNERR SWMP datasondes concurrently with the current technology CT probes to test them on behalf of the NERRS.

Prepared for, and recovered from, winter storm Jonas (January 23-25, 2016). All JCNERR assets were relocated and/or secured in advance. SWMP weather and water monitoring, including telemetry, continued through and after the storm.

Discolored water and sediment were discovered in the water supply at RUMFS in late January 2016 resulting in temporary suspension of use for the latter half of the month. *E. coli* contamination was discovered in the water supply in early February 2016, necessitating a shutdown of the water supply, impacting many laboratory and field operations.

Unable to continue SWMP nutrient sampling in February and March due to the lack of a supply of deionized water and, equally important, eyewash and body wash-down safety stations.

Managed to continue SWMP datasonde calibrations, post-calibrations, and data submissions January-March despite having no water supply at the Rutgers University Marine Field Station. This was accomplished through a number of work-arounds including relocation of some efforts and transport of copious amounts of water to the site.

Conducted the telemetry troubleshooting training session at the NERRS Technician Training Workshop in Pawleys Island, SC, on March 14-18, 2016.

Presented a poster on behalf of JCNERR regarding SWMP data code authored by JCNERR staff at the NERRS Technician Training Workshop in Pawleys Island, SC, March 14-18, 2016.

Co-authored (with Jeremy Miller at Wells NERR in Maine) the system-wide NERRS Telemetry SOP for/on behalf of the NERRS Central Data Management Office (CDMO). This item was

presented at the NERRS Technician Training Workshop in Pawleys Island, SC, on March 14-18, 2016 and “published” online by the CDMO for dissemination among NERRS as guidance.

Outcome End Date: March 2017

