

FY2014
ANNUAL ACCOMPLISHMENTS REPORT
FOR INVENTORIES AND VITAL SIGNS MONITORING
NORTHEAST COASTAL AND BARRIER NETWORK (NCBN)

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Northeast Coastal and Barrier Network FY 2014 Accomplishments Report

The Northeast Coastal and Barrier Network (NCBN) includes eight parks located along the Atlantic coast from Massachusetts to Virginia: Cape Cod National Seashore (CACO), Fire Island National Seashore (FIIS), Sagamore Hill National Historic Site (SAHI), Gateway National Recreation Area (GATE), Assateague Island National Seashore (ASIS), George Washington Birthplace National Monument (GEWA), Thomas Stone National Historic Site (THST), Colonial National Historical Park (COLO). These parks contain critical coastal habitat for many rare and endangered species, as well as migratory stopovers, acting as essential corridors for birds, sea turtles, and marine mammals. They also protect vital coastal wetlands, essential to water quality, fisheries, and the biological diversity of coastal, near shore, and terrestrial environments. All NCBN parks continue to be pressured by encroaching development, intense recreational activity, and now the effects of rapid climate change. Sea level rise, increased storm intensity, amplified variability in surface and groundwater levels, and ocean acidification are expected to be among the most pressing natural resource management challenges in the near future. In addition to the effects of climate change, being within the urban sprawl of the Northeast creates additional management pressure to monitor the condition of these sensitive and often last remaining pristine ecosystems.

The NCBN Inventory and Monitoring Program was developed to provide parks with credible, defensible scientific information that will help managers and scientists track the changes that occur in condition of a park's natural resources. As part of the National Park Service's original effort to "improve park management through greater reliance on scientific knowledge," the Cape Cod Ecosystem Monitoring (CCEM) program, an NCBN park, was established to develop and implement a long-term monitoring program that would serve to aid park managers in making sound stewardship decisions. The program at CACO was established in the early 1990's as one of the few "Prototype" parks tasked with developing a monitoring program for coastal parks. As part of this process, the CCEM program adopted an ecosystem-based, issue-oriented approach for monitoring ecosystem integrity, working closely in partnership with the USGS-Biological Resources Division. CCEM developed monitoring protocols based on the issues identified in Roman and Barrett's 1999 report *Conceptual Framework for the Development of Long-term Monitoring Protocols at Cape Cod National Seashore*. Not long after, in 2000-2001, the NCBN Monitoring Program was established as part of the newly formed and funded NPS Inventory and Monitoring Program (NPS I&M). The NCBN program extended the Cape Cod CCEM program by building the Network monitoring plan on the same approach developed by Roman and Barrett for the additional seven network parks. Cape Cod National Seashore is one of the NCBN Program parks and shares the monitoring along with the seven other parks.

The following report provides a summary of accomplishments for FY14 on inventory and monitoring projects being developed and implemented by the NCBN program. Because the CACO CCEM program is a Network park and some monitoring is shared by CACO CCEM staff and Network staff, the CCEM annual accomplishments report is attached as an addendum to this report. In FY14, the network received a total of \$914,800; this includes \$782,000 in Vital Signs Monitoring funding, and \$82,300 from the NPS Water Resources Division. We also received \$50,500 of additional I&M funds to help meet our science communication needs. The NCBN program manager also developed a CESU task agreement for COLO for a herpetological inventory, added onto the work presently being conducted at FIIS and SAHI, this was an additional \$50,000.

Cape Cod National Seashore received \$702,375 for the park's CCEM program.

FY14 Summary

Vital Signs Monitoring continued in FY14 with salt marsh vegetation and nekton monitoring occurring at ASIS and COLO. One seasonal employee and one pathways student were hired to conduct the monitoring under the supervision of Network Biologist, Erika Nicosia. Sediment Elevation (SET) data was collected at 120 SET sampling locations, two times at each location during the year by NCBN biologist, Jim Lynch, with the assistance of other NCBN and park staff. SET data was collected in nine parks, including 2 parks (ACAD, BOHA) in the Northeast Temperate Network and 2 parks (NACE, GWMP) National Capital Region Network. Collaboration continued with NOAA and USGS scientist on the development of the SET monitoring protocol. The three agencies continue to work together to develop a protocol that can be adopted widely by other agencies, organizations, and institutions interested in monitoring surface marsh sediment elevation. The NCBN citizen science marsh bird monitoring program was implemented for the second year at COLO and third year at CACO and for the first year at ASIS. Our partnership also continued with the Saltmarsh Habitat & Avian Research Program (SHARP) that collected marsh bird data at CACO, FIIS, GATE and ASIS. The SHARP program was founded by a group of academic, governmental, and non-profit collaborators to provide critical information for the conservation of tidal-marsh birds. The NCBN continues to work closely with these partners to share data and develop a monitoring program with comparable goals, objectives and data collection methods.

The network also developed cooperative agreements with the University of Rhode Island (URI) for herpetological inventories and science communication needs, the Virginia Institute of Marine Science (VIMS) and the Seagrass Ecology Lab at SUNY Stony Brook in New York for estuarine

water quality and seagrass monitoring. Because NCBN parks were severely affected by Super Storm Sandy in 2012, funding was provided from Superstorm Sandy Recovery/Construction funds in 2013, to assure implementation of estuarine nutrient enrichment and seagrass monitoring for FIIS both 2013 and 2014 field seasons. SeagrassNet and bay-wide monitoring occurred at FIIS and ASIS to help evaluate the impacts of Super Storm Sandy on water quality in the bays. Funding was recently made available through Hurricane Sandy mitigation funding to continue the water quality and Seagrass monitoring in Great South Bay in order to understand changes that may be occurring due to the Old Inlet breach that has remained open since the storm. Ocean shoreline position monitoring continued during both fall 2013 and spring 2014 at FIIS, GATE, ASIS, GEWA, SAHI and CACO, following the network's published protocol.

The NCBN Program Manager also received funding for a number of additional Hurricane Sandy funded projects in FY14, including a \$3,000,000 project to model the resiliency of salt marsh in hurricane sandy affected parks. This project entails a two year intensive field component and data collection, and a final year of ecological modeling and science communication.

I. NCBN Accomplishments

Inventories

- A paleontological resource report was funded a by the NCBN and completed by GRD in FY14. This report represents a substantial update to the previous NCBN paleontology summary completed by Kenworthy and Santucci (2003).
- NCBN supported box turtle inventory/monitoring being conducted at FIIS (WIFL estate) by University of Rhode Island scientist, Nancy Karraker. A total of 142 turtles were captured and marked during an intensive one-week survey during the summer of 2014 at WIFL. About 30% of the turtles were new individuals.
- University of Rhode Island scientists also conducted herpetological inventories at FIIS (including WIFL Estate) and SAHI, spring-fall 2014. Survey methods employed at FIIS and SAHI in 2014 replicated those used in previous NCBN inventories (2002-2003) so that comparisons of herpetofaunal diversity can be made over time. Data summary and report available 2015.
- As part of the inventories described above, a graduate student from the University of Rhode Island, along with faculty and students conducted a field experiment at FIIS (WIFL Estate) to determine the risk of mowing to box turtles in fields (using model turtles). They found that a turtle occurring in a field that is mowed has an approximately 40% probability of being killed by the mower. This work will be

written not only as a graduate student thesis, but will be presented to park cultural resource managers for incorporation in park landscape management planning.

- In addition, the URI scientists and students are trying to quantify the environmental triggers of hibernation and emergence in box turtles to help inform mowing activities in parks. At the WIFL Estate, 40 box turtles are being tracked using radio-telemetry. Weather stations will be established at turtle hibernation sites and random locations to determine the temperature, precipitation, and humidity thresholds associated with the initiation of hibernation in the fall and emergence in the spring.
- NCBN Biotech, Dana Filippini began to update the avian inventories for NCBN parks. This year she started at SAHI and conducted 3 surveys in the park. The inventory method is based on the MIDN forest bird monitoring protocol, and MIDN staff assisted NCBN in developing the sampling design for the park. Surveys will continue this fall.
- The NCBN Data Manager continues to work with Natureserve on the vegetation mapping report for ASIS. All other products for ASIS are complete; NCBN staff are working closely to assist the cooperator in completing the report.
- Rutgers collaborators completed and submitted the pre-Sandy report and maps for Fire Island National Seashore to GRD and NCBN; pre-Hurricane Sandy map is completed and the report is in progress for Gateway National Recreation Area; pre-Hurricane Sandy maps for Assateague Island National Seashore are in process. Post-Hurricane Sandy maps and reports for FIIS and GATE are in process.

Inventory products

- Paleontological resource inventory and monitoring: Northeast Coastal and Barrier Network
- Geomorphological Map for Fire Island National Seashore.

NCBN Vital Signs Monitoring

Forest vegetation monitoring (GEWA, THST, COLO)

- A four-person field crew shared with MIDN and NETN conducted forest health monitoring at three NCBN parks (GEWA, THST, COLO).
- Natural Resource Data Series Report for the 2013 field season and two resource briefs for COLO, GEWA and THST were completed. Spatial and biological data finalized and posted to IRMA.

Ocean shoreline position monitoring (FIIS, ASIS, CACO, GATE, GEWA, SAHI)

- Shoreline monitoring (1D) continued to be collected by NCBN and Park Staff for fall and spring shorelines at ASIS, CACO, GATE, SAHI, GEWA, and FIIS. Rutgers' scientists under an NCBN/CESU task agreement continued to conduct the monitoring for the Network at GATE.
- Two GeoCorps Interns were hired by NCBN to assist at GATE under the supervision of Dr. Norb Psuty. The interns collected shoreline and topographic monitoring data for the Network and Hurricane Sandy projects and assisted with data analyses and report preparation.

Coastal topography monitoring (GATE)

- Rutgers collaborators expanded 3D monitoring at GATE to include Miller Field, Riis Park, and Aviation Road with future plans to include Fort Tilden. The data are used to provide metrics on the post-Sandy adjustment and resilience of the coastal system on both a site-specific and regional basis.
- The Rutgers team made an intensive topographical survey of the Riis Park beach to establish the base surface for beach nourishment, and calculated the volumes and templates for the park nourishment project.
- The NCBN data manager presented a day-long field trip on coastal erosion in National Parks and Southern Rhode Island to a local Rhode Island public school.

Marsh Bird monitoring (CACO, COLO, ASIS)

- Marsh Bird monitoring was implemented for the first time at ASIS this year, April-July, 2013.
- Monitoring continued at CACO for the 3rd consecutive year and COLO for the 2nd consecutive year.
- Marsh Bird Monitoring resource briefs for 2013 were completed for COLO and CACO.
- NCBN Data Manager and Marsh Bird Project Lead began discussions with SHARP and FWS personnel concerning the possibility of developing shared Avian Knowledge Network (AKN) Data Node for the common storage and archiving of marsh bird monitoring data.

Salt marsh vegetation and nekton monitoring (ASIS, COLO)

- 2014 was the fourth year that salt marsh monitoring was conducted at ASIS and COLO (initiated in 2008).
- One Pathways Intern (East Carolina University graduate student), and one Biological Technician were hired and stationed at ASIS and completed the sampling under the supervision of NCBN staff. Data entry for the 2014 field season has been completed. Data will undergo quality control procedures this winter prior to analysis for the annual data

summary reports.

- 2013 annual salt marsh vegetation and nekton monitoring reports were published in the NR Data Series for FIIS and SAHI.
- NCBN and USGS scientists received funding from USGS NPMP for a project entitled "Development of a Multimetric Index for Integrated Assessment of Salt Marsh Condition in the Northeast Coastal and Barrier Network." Collaborative work continued on this project. This is a three year project and will be completed in 2015.

Salt marsh sediment elevation monitoring (NCBN Parks CACO, GATE, FIIS, ASIS, COLO; NETN Parks ACAD, BOHA; NCRN Parks NACE, GWMP)

- 86 SET monitoring stations at five NCBN parks (GATE, FIIS, CACO, ASIS, COLO) were sampled in the fall and spring in FY14.
- NCBN completed the first measurements on 6 new SET's installed at CACO this year. This is the first round of upgrades to the SETs at CACO.
- 19 SET stations at two NCRN parks (NACE, GWMP) were sampled in the fall and spring of FY14 in collaboration with NCRN colleagues.
- 21 SET stations at two NETN parks (BOHA, ACAD) were sampled in the fall and spring of FY14 with the support of NETN colleagues.
- Data from all NER SET sites (except CACO) has been entered and validated.
- Water level recorders were deployed at GWMP, COLO, ASIS, GATE, FIIS, CACO, BOHA and ACAD during FY14. These are being used to characterize the tidal patterns and differences in marsh flooding at the various SET sampling stations within each park.
- Permanent 1m² vegetation plots were established at ASIS at the 16 SET stations. Vegetation data will now be recorded when sampling SETs.
- Work on the SET monitoring protocol continued in FY14. NCBN staff collaborated with colleagues and co-authors Dr. Don Cahoon (USGS) and Dr. Philippe Hensel (NOAA) via conference call, email, and face-to-face meetings to develop the main text and standard operating procedures for the protocol.
- Conducted an RTK GPS surveys of marshes at FIIS and CACO in FY14
- NCBN assisted ASIS with the establishment of a water level gauge located at Chincoteague Island National Seashore. The gauge is being installed to characterize the flooding patterns at the southern end of Assateague Island and at Chincoteague Island. Data will be used to update the tidal datums in the park.
- NCBN staff assisted colleagues from the NOAA National Geodetic Survey with leveling projects in Maryland at ASIS and the Smithsonian Environmental Research Center in Edgewater, MD.
- NCBN, NCRN, and NETN data managers completed the design and implementation of the

NRDT-compliant SET database and began discussions with WASO support staff regarding the possibility of migrating to a central, web-accessed SQL Server database in order to simplify data entry.

NCBN Water Quality Monitoring

Funds transferred to the NCBN from the Water Resources Division paid for approximately one third of the NCBN water quality monitoring effort in FY14.

Estuarine nutrient enrichment (ENE) monitoring (FIIS, CACO, GEWA, COLO, ASIS)

- NCBN staff continued to work with USGS scientists on the NCBN estuarine water quality analysis and synthesis project funded through the USGS NPMP. The project working group completed certifying all NCBN water quality data to standards specified in the network protocol and completing the development of new water quality data analysis and summary tools. Products were delivered to the NCBN in 2014.
- NCBN collaborators from the Virginia Institute of Marine Sciences (VIMS) and Stony Brook University continued to collect estuarine water quality data for the NCBN based on the network's Estuarine Nutrient Enrichment (ENE) protocol. Water quality monitoring occurred at ASIS, COLO, GATE and FIIS this year. All stations were successfully sampled. Chlorophyll samples were sent to Cape Cod National Seashore North Atlantic Coast Laboratory for analyses. Results have been returned to VIMS and Stony Brook. Digital copies of all data were created. All data collected at ASIS and COLO will be submitted to the NCBN Estuarine Nutrient Enrichment Database in late 2014.

Seagrass monitoring (CACO, ASIS)

- The Virginia Institute of Marine Sciences (VIMS) continued to monitor seagrass at ASIS for the NCBN based on the network's Estuarine Nutrient Enrichment (ENE) protocol. To better evaluate the cause and effect of stressors, especially those related to climate change, two additional SeagrassNet surveys, were added to the monitoring this year. VIMS personnel travelled to ASIS and successfully performed a fall, spring, and summer SeagrassNet survey. A continuous water quality monitoring station was deployed and maintained by the ASIS park staff for approximately two weeks during each of the three seasonal survey periods. All final data from the 2013 SeaGrassNet samplings were added to the NCBN database and SeagrassNet database.
- A general lecture was provided on the evening of February 13, 2014 to the Piankatank Rotary Club in Mathews Virginia by Dr. Kenneth Moore. In this lecture a description of the status of seagrass populations in Chincoteague Bay, Maryland using information generated as part of the NCBN SeagrassNet monitoring program.
- Stony Brook personnel conducted the park-wide rapid seagrass assessment from July 2 to

July 31, 2014, visiting 198 locations within Great South Bay. A significant reduction in the number of sites that had seagrass from the previous 2009 rapid seagrass assessment was observed. Some recovery was observed at locations near Fire Island Inlet (Zone 1). Digital copies of all data were created. Data were quality controlled and entered into the NCBN database.

- Stony Brook personnel also successfully performed the summer NCBN SeagrassNet survey on August 20, 2014. Biomass samples were collected and processed. All data was digitized, and will be entered into the SeagrassNet database, fall 2014.

Marine Invasive Species Monitoring (NCBN parks)

- NCBN biotech, Dana Filippini presented *Marine Invasive Species Monitoring in the National Parks*, to 350 primary school children at one Rhode Island public school over a course of three days.

NCBN Data Management

- This year the NCBN program manager submitted a proposal to the IMD requesting funding to help the Network develop science communication products and tools. The Network received \$50,500 late in the fiscal year for obligation towards a CESU Task Agreement. A research associate will be hired at the University of Rhode Island to work on this project in October 2014 under the guidance of NCBN staff.
- The NCBN data manager collaborated closely with WASO staff to implement additional REST services and IRMA bibliographic widgets, allowing for automatic website updates when new content is posted. In addition, new Species List widgets (tapping certified species lists in the NPSpecies database within IRMA) were added for each park.
- NCBN data management / GIS staff were recognized by the parks and region for providing data and GIS assistance for post Hurricane Sandy recovery efforts. Staff served as part of a team of NER GIS specialists surveying first-floor elevations of over 100 structures and other natural and cultural resources at Fire Island National Seashore.
- NCBN Data Manager served a final year as the I&M Program representative to the NPS GIS Council (GISC), where he represented the geospatial needs of the 32 I&M Networks to the council and provided insight on the needs and direction of Network monitoring activities. The Data Manager participated in monthly conference calls and annual meetings, served on committees, and spearheaded the search for the new I&M representative.
- NCBN staff continued to collaborate with USGS scientists on two NPMP funded projects. The NCBN Data Manager provided GIS expertise in support of a project examining Estuarine Water Quality in Relation to Watershed Characteristics in Northeastern National Parks, as well as aided in compiling and organizing the Network's salt marsh monitoring data in support of a project developing a multimetric index for integrated assessment of salt

marsh condition.

- NCBN data manager, Dennis Skidds and collaborator, Thom Curdts worked closely with WASO Water Quality staff to develop and implement the latest-generation Electronic Data Deliverables (EDDs) to streamline the uploading of certified NCBN ENE water quality monitoring data into EPA STORET.

Other Activities

Development of \$5.3 million in post-Hurricane Sandy funded research and monitoring projects

In the fall of 2012, the NCBN Program Manager began working with a small science team in the Northeast Region to develop projects related to the recovery and science of Superstorm Sandy. This entails developing proposals and requests for funding, identifying cooperators, developing the contracts and cooperative agreements. In FY13 the following projects, equaling \$2.3 million dollars, were developed and will continue to be managed by the NCBN Program Manager through FY16.

- Revisions of Geomorphic Maps Post Storm and pre-post storm change analysis (GATE, FIIS, ASIS).
- QuickBird Methodology update for monitoring Salt Marsh Landscape Change (contribution)- (FIIS, GATE, ASIS)
- Response of Great South Bay submerged aquatic vegetation (SAV) to the breach in FIIS
- Geospatial Data Collection and Change Analysis in Support of Storm Event Recovery and Planning
- Obtain high resolution elevation and water level data and conduct a change analysis

During the summer of 2013, the NCBN program manager developed a proposal to enhance elevation data and monitoring in four NCBN parks. This project was funded in FY14 under the DOI Hurricane Sandy Mitigation Funds for \$3,000,000. Five CESU task agreements were completed this year, along with a contract for RTK and Total Station equipment, and an IAA with USGS for the installation of a tide gauge at FIIS. One more CESU agreement and IAA will be completed in FY15. This project involves a large effort to collect on-the-ground elevation data, water level data, vegetation, and other parameters on NCBN long-term salt marsh monitoring sites at four NCBN/Hurricane Sandy affected parks. The data will be used to model marsh resiliency and enhance marsh mitigation efforts in the parks.

II. Public Interest Highlights

The Use of Baseline Monitoring Data Used to Assess Changes following Superstorm Sandy:

Miller Field Dunes, Staten Island Unit, Gateway National Recreation Area

Superstorm Sandy created significant change to coastal areas throughout much of New York and New Jersey. The coastline of Staten Island was a scene of great change because of the high surge associated with the storm. One of these areas is the dune zone at Miller Field, part of the Gateway National Recreation Area. It was eroded and over-washed by the storm, but the dunes within the park area fared well compared to other areas on either side of the site. This was partly due to years of planting of dune grass and other cover providing greater strength to the Miller Field dunes, as well as their considerable mass, 3-4 times the width of the dunes in the adjacent areas. Following the storm, more than half of the vegetated dune system remained within this area, compared to total loss in the adjacent areas. The monitoring of the dune-beach system conducted under the NCBN allowed for analysis and evaluation of the dune field and its response to the storm.

Following the storm, new planting of dune grass and other pioneer plant species as well as natural vegetative recovery was promoting sediment accumulation and dune augmentation. Recognition of the vital role of dunes in the mitigation of the storm surge impacts has resulted in the promotion of vegetation recovery and a reduction of paths and lanes through the dune zone. Having long-term data to understand and quantify the ecological changes that occur during and after major storms is critical to inform management decisions and initiatives.

NCBN Estuarine Nutrient Enrichment Monitoring in a Regional Context

Over the past two years, NCBN staff have been working closely with cooperators Hilary Neckles of the USGS Patuxent Wildlife Research Center and John Kiddon of the EPA Atlantic Ecology Division to develop enhanced tools and procedures for the analysis and reporting of the Network's water quality monitoring data. These data, collected at six NCBN coastal parks in support of the Network's Estuarine Nutrient Enrichment monitoring program, include a wide array of parameters, including chlorophyll-a concentration, dissolved oxygen, light attenuation, and specific conductance. The Microsoft Excel-based tools utilize existing EPA data from the National Aquatic Resource Monitoring program to automatically place park data into a regional context, allowing resource managers to better understand their data in a regional context, as well as in park-specific context in order to make informed management decisions. Information produced by the tools is presented in multiple formats (including tables, charts, graphs, and maps), that can easily be used in reports and other informational material.

Box Turtle Monitoring on Long Island; a Thriving Population in an Oasis Surrounded by Developed Land

Eastern box turtles, once common throughout the Northeast, are common still, but only in some areas of the Northeast. Some national parks have become those key areas that maintain the larger populations of these turtles. One population of box turtles at Fire Island National Seashore in New York, has been studied since 1915, with unique marks having been made on the turtles' shells so that they can be individually identified and counted. Beginning in 2010, Dr. Nancy Karraker of the University of Rhode Island, began monitoring the population, with the support of the Fire Island National Seashore, the Northeast Coastal and Barrier Network, and assistance from students and scientists from throughout the region. The turtle surveys are conducted for seven days every year. In 2010, the scientists counted 111 turtles, and numbers each year since have ranged from 106-168 turtles. The shell of one turtle, first marked in 1921 and recaptured alive in 2002 as part of the Inventory and Monitoring program, was found to be over 100 years old at its death, many other turtles have been captured that are over 50 years old. The annual monitoring and data collection on the turtles will be used to determine if the population is stable. Other studies on the FIIS population include understanding how mowing activities in the park are affecting box turtles.

Students and scientist from five universities in the Northeast have participated in this project, and the vast majority of participants have been students. At least 50 university students have been trained in methods for conducting wildlife surveys and data collection, and how to work as part of a team as part of this project. They have also learned about the value of our national parks for protecting important species of plants and animals and as a means for sharing our natural heritage with the public.

NCBN Staff Provide a Hands-on Look at Marine Invasive Species to 6th Grade Scientists

For 3 days in June Broad Rock Middle School science classes of Wakefield, Rhode Island, were invaded by tunicates, amphipods, crabs, algae, isopods, and a giant Chinese Mitten crab. Dana Filippini, a Biological Technician for the Northeast Coastal and Barrier Network (NCBN) developed and presented a program on marine invasive species to over 350, 6th grade science

students over a course of three days.

Along with an introduction about the National Park Service Inventory and Monitoring Program and the importance of monitoring marine invasive species in the parks, the students learned about the different animal's and their natural history, how to identify tunicates and crab species, and the various ways they got to the Northeast coast, and why they are such a problem. The students learned how these creatures hitch-hike around the world via both commercial and recreational vessels. How the pet trade and aquaculture have added invasive species to the marine environment. Why they have cost the U.S. economy billions of dollars, and why they are such a threat to local biodiversity.

Then the fun began! There were tubs at each wet station containing a variety of tunicate species, crabs, anemones, skeleton shrimp, seaweed and various other critters for the students to take out and touch. An aquarium containing a representation of the marine invasive animals was set up so the students could see what a functioning environment may look like. Hand lenses, identification cards, field guides, and a microscope were provided to each of the groups. The kids had a blast, and loved every minute of the hands on work. They even had an opportunity to show off their new found skills in marine invasive animals and seaweed identification along with using the new vocabulary words they learned.

Towards the end of class a volunteer donned a full size Chinese Mitten crab costume. Certainly a highlight, of the program!

III. Contributions to the parks and broader scientific community (FY14)

Publications and Presentations

Anthony, E.J., and N.P. Psuty, guest editors, 2014. Human-altered Coastal Systems: Processes, Monitoring, and Management. *Journal of Coastal Conservation*, 18, 113 p.

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- Psuty, N. P., W. J. Schmelz, M. Patel, W. Hudacek, S. McLachlan, J. Freeman, W. Robertson,

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- Spahn, A., and Psuty, N. P., August 2014. East Pond Dike Elevation and Benchmark Survey, Gateway National Recreation Area. Submitted to David Taft, Chief, Natural and Cultural Resources, GATE, 10 p.
- Stevens, S. M. 2014. National Park Service Student Opportunities. University of Rhode Island, Natural Resource Science Department, Kingston, RI. October 2014. (Presentation to NCBN Annual Accomplishments Report FY14

Undergraduate Students)

Stevens, S. M. 2014. National Park Service Inventory and Monitoring Program. University of Rhode Island, Natural Resource Science Department, Kingston, RI. November 2014.

(Presentation to New Graduate Students)

Stevens, S. M. 2014. Enhanced Salt Marsh Monitoring. I&M Summer Newsletter, Inventory and Monitoring Division.

Tefft, Erica; Bonyng, Greg; Duhaime, Roland; Mandeville, Aimee; Campbell, Anthony; LaBash, Charles; Stevens, Sara; Skidds, Dennis; Christiano, Mark; August, Peter. Mosaic Datasets and LiDAR Data: Quick Processing and Versatile Results. Environmental Data Center at the University of Rhode Island, and the National Park Service.

Tweet, J. S., V. L. Santucci, and T. Connors. 2014. Paleontological resource inventory and monitoring: Northeast Coastal and Barrier Network. Natural Resource Technical Report NPS/NCBN/NRTR—2014/897. National Park Service, Fort Collins, Colorado.

<https://irma.nps.gov/App/Reference/Profile/2214467>

Teaching and Advising Students and Interns

- The NCBN Data Manager, Dennis Skidds, co-taught a graduate-level course on the theory and application of Global Positioning System (GPS) technology for the University of Rhode Island's Natural Resources Science Department during the spring 2014 semester. The course offered a hands-on introduction to the use of GPS for navigation and data-collection and culminated in a multi-day visit to GATE to assist in gathering data for actual park resource management projects.
- Salt Marsh Project Lead (Erika Nicosia) conducted a field workshop for a Biological Sciences department salt marsh ecology class at the University of Rhode Island, demonstrating nekton sampling and field techniques.
- Sara Stevens and Erika Nicosia were invited guest lecturers at the Natural Resources Science Department Senior Colloquium at the University of RI. The colloquium included ethics in science and developing a professional resume and cover letter, and interviewing techniques.
- Sara Stevens was a guest lecturer for an undergraduate science course at URI to present the NCBN monitoring program, and NPS opportunities and employment.
- Sara Stevens was a guest lecturer for the Masters in Environmental Science and Management (MESM) program at the University of Rhode Island. Sara also mentors MESM graduate students on an annual basis.
- All NCBN staff mentor both undergraduate and graduate students in the Department of Natural Resources Science at the University of Rhode Island on an ongoing, year-round

basis.

- Dennis Skidds developed primary school curriculum based on the NCBN coastal shoreline and topography monitoring protocols and conducted a one day field trip for a local primary school.
- Dana Filippini presented marine invasive species monitoring to 350 primary age students over a course of three days.

IV. Program Administration

Fiscal Responsibility

- This year the NCBN received a total of \$914,800; this includes \$782,00 in Vital Signs Monitoring funding and \$82,300 from the NPS Water Resources Division to assist with the network's estuarine water quality monitoring program and \$50,500 addition I&M funds to support science communication needs. Approximately 33% of this funding was used to develop partnerships (via cooperative agreement/contracts) with a number of CESU member Universities for the development and implementation of monitoring protocols. Permanent and seasonal NPS personnel expenses constituted approximately 60% of the budget in FY14. Travel (4%) and general operations, equipment purchases, and administrative/office support (3 %) rounded out NCBN expenditures for FY14.
- This year, the Network was provided with \$50,000 by COLO to help them develop a project to conduct a follow-up herpetological inventory at the park. The NCBN had previously funded, Dr. Nancy Karraker a herpetologist from the University of RI to monitor box turtles at FIIS as well as conduct a follow-up inventory at FIIS, SAHI, and GATE. This year the Task Agreement with Dr. Karraker was modified to include an inventory at COLO that will be conducted in 2015.
- In collaboration with USGS scientists, we have received three NPMP grants. We have successfully completed two projects with our USGS partners related to our Estuarine Nutrient Enrichment Program and received a new grant in 2013 to develop an MMI for our salt marsh monitoring program that will be completed in 2015.

Safety

- In FY13, the Network completed GARs and JSAs, and finalized safety SOPs for the following monitoring protocols: SETs, Marsh Birds, Shoreline Change, and Salt Marsh Vegetation and Nekton. Park-specific safety SOPs (such as UTV and boat use) and emergency contact information documents have been gathered. Prior to conducting field work in FY14, staff conducting field work in the parks confirmed local emergency contact information as needed.

- The salt marsh field crew was required to review and discuss the safety procedures with the Project Leader (Erika Nicosia) prior to conducting any field work during the 2014 season. This included discussions regarding checking in and out each day, driving while on official travel, and ensuring that they had emergency contact numbers saved to their phones. In addition to remaining in close contact with Erika regarding any changes to the field schedule, the crew also kept Park Staff informed of their site locations.

V. Staffing

NCBN Board of Directors

Deborah Dardin, ASIS
 George Price, CACO
 P. Daniel Smith, COLO
 Chris Soller, FIIS
 Jennifer Nersesian, GATE
 Melissa Cobern, GEWA/THST (current acting Taronna Armstrong)
 Kelly Fuhrman, SAHI
 Sara Stevens, NCBN Program Manager
 Mary Foley, Chief Scientist Northeast Region
 Jim Comiskey, I&M Program Manager Northeast Region

Northeast Coastal and Barrier Network Staff

Sara Stevens-NCBN Program Manager
 Dennis Skidds-NCBN Data Manager
 Erika Nicosia-NCBN Biologist (Salt Marsh)
 Jim Lynch-NCBN Biologist (SET)
 Dana Filippini-NCBN Biological Science Technician (Marsh birds)

Seasonal Staff and Interns (2014)

Casey Nolan, Pathways student-seasonal (Marsh monitoring)
 Danielle Sims-NCBN Seasonal (Marsh Monitoring)
 David Ridell-GeoCorp Intern (stationed at GATE)
 Kyle Nicolas-GeoCorp Intern (stationed at GATE)

NCBN Technical Steering Committees

Note: The original NCBN Technical Steering Committee has been disbanded and new “protocol” specific technical steering committees are in place for shoreline monitoring, salt marsh monitoring, and water quality monitoring.

Estuarine Water Quality Monitoring Members:

Sophia Fox, CACO (Lead)

Kelly Medieros, CACO
Penelope Pooler, NCBN
Sara Stevens, NCBN
Dennis Skidds, NCBN
Hilary Neckles, USGS
Kenneth Moore, VIMS
Brad Peterson, SUNY
Brian Sturgis, CACO

SET Monitoring

James Lynch, NCBN (Lead)
Sara Stevens, NCBN
Geoff Sanders, NCRN
Phillipe Hensel, NOAA
Don Cahoon, USGS
Charles Roman, NPS CESU
Bill Thompson, USFWS
Sue Adamowicz, USFWS
Bill Crouch, USFWS
Laura Mitchell, USFWS

Salt Marsh Vegetation and Nekton Monitoring

Erika Patenaude, NCBN (Lead)
Sara Stevens, NCBN
Charles Roman, NPS CESU
Mary-Jane James-Pirri, URI
Megan Tyrell, CACO

Key NCBN Contractors and Cooperators

Dr. Norbert Psuty, Rutgers University, Institute of Marine and Coastal Sciences (NCBN Geomorphological monitoring protocols, data collection and reporting and analysis)
Dr. Hilary Neckles, USGS Patuxent Wildlife Research Center, Augusta, ME (ENE and Seagrass monitoring and assistance)
Dr. Nancy Karraker and Research Assistant Robin Baranowski, University of Rhode Island, (Herp Inventories and Box Turtle monitoring).
Dr. Peter August (NRS faculty), Research Associates Charles LaBash, Roland Duhaimé, Mike Bradley, Aimee Mandeville, Andrew Neil, Scott Ransmussen, and Greg Bonyngé. University of Rhode Island, URI Environmental Data Center (GIS, Data Mgt Support/Elevation monitoring)
Dr. Brad Peterson, State University of New York, Stony Brook, School of Marine and Atmospheric Science (ENE monitoring FIIS/GATE)
Dr. Kenneth Moore and Betty Neikirk Virginia Institute of Marine Science (ENE monitoring ASIS, GEWA, COLO)
Dr. Dave Ullman, University of Rhode Island (tidal datum analysis)
Dr. Phillipe Hensel, NOAA-National Geodetic Survey (SET and salt marsh elevation protocol development)
Dr. Don Cahoon, USGS (SET and salt marsh elevation protocol development)

Dr. Mary Jane James-Pirri, URI (Coastal Park Condition Assessments/Salt Marsh Monitoring)
Dr. John Kiddon, U.S. Environmental Protection Agency (ENE monitoring data synthesis)
Dr. Jim Caldwell, USGS (ENE monitoring data synthesis)
Dr. Charles Roman, NPS CESU (Salt Marsh Monitoring)

VI. NCBN Protocol Status Summary Table

Name of Protocol	Protocol Status – Dates for Actual/Expected Milestones					Comments on Protocol Status
	Draft Available	Submitted for Review	Approved by Regional Mgr.	Published and Uploaded to Data Store	Network Protocol Review *	
Coastal topography			Approved 2012	Published 2012	Not implemented due to lack of funding	Protocol not implemented
Estuarine nutrient enrichment			Approved 2009	Published 2009	Reviewed annually, but no updates made yet.	Trend report completed in 2014. Resource Briefs for each park in development as part of USGS NPMP funding 2015. Reviewed by technical committee and needs to updates incorporated
Forest vegetation			Approved 2009	Published 2009	May 2014	Adopted MIDN protocol ¹ . Final peer review complete. Annual report and resource briefs available.
Ocean shoreline position			Approved 2010	Published 2010	Reviewed annually, but no updates made yet.	Final peer review complete. Annual reports available. ASIS 5-yr trend report published 2012.
Salt marsh nekton			Approved 2012	Published 2012	Reviewed-no updates	Published 2012 Annual reports available.
Salt marsh vegetation		May 2011	Jan 2015 (anticipated)			Currently undergoing revisions by the authors. Completed revisions were anticipated in January 2014 with anticipated final approval and publication in Feb 2014. Protocol still needs review by authors.
*Salt marsh birds (not an original VS, added in 2011 following Climate Change report)	Draft Feb 2015 (anticipated)					Currently adapting Saltmarsh Habitat & Avian Research Program (SHARP) North American Marsh Bird Monitoring Protocols ² . University cooperators failed to complete draft, protocol development brought in-house and is being worked on by NCBN staff. Draft complete and being reviewed by NCBN staff.
*Salt marsh sediment elevation (not an original VS, added in 2011 following Climate Change report)	Draft February 2015 (anticipated)					Protocol under development-first draft of narrative completed Sept 2012. This is a collaborative effort and dependent on other agencies. Expected completion of full draft was to be in FY14, but was not completed. First draft expected February 2015.

¹ Comiskey, J. A., J. P. Schmit, and G. Tierney. 2009. Mid-Atlantic Network forest vegetation monitoring protocol. Natural Resource Report NPS/MIDN/NRR—2009/119. National Park Service, Fort Collins, Colorado. ² Conway, C. 2007. SHARP Avian Point-Count/Callback Survey Protocol: Summary of the Standardized North American Marsh Bird Monitoring Protocols. Modified From Wildlife Research Report #2007-04. Saltmarsh Habitat & Avian Research Program (SHARP).

VII. Budget

NCBN Budget Summary FY14

Income

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
Vital Signs Monitoring	\$782,000.00	I&M - VS Monitoring	\$\$	
Funds for Science Communication	\$50,500.00	I&M - VS Monitoring	\$\$	
Water Quality Monitoring	\$82,300.00	WRD - WQ Monitoring		
Subtotal	\$914,800.00			

Personnel

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
NCBN Staff Salary	\$461,700.00	I&M - VS Monitoring	\$\$	
NCBN Staff Salary	\$82,300.00	WRD - WQ Monitoring		
Subtotal	\$544,000.00			

Coop. Agreements

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
CESU TA-URI Science Comm/Herp Inventories/Program Office Space	\$198,577.00	I&M - VS Monitoring	\$\$	
VIMS-CESU TA-ENE ASIS, COLO	\$50,000.00	I&M - VS Monitoring	\$\$	
CESU TA-Stony Brook ENE GATE	\$21,658.00	I&M - VS Monitoring	\$\$	
CESU-CO State U Data Mgt Support	\$24,100.00	I&M - VS Monitoring	\$\$	
GeoCorp Interns	\$6,000.00	I&M - VS Monitoring	\$\$	
Subtotal	\$300,335.00			

Operations/Equipment

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
Office Supplies	\$12,760.00	I&M - VS Monitoring	\$\$	
Housing GATE Geocorp Interns	\$2,011.00	I&M - VS Monitoring	\$\$	
Equipment purchase and repair	\$13,894.00	I&M - VS Monitoring	\$\$	
Subtotal	\$28,665.00			

Travel

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
NCBN Staff Travel	\$33,200.00	I&M - VS Monitoring	\$\$	
Subtotal	\$33,200.00			

Other

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
Regional Assessment	\$2,000.00	I&M - VS Monitoring	\$\$	
Awards	\$6,600.00	I&M - VS Monitoring	\$\$	
Subtotal	\$8,600.00			

Budget Analysis

Analysis of Expenses by Category

<i>Funding Source</i>	<i>Total \$\$</i>	<i>Personnel:</i>	<i>Coop Agree.</i>	<i>Contracts</i>	<i>Operations/Equip</i>	<i>Travel</i>	<i>Other</i>
I&M - VS Monitoring \$\$	\$832,500	\$461,700	\$300,335		\$28,665	\$33,200	\$8,600
WRD - WQ Monitoring	\$82,300	\$82,300					
Totals	\$914,800	\$544,000	\$300,335		\$28,665	\$33,200	\$8,600

Expense Totals By Category

<i>Category</i>	<i>SubTotal</i>	<i>Percent</i>
2_Personnel	\$544,000	59.47%
3_Coop. Agreements	\$300,335	32.83%
5_Operations/Equipment	\$28,665	3.13%
6_Travel	\$33,200	3.63%
7_Other	\$8,600	0.94%
	\$914,800	

Cape Cod Ecosystem Monitoring FY14 Annual Accomplishment Report

For addition to the Northeast Coastal Barrier Network report

Submitted by Megan Tyrrell

Nov 7 2014

FY14 Summary

Vital signs monitoring on eleven protocols was accomplished at CACO by the CCEM team in FY14. Highlights for this year include: publication of the coastal forest monitoring report in the NRTR, a well-received presentation to the CACO senior management staff on the status and trends of selected protocols in the CCEM program, and popular “Science Tuesdays” outreach events at the Salt Pond Visitor Center. 2014 was also the first year that meso-mammal monitoring was accomplished since protocol development sampling was conducted in 2001 and 2004/5. Two new resource briefs were created and posted on the CCEM website. Finally, CCEM staff were primary or co-authors on seven peer-reviewed publications stemming from monitoring and related research activities.

Ecosystem monitoring at CACO is mostly accomplished by Cape Cod Ecosystem Monitoring staff (wildlife ecologist, plant ecologist, aquatic ecologist, aquatic ecology technician, hydrology technician and research and monitoring coordinator) and seasonal technicians and student interns. Other members of the natural resource division act as protocol leads on air quality, shoreline position monitoring, coastal topography and shorebird monitoring. NCBN staff collect the SET and marsh bird monitoring data for the park, in coordination with CCEM staff.

I. NCBN and CCEM Program Accomplishments

Inventories

- Continued inventory of eastern box turtles and eastern hog-nosed snake through incidental encounters. Inventory includes marking for future recognition, collecting data on size, weight, age, sex, and location, and photo-documentation. In FY 2014 there were 20 incidental box turtle records. As a result of this work, CACO region has been designated a “core area” in MA Box Turtle Conservation Plan. A total of 10 hog-nosed snakes were recorded.
- In collaboration with USFWS, staff collected pellets from cottontail rabbits for DNA extraction to determine the presence and distribution of New England Cottontail, a Candidate Endangered species. In a total of 14 surveys, 66 samples were collected, but all were identified as the non-

native Eastern Cottontail.

- Odonate inventory data dating back to 1990 that previously existed in two separate databases with different place name conventions were merged into a single database using CACO-approved place names and coordinates.
- A total of 122 occurrence records, plus documentation, for 12 rare species listed by the MA Natural Heritage and Endangered Species were submitted to that agency.

NCBN Vital Signs Monitoring

Ocean shoreline position monitoring (FIIS, ASIS, CACO, GATE, GEWA, SAHI)

- Shoreline monitoring (1D) continued with both fall and spring surveys at CACO following the NCBN Geomorphological Monitoring Protocol-Phase I Shoreline Position.
- Assisted NCBN data manager with compilation of multi-year CACO shoreline position protocol data.

Coastal topography monitoring (FIIS, ASIS, CACO, GATE, GEWA)

- Worked with Provincetown Center for Coastal Studies to document variations in geomorphology due to tidal cycles. Collected field data for 24 coastal elevation profiles in the summer in support of 3D coastal monitoring protocol.

Marsh bird monitoring (NCBN, NETN, NCRN coastal parks)

- Provided boat support to NCBN staff during NCBN use during bird surveys.

Salt marsh vegetation and nekton monitoring (ASIS, GEWA, COLO, GATE (SHU), CACO)

- CACO nekton sampling was accomplished by the park's CCEM program. CACO estuaries sampled in 2014 included: East Harbor, Moon Pond, Hatches Harbor, and Nauset Marsh. QA/QC of 2014 data is underway.
- Salt marsh vegetation and various environmental parameters were sampled in 8 CACO marshes, including both tidally-restricted and unrestricted sites. The surveys were conducted as part of CACO's ongoing I&M protocol for salt marsh vegetation, which calls for monitoring every 5 years. The data were compared with previous surveys conducted in 2003 and 2008 and the results summarized in two technical reports (tidally restricted and unrestricted marshes were reported on separately) that were completed in 2014 and are under internal review with the NE Regional I&M Program Manager.

Salt marsh elevation monitoring (NCBN Parks CACO, GATE, FIIS, ASIS, COLO; NETN Parks ACAD, BOHA; NCRN Parks NACE, GWMP)

- With the assistance of CCEM staff, SET measurements were collected in fall and spring by NCBN staff. NCBN continued to measure all 28 established SET sites (22 old, 6 new rSET) in three CACO estuaries: Hatches Harbor, Herring River/Wellfleet Bay, and Nauset Marsh.
- Assisted James Lynch with QA/QC all CACO salt marsh elevation data from 1998 through present. Evaluated all data sets from all years in a systematic way in order to ensure confidence in the long-term data trends.

- Analyzed all data from all years in order to calculate an annual rate of change in marsh surface elevations of three systems (Hatches Harbor, Herring River and Nauset Marsh).

NCBN Water Quality Monitoring

CCEM staff continue to collect water quality data at CACO following the NCBN ENE monitoring protocol. NCBN provides equipment support as needed to CACO, and, in return, the park continues to handle the analysis of all NCBN chlorophyll *a* samples.

Estuarine nutrient enrichment (ENE) monitoring (FIIS, CACO, GEWA, COLO, ASIS)

- CACO staff conducted the ENE monitoring during four-week index periods for each of three strata within CACO (Pleasant Bay, Nauset Marsh, and salt ponds). All 2013 data were entered into the NCBN database.
- QA/QC of 2014 data is underway, and will be entered into the new resource assessment tool developed by USGS.
- Completed chlorophyll *a* analyses for CACO, as well as all other participating NCBN parks (FIIS, ASIS, COLO, and GATE) for the ENE protocol in 2014 at the Atlantic Research Learning Center's analytical lab. CCEM & NCBN chlorophyll analyses, equipment calibrations, and data analysis/management were conducted according to the provisions of the protocol. All data and controls were submitted to the respective cooperators as well as the NCBN Program and Data Managers.

Seagrass monitoring (CACO, ASIS)

- Monitoring by CCEM staff in cooperation with Dr. Hilary Neckles continued at CACO in Pleasant Bay and Duck Harbor for the eleventh consecutive year following the NCBN protocol. All 2013 data were entered into the NCBN database.
- For the second season, collaborated with Mary Carman at Woods Hole Oceanographic Institution, Phil Colarusso at EPA, and Hilary Neckles at USGS to conduct a survey of invasive tunicates on eelgrass blades at ENE sites.

CCEM Vital Signs and Water Quality Monitoring

Note: The following monitoring protocols and information have been developed by the CCEM. Support and funding for this work at CACO is solely supported through the CCEM budget.

Kettle pond monitoring (Water Quality)

- Continued to collect water quality data from 20 kettle ponds, as well as hydrologic measurements of pond stage at 10 primary ponds bi-weekly from March through November and 10 secondary ponds seasonally. Monitored chlorophyll *a* and nutrient (NO₃, NH₄, PO₄, total N and total P) concentrations of surface and deep water grab samples as a means of detecting seasonal and inter-annual changes in trophic status.
- Processed and analyzed 2013 water samples for total nutrients (NO₃, NH₄, PO₄, total P and total N), anions (chloride and sulfate), and chlorophyll *a* in the Atlantic Research Center's analytical lab (240 samples for total nutrients, 40 for anions, and 360 for chlorophyll), and sent 2013 water samples for dissolved inorganic nutrients (164 samples) and cation analysis (Na, K, Ca, Mg) to outside laboratories (20 samples).
- Initiated an in-depth analysis of water quality data to examine impacts of climate change. The data analysis will integrate I&M data from the kettle pond water quality and the atmospheric monitoring programs.

- Continued a comprehensive QA/QC review of kettle pond water quality monitoring data. Conducted methodology research, sample collection, and testing in support of refining the protocol. Protocol will be sent out for external peer review in FY15.
- The Aquatic Ecologist met with the Town of Wellfleet Natural Resource Advisory Board to discuss pond water quality and shoreline issues associated with visitor use.

Hydrology and ground water quality monitoring

- Continued implementation of the ground water and pond stage portion of the hydrology monitoring protocol including six wetland observation wells. The wetland wells are instrumented with continuous water level loggers and are monitored on a bi-monthly basis.
- Water level loggers were removed and data will be analyzed and included in a final report for FY15.
- With assistance from an AmeriCorps member, CCEM staff collected streamflow data from four stream gage sites. Continuous water level loggers were deployed at 2 of these sites in winter 2012 to collect continuous stage measurements while collecting streamflow data bi-weekly.
- Recommendations for future monitoring were reassessed by Gwen Gerber, of the NPS Water Resources Division, in Fort Collins, CO during a follow up site visit in September. Key recommendations include: Only 3 streamflow sites will be monitored in future years and new equipment is needed to continue to collect quality data at these 3 locations.
- All groundwater level data collected from observation wells was entered into the Aquarius database successfully and a protocol was drafted for this process (field to database).

Dune slack wetland monitoring

- CCEM staff completed the third survey of dune slack wetland vegetation. The 2014 data will be compared with the previous two surveys conducted in 2004 and 2009 and a technical report finalized in FY15. A total of 25 dune slack wetlands were assessed for water quality, hydrology, and soil parameters and their vegetation surveyed along permanent transects. The data will be analyzed and written up as a report in spring 2015.

Dune grassland monitoring

- CCEM staff completed the third survey of dune grassland vegetation monitoring along permanent transects. The 2014 data will be compared with the previous two surveys conducted in 2005 and 2010. The data will be analyzed and written up as a report in Spring 2015.

Amphibian monitoring

- Preliminary analysis of spotted salamander egg-mass count data collected from 2002 to 2013 at 14 ponds showed that the most significant factors affecting annual variation in numbers of egg masses laid were year, late summer groundwater depth 4-7 years prior, and April water depth.
- Monitored weather forecasts and ground water level to determine nights when CACO should close Province Lands Road to traffic to protect spadefoot toads. Coordinated with CACO operational staff on road closure. Implemented road closure on three nights.

Meteorologic, atmospheric deposition and air quality monitoring

- Continued to implement the meteorologic and atmospheric monitoring program and

served as site operator and/or site supervisor for participation by and communication among the following partners and cooperators: USGS, NPS Air Resources Division (ARD), the National Atmospheric Deposition Program-National Trends Network (NADP-NTN) and the University of Illinois for precipitation and wet deposition chemistry, the National Atmospheric Deposition Program-Mercury Deposition Network (NADP-MDN) and Frontier Geosciences for wet mercury deposition, the Interagency Monitoring of Protected Visual Environments Program (IMPROVE) at UC Davis for aerosols, the Commonwealth of Massachusetts (MA DEP) for ozone and primary pollutants, and UMASS-Amherst for Acid Rain Monitoring (ARM) in surface waters.

Forested Vernal wetland monitoring

- 63 Anion samples from 2013 (chloride and sulfate) were processed and analyzed at the Atlantic Research and Learning Center's analytical lab for the vernal wetland monitoring program.

Heathlands Monitoring

- The vegetation in twenty heathland monitoring sites was surveyed in 2013. This is the second survey following one completed in 1999 for 9 of the sites. The other 11 sites are new to the monitoring network and were added in 2013. The data were summarized in a report that was completed in 2014 and is currently in review with the NE Regional I&M program manager.

Landbirds monitoring

- Work on completing the landbird point count monitoring report and protocol is continuing to be led by a post-doc at University of Massachusetts, Amherst. A report on pilot studies, including power analysis, has been written, reviewed, revised, and is ready for finalization. The protocol based on the pilot studies has been drafted, and reviewed, and is undergoing revision. These two will be combined in to a single document and submitted for I&M protocol peer review.

Meso-mammal monitoring

- The last phase of field work for the meso-mammal protocol development study, led by Dr. Allan O'Connell, USGS, was completed in FY2006. Dr. O'Connell met with CACO staff in May 2014 to discuss completing his work on this protocol. Some of the issues CACO staff felt needed further clarification or revisiting since the pilot studies were conducted included location of sample points, numbers of points, numbers of sampling occasions, seasonality of sampling, and power associated with different sampling scenario options. Dr. O'Connell left with a plan to have USGS quantitative group staff at Patuxent WRC conduct the power analysis. The status of that work and any other work towards completing this protocol is unknown at this point.
- Field trials of camera traps and cubby boxes continued and expanded. Six sampling stations with a camera trap and cubby box were operated for six weeks in early summer and expanded to 12 stations in August 2014. This sampling is providing staff with an opportunity to gain operational level experience in operating these stations, and providing a new round of data on meso-mammals at CACO.

Cover-type change monitoring

- Conducted internal scoping of landcover change methods, reviewed and refined satellite

classification products from pilot study area in Wellfleet. Identified issues regarding georeferencing errors inherent in satellite products. Compared results to LIDAR LAS (waveform analysis) canopy height classes and ground elevation classes. Reviewed proposed methods refinements from University of Rhode Island's Dr. YQ Wang related to additional satellite bands in marsh areas.

Shorebird monitoring

- Monitored nesting and brood-rearing activity of piping plovers, least terns, and American oystercatchers on 25 beaches, on over 40 miles of coastline from Provincetown to Orleans.
- Created and implemented a new Access database, housing past and present shorebird monitoring data.

CCEM Data Management

- Using Hurricane Sandy funds, the CCEM aquatic ecology technician was hired as a term assistant data manager. She started in her new position in August. Following up on her assessment of data management needs from her detail earlier in the fiscal year, her focus is to improve CCEM data storage, archiving and accessibility.
- Hardcopy data sheets on salt marsh monitoring were sent to NCBN data manager for scanning and archiving.

II. Public Interest Highlights

Water table variation tied to spotted salamander population changes

Using counts of spotted salamander egg masses as a measure of abundance, an analysis of egg mass count totals for 14 ponds found a significant increase during the 2002 to 2013 period. In addition to year, the most significant environmental variable explaining this was mean depth of water table in September, 4-7 years prior to the year of egg mass count. Spotted salamanders lay their eggs in vernal ponds in early spring and their larvae transform and leave the ponds as air breathing, terrestrial "metamorphs" in late summer. In dry years, when pond and groundwater levels are low, more ponds dry out before the larvae are able to transform and reproductive success is low. Because it takes about 5 years for young to first return to ponds as breeding adults, the numbers breeding in any given year appear to be affected by reproductive success several years previously, which in turn reflects pond and water table conditions. The late 1990's was a period of drought on Cape Cod, with many ponds that hold water most years going dry, so it appears that CACO began this monitoring program when spotted salamander population levels were low due to the recent drought.

Science Tuesdays at the Salt Pond Visitor Center- direct outreach and interpretation

CCEM and other Natural Resource Management and Science staff participated in a newly dubbed "Science Tuesday" outreach series at CACO's largest visitor center during the busiest visitation months. Over the course of 8 weeks, science staff set up tables in the visitor center lobby and demonstrated their data collection techniques. In most cases, they drew crowds by using their instruments; in some cases, they also brought live animals. Feedback from the public as well as the interpretative staff was extremely positive. Additionally, the increased interaction between staff from different divisions led to enhanced understanding of each other's activities and how each division

contributes to the NPS mission.

CCEM status and trends management update implemented- park management decision making

In April, CCEM staff, in conjunction with other Natural Resource Management and Science staff, prepared seven presentations summarizing the monitoring program objectives along with results from selected protocols. The CACO senior management staff were the primary audience for the 15 minute presentations, but other Park staff also attended the status and trends update. Each presentation contained results for several Vital Signs and an assessment of the condition of these parameters at CACO as compared to a reference condition. Explicit ties were also made to how the information was relevant to the management of the Park. The superintendent was particularly interested in the air quality and water quality presentations. Many in the audience expressed interest in the results, especially because they were summarized in the context of a reference condition.

III. Contributions to the parks and broader scientific community

NRTR, NRR, and NRDT publications

Smith, S.M. 2014. Coastal forest monitoring report, Cape Cod National Seashore: Comparison of 2003 and 2013 data. Natural Resource Technical Series NPS/CACO/NRTR—2014/876. National Park Service, Fort Collins, Colorado.

Journal and other peer-reviewed publications

Buchanan, S.B., B.C.Timm, R.P. Cook, and R. Couse. 2013 *Heterodon platirhinos* (Eastern Hog-nosed Snake). Reproduction – Oviposition Frequency. *Herpetological Review* 44(4):691-692.

Buchanan, S.B., B.C.Timm, R.P. Cook, and R. Couse, and L.C. Hazard. *revision in review*. Surface Activity and Body Temperature of Eastern Hognose Snakes (*Heterodon platirhinos*) at Cape Cod National Seashore, Barnstable County, Massachusetts, USA. *Journal of Herpetology*.

Mittermayr, A., S.E. Fox, U. Sommer. 2014. Temporal stability of food webs in temperate *Zostera marina* communities revealed by simultaneous triple ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$ and $\delta^{34}\text{S}$) stable isotope analysis. *Marine Ecology Progress Series*. 505:95-105, doi:10.3354/meps10797.

Smith, S.M., M.C. Tyrrell, and M. Congretel. 2013. Palatability of salt marsh forbs and grasses to the purple marsh crab (*Sesarma reticulatum*) and the potential for re-vegetation of herbivory-induced salt marsh dieback areas in Cape Cod (Massachusetts, USA). *Wetlands Ecology and Management* 21:263-275.

Smith, S.M. 2014. Vegetation change in salt marshes of Cape Cod National Seashore (Massachusetts, USA) between 1984 and 2013. *Wetlands (in press)*

Timm, B.C., K. McGarigal, and R.P. Cook. 2014. Upland movement patterns and habitat selection of adult eastern spadefoots (*Scaphiopus holbrooki*) at Cape Cod National Seashore. *Journal of Herpetology* 48(1):84-97.

Tupper, T.A., C.A. Bozarth, K.S. Jones, and R.P. Cook. 2014. Detection of *Batrachochytridium dendrobatidis* in the Eastern Spadefoot *Scaphiopus holbrooki*, at Cape Cod National Seashore, Barnstable County, Massachusetts, USA. *Herpetological Review* 45(3):445-447.

Meeting presentations and posters

Carman, M.R., P.D. Colarusso, D.W. Grunden, M.C. Wong, C. McKenzie, K. Matheson, J. Davidson, C. Heinig, S. Fox, H. Neckles, S. Schott, C. Pickerell, and J. Dijkstra. 2014. Distribution and diversity of invasive tunicates on eelgrass in eastern North America: a latitudinal study between N 40° and N 50°, New Jersey to Newfoundland. EPAs Eelgrass Extravaganza, March 18, 2014. Poster

Colarusso, P.D., M.R. Carman, D.W. Grunden, M.C. Wong, C. McKenzie, K. Matheson, J. Davidson, C. Heinig, S. Fox, H. Neckles, S. Schott, C. Pickerell, and J. Dijkstra. 2014. Casual observations, random musings and wild extrapolations based on some actual data on the impact of invasive tunicates to near shore waters. New England Estuarine Research Society. May 1-3, 2014. Salem, MA. Oral

Fox, S.E., D.K. Ralston, J.A. Colman, H.K. Bayley, K.D. Lee, K.C. Medeiros, B.A. Keafer, D.M. Anderson, and M.L. Brosnahan. 2014. Nutrient Dynamics of a Temperate Estuary: Nauset Marsh Estuary. New England Estuarine Research Society. May 1-3, 2014. Salem, MA. Oral

Fox, S.E., 2014. Section 208 Update– Improving Cape Cod’s water quality by reducing nutrients. Presentation to CACO senior management staff, July 22.

Lee, K.D. Cape Cod National Seashore Long term Air Quality Monitoring: Analyses and trends, Cape Cod National Seashore Advisory Commission Meeting. June 2014.

Medeiros, K.C., J.Lynch, C. T.Roman, and MJ James-Pirri. 2014. Monitoring Salt Marsh Elevation at Cape Cod National Seashore: Understanding the response to sea-level rise. New England Estuarine Research Society. May 1-3, 2014. Salem, MA. Poster

Sisterson, J., K. Shea, K Lee, and M Tyrrell. 2014 Citizen Science: Mercury in Dragonfly larvae study in CACO Kettle Ponds. Cape Cod Natural History Conference, March 2014. Poster

Smith, S.M. 2014 Salt marsh restoration: challenges of predicting outcomes and real-life examples from Cape Cod National Seashore. New England Estuarine Research Society. May 1-3, 2014. Salem, MA. Oral

Tyrrell, M.C, K. Adams, M. Adams, B. Argow, J. Barnes, K. Corwin, R. Dye, A. Dijkstra, P. Gares, C. Mejia, S. Smith, M. Tanis, A. Thime, T. Wasklewicz. 2014 Cape Cod’s salt marsh dieback - marked elevation change, shifts in plant distribution and erosion stemming from crab activity. New England Estuarine Research Society. Salem, MA, May 1-3, 2014. Oral

Resource briefs and other publications

Miglone, E., L. McKean, S. Fox. 2014. Pond Condition Progress Report and Work Plan. Cape Cod National Seashore.

- Hatches Harbor salt marsh vegetation monitoring and heathlands management resource briefs

were completed and posted on the CACO websites.

- Information on kettle pond stewardship was created and added to the CACO website. In addition, a new “Protect Ponds” educational sign was posted to the CACO website.
- The Ponds Working Group continues to actively apply CCEM data to pond shore management. The 2013 and 2014 Ponds Condition Work Plans have been posted to the CACO website.

Journal peer review support

Eleven peer reviews were conducted by CCEM staff for journals or NPS NRTR.

Teaching and advising students

Cook, R.P. 2013. Wildlife ecology and management at CACO. Field trip for students from Antioch College, 10/1/2013.

Continued scientific guidance to Agnes Mittermayr, PhD student from GEOMAR, Germany on publications stemming from her CACO fellowship.

IV. Program Administration

Fiscal responsibility

The Cape Cod National Seashore CCEM program received their annual base of \$702,375. This funding was transferred directly to the park’s base account for regular program expenses and operations.

V. Staffing

Cape Cod National Seashore CCEM Staff

Jason Taylor, Natural Resource Management Division Chief

Megan Tyrrell, Research and Monitoring Coordinator*

Robert Cook, Wildlife Ecologist*

Stephen Smith, Plant Ecologist*

Sophia Fox, Aquatic Ecologist*

Kelly C. Medeiros, Hydrology Technician*

Judith Oset, Budget Technician

Krista Lee, Physical Scientist

Holly Bayley, Aquatic Ecology Technician*/Assistant Data Manager (August 2014)

Mark Adams, GIS Specialist

Mary Hake, Natural Resource Specialist

Nuray Taygan, Shorebird Technician

Tim Smith, Restoration Ecologist

Gabrielle Robinson, Shorebird Technician

Seasonal technician for: Vegetation monitoring

Student Conservation Association interns* for: Vegetation monitoring, meso-mammal monitoring (2), Kettle Pond Water Quality and Salt Marsh Nekton monitoring (3)

Diversity GeoCorps Intern, Bradford Folta

** majority of salary funded by Cape Cod Ecosystem Monitoring funds*

Key CCEM Contractors and Cooperators

Dr. Mark Borrelli, Provincetown Center for Coastal Studies (geomorphology, sea floor mapping)
Dr. Barbara Brennessel, Wheaton College, (diamondback terrapin ecology and genetics)
Dr. Michael Brosnahan, Woods Hole Oceanographic Institution (harmful algal blooms)
Scott Buchanan, Montclair State University (hog-nosed snake ecology)
Dr. Jim Caldwell, USGS (ENE monitoring data synthesis)
Mary Carman, Woods Hole Oceanographic Institution (invasive tunicates on eelgrass)
Dr. Phil Colarusso, EPA (invasive tunicates on eelgrass)
Dr. John Colman, US Geological Survey (nutrient loading to estuaries)
Lori Erb, Massachusetts Natural Heritage Program (box turtle monitoring and radio- telemetry)
Mark Faherty, University of Massachusetts, Amherst (landbird point-count protocol)
Gwen Gerber, NPS Water Rights Branch (hydrology monitoring)
Dr. Graham Giese, Provincetown Center for Coastal Studies (geomorphology and tides)
Dr. Curtice Griffin, University of Massachusetts, Amherst (landbird point-count protocol)
Dr. Mary Jane James-Pirri, URI (horseshoe crab ecology)
John Kiddon, U.S. Environmental Protection Agency (ENE monitoring data synthesis)

Dr. Kevin Kroeger, US Geological Survey (carbon sequestration in estuaries, “blue carbon”)
Larry Martin, NPS Hydrogeologist (hydrology monitoring)

Randall Mickley, Wildlife Disease Biologist, USDA APHIS (common eider die-off research)

Dr. Agnes Mittermayr, GEOMAR, Germany (seagrass food web study)
Dr. Bill Monahan, NPS Inventory and Monitoring Division (ENE monitoring data synthesis)

Dr. Hilary Neckles, USGS (seagrass monitoring, ENE monitoring data synthesis)
Dr. Christopher Neill, Marine Biological Laboratory (nutrient loading to ecosystems)
Dr. Allan O'Connell, USGS, Patuxent WRC (meso-mammal protocol)
Dr. David Ralston, Woods Hole Oceanographic Institution (harmful algal blooms)
Dr. Rachel Thiet, Antioch College of New England (soft-shell clams, salt marsh vegetation. ant-*Corema* interactions)
Dr. Todd Tupper, Northern Virginia CC (chytrid fungus surveys)
Dr. Betsy Von Holle, Univ. Central Florida (coastal heathland vegetation)

VI. Status of monitoring protocols being developed by the Northeast Coastal and Barrier Network and Cape Cod Ecosystem Monitoring Program (see Excel workbook)

VII. Budget - FY2014 Annual Report Narrative

The Cape Cod National Seashore CCEM program received their annual base of \$702,375. This funding was transferred directly to the park's base account for regular program expenses and operations.