
**ANNUAL ADMINISTRATIVE REPORT FOR INVENTORIES AND VITAL SIGNS
MONITORING
FY2010
NORTHEAST COASTAL AND BARRIER NETWORK (NCBN)**

Northeast Coastal and Barrier Network Approval Signatures

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Executive Summary

Northeast Coastal and Barrier Network (NCBN) FY 2010 Annual Administrative Report

Background

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 represent some of the most ecologically similar collections of lands within the National Park Service. They consist of critical coastal habitat for many rare and endangered species, as well as migratory 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 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. Climate change is rapidly adding to the vulnerability of these parks to extreme ecosystem degradation. Coastal parks are being faced with substantial increases in the extent and frequency of flooding and are at increased risk of severe storm-related damage. Sea-level rise is also projected to permanently inundate low-lying coastal areas and increase shoreline erosion and wetland loss. Areas most vulnerable to shoreline erosion in the Northeast include portions of Cape Cod, Long Island, and most of coastal New Jersey. Waves, currents, and tides constantly reshape shorelines, and as sea-level rise accelerates, these forces have the potential to dramatically alter the Northeast's coast.

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. Scientifically-based data and information on the condition of these park natural resources are key in developing effective management prescriptions to maintain coastal park ecosystems as pristine as possible.

The NCBN Inventory and Monitoring Program has been developed to assist and provide parks with credible, defensible scientific information that can be used in a management context to predict both natural- and human-induced changes to conditions of park 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 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 scientifically sound 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. Based on Roman and Barrett's 1999 report *Conceptual Framework for the Development of Long-term Monitoring Protocols at Cape Cod National Seashore*, CCEM began developing monitoring protocols based on the issues identified as part of Roman and Barrett's work. Not long after, in 2000-2001, the Northeast Coastal and Barrier Network (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 in that the network built on the same approach developed by Roman and Barrett for the additional seven parks in the network.

The following report provides a summary of accomplishments for FY2010 on inventory and monitoring projects being developed, implemented, and completed by the NCBN (including CACO CCEM) program. This year the NCBN received a total of \$797,800 in Vital Signs Monitoring funding to continue implementing monitoring in the coastal parks, \$87,100 from the NPS Water Resources Division to assist with the network's estuarine water quality monitoring program, and \$7,900 from the Vegetation Mapping Program to complete mapping and report and data review. In FY10 an additional \$200,000 was also transferred to NCBN for the development of a strategy for enhancing existing monitoring in light of rapid climate change. This funding is to be shared among three Networks; NCBN, Northeast Temperate Network (NETN), and the National Capital Region Network (NCRN). Only the North Atlantic coastal parks from these networks were including in the strategy. With this additional funding the Network received a total of \$1,092,800. In addition, Cape Cod National Seashore received \$702,400 for the park's CCEM program. Due to a salary lapse in

FY10, \$30,002 was absorbed by the park in accordance with park policy, therefore, \$672,398 went towards the park's CCEM program.

Summary

In (FY) 2010 several groups of I&M Networks were provided funding from WASO to review their existing monitoring programs in light of climate change and propose appropriate enhancements. One of these groups was the North Atlantic Coast Networks, including the Northeast Coastal and Barrier Network (NCBN), the Northeast Temperate Network (NETN), and the National Capital Region Network (NCRN). These networks were directed to use the new funding to enhance existing monitoring and to build and extend partnerships and collaboration with other federal agencies collecting similar monitoring data and information on natural resources. The NETN, NCBN and NCRN, with the input of federal partners and scientists from academic institutions, developed a strategy describing their process for identifying critical monitoring needs to meet these objectives while also enhancing each park's understanding of the effects of climate change on specific coastal ecosystems. The *Strategy for enhanced monitoring of natural resource condition in North Atlantic coastal parks to address the effects of rapid climate change (see publication section)* includes existing monitoring needing enhancement, as well as new monitoring to better understand the effects that rapid climate change has on parks.

The highest priorities were determined to be:

1. Expand existing interagency collaborative effort to monitor salt marsh capital along the North Atlantic coast in 10 national parks in conjunction with 12 coastal United States Fish and Wildlife Service (USFWS) sites, as well as National Estuarine Research Reserve sites (NOAA, NERR) along the North Atlantic. This effort will include standardized protocols, databases, and data collection.
2. Expand analysis, synthesis, and reporting of datasets produced by other agencies and organizations such as climate, tide, sea level, and remotely-sensed data to park managers and others to enhance our understanding of the effects of climate change.
3. Expand the existing interagency effort to monitor breeding marsh birds in North Atlantic parks within Bird Conservation Area 30 (BCR 30) through the Northeast Coordinated Bird Monitoring Partnership.

These projects will continue collaborative efforts among the I&M Networks, USFWS, National Oceanic and Atmospheric Administration (NOAA), the United States Geological Survey (USGS), State wildlife agencies, universities, and NGOs.

In September 2010, the North Atlantic coastal park's enhanced monitoring plan was submitted to WASO. The plan was accepted and, beginning in FY11, a base budget of \$200,000 will be added to the NCBN base for this additional monitoring effort. This funding will be used to meet priorities 1 and 2 above.

This year, in addition to planning for climate change monitoring, the NCBN continued to format and publish park reports in the NPS Technical Report Series. Twenty-six reports were published this year thanks to a University of Rhode Island student hired through the STEP program to handle formatting and publishing. All reports are available on the NER Science website (<http://www.nps.gov/nero/science/>) and the NCBN website (<http://science.nature.nps.gov/im/units/ncbn/>). All associated data products were uploaded and are available to parks on the NPS NRInfo site (<http://science.nature.nps.gov/nrdata/index.cfm>).

Five of the eight network park vegetation maps (COLO, GEWA, SAHI, GATE, and FIIS) were completed prior to FY10 and made available on the USGS Vegetation Characterization Program (VCP) website (<http://biology.usgs.gov/npsveg/products/parkname.html>). Funding was provided to the network this year by the Vegetation Mapping Program to complete data product reviews for CACO and THST. The CACO vegetation map and associated data products were revised by NatureServe and returned, and were reviewed and approved by network and park staff. In FY11, the NCBN data manager will deliver all CACO products to NC State University for uploading to the USGS VCP website. NatureServe will continue working on revisions to the ASIS and THST products in FY11.

Vital Signs Monitoring continued in FY10 with cooperative agreements being developed between the NCBN and the University of Rhode Island (URI) for a marsh bird monitoring feasibility study and geodetic marker inventory, Virginia Institute of Marine Science (VIMS) and the Seagrass Ecology Lab at SUNY Stony Brook in New York for implementation of estuarine nutrient enrichment monitoring at COLO, ASIS and GATE. SeagrassNet monitoring occurred at ASIS during three sampling periods in 2010, and a third year of seagrass monitoring was completed at FIIS with the assistance of Dr. Brad Peterson from SUNY Stony Brook.

Interagency agreements were implemented with the Patuxent Wildlife Research Center to install sediment elevation tables (SETs) and collect salt marsh elevation data at CACO, FIIS, GATE and ASIS, and with the Center for Coastal Studies in St. Petersburg, Florida to collect LiDAR for ASIS,

CACO, FIIS, and GATE. Through additional funds made available to NCBN, NETN, and NCRN for enhanced climate change monitoring, an interagency agreement was established with USGS Patuxent to install and monitor SETS at Acadia National Park (ACAD), COLO, and Boston Harbor Islands (BOHA).

This year, the network's ocean shoreline position protocol (*NCBN Geomorphological Monitoring Protocol-Phase I Shoreline Position*) and a prototype annual report completed for FIIS were published in the NPS Technical Report Series following peer review. Ocean shoreline position monitoring continued during both fall 2009 and spring 2010 at FIIS, GATE, ASIS, and CACO, following the network's published protocol. The protocol was implemented for the first time at GEWA by NCBN staff member Dennis Skidds, both in the fall and spring. Collaboration continued with scientists from Rutgers University on the second phase of protocol development for monitoring beach and dune topography. The cooperators submitted the first draft of this protocol along with the first draft of a prototype trend report of beach and dune topography monitoring data from ASIS. This protocol and report will go out for peer review in FY11 and, following any necessary revisions, will be published in the NPS Technical Report Series. Data products and a draft report developed by the URI Geosciences Department and USGS for baseline historical topography for four network parks (CACO, FIIS, GATE (Sandy Hook Unit), and ASIS) were submitted in FY10 and are in review with NCBN staff. These data will be used to help better predict the effects of climate change, such as sea-level rise and increased storm intensity, by comparing historic data sets to those currently being collected by the network. Another important part of the network's coastal geomorphological monitoring program is the collection of LiDAR on a biennial cycle. The NCBN and staff from the USGS Florida Integrated Science Center collaborated on collecting and processing EAARL LiDAR for FIIS, GATE, and ASIS in the fall of 2009 and spring of 2010. The CACO flight was postponed until the spring of 2011 in order to take advantage of data collection using a new NASA/USGS sensor that potentially will provide high quality bathymetry data.

Four STEP students from the University of Rhode Island, managed by the NCBN Salt Marsh monitoring lead, Erika Patenaude, were hired and stationed at ASIS for the summer of 2010 to collect vegetation and fish data at ASIS, GEWA, COLO, and Sandy Hook, GATE as part of the network's salt marsh monitoring program.

I. Program Accomplishments

Inventories

- Products from the network's inventories continued to be formatted and published in the NPS Northeast Region Technical Report Series. Eighteen new reports were completed this year and are available on the NER Science website (<http://www.nps.gov/nero/science/>) as well as the NCBN website (<http://science.nature.nps.gov/im/units/ncbn/>). All reports and associated data products have been uploaded and are available to parks on the NPS NRInfo site (<http://science.nature.nps.gov/nrdata/index.cfm>).
- Five of the eight vegetation maps were completed prior to FY10 and made available on the USGS VCP website (<http://biology.usgs.gov/npsveg/products/parkname.html>): COLO, GEWA, SAHI, GATE, and FIIS. In FY 10, the CACO final products were delivered by NatureServe and reviewed and approved by the park, network data manager, and regional I&M program manager. Jennifer Stringlin, a private contractor, reviewed the CACO plots database and report for taxonomic errors. In FY11, the NCBN data manager will deliver all CACO products to NC State University for uploading to the USGS VCP website. NatureServe will continue to work on the ASIS and THST products in FY11.
- Terrestrial reptiles – Eastern box turtles and eastern hog-nosed snakes were inventoried by CCEM staff at CACO through incidental encounters. Inventory procedures included marking for future recognition, collecting data on size, weight, age, sex, and location, and photo-documentation. In FY10 there were 41 incidental box turtle records, plus 11 encountered during monitoring surveys conducted in collaboration with MA Natural Heritage Program. As a result of this work, the CACO region has been designated a “core area” in the MA Box Turtle Conservation Plan. A total of 30 hog-nosed snakes were recorded.

Inventory products

Inventories Formatted and Published in FY10:

- Barry, R. E., and T. L. Dolbeare. 2010. Inventory of mammals (excluding bats) of Thomas Stone National Historic Site. Natural Resource Technical Report NPS/NCBN/NRTR—2010/315. National Park Service, Fort Collins, Colorado.

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- Barry, R. E., and T. L. Dolbeare. 2010. Inventory of mammals (excluding bats) of George Washington Birthplace Monument. Natural Resource Technical Report NPS/NCBN/NRTR—2010/311. National Park Service, Fort Collins, Colorado.
 - Barry, R. E., H. P. Warchalowski, and D. T. Strang. 2010. Inventory of mammals (excluding bats) of Colonial National Historical Park. Natural Resource Technical Report NPS/NCBN/NRTR—2010/321. National Park Service, Fort Collins, Colorado.
 - Briggs, N., E. G. Schneider, J. Sones, and K. Puryear. 2010. Inventory of Odonata (dragonflies and damselflies) at Fire Island National Seashore. Natural Resources Technical Report NPS/NCBN/NRTR—2010/295. National Park Service, Fort Collins, CO.
 - Briggs, N., E. G. Schneider, J. Sones, and K. Puryear. 2010. Inventory of Odonata (dragonflies and damselflies) at Sagamore Hill National Historic Site. Natural Resources Technical Report NPS/NCBN/NRTR—2010/192. National Park Service, Fort Collins, Colorado.
 - Briggs, N., E. G. Schneider, J. Sones, and K. Puryear. 2010. Inventory of Odonata (dragonflies and damselflies) at Gateway National Recreation Area. Natural Resource Technical Report NPS/NCBN/NRTR—2010/296. National Park Service, Fort Collins, Colorado.
 - Cook, R. P., D. K. Brotherton, and J. L. Behler. 2010. Inventory of amphibians and reptiles at Fire Island National Seashore. Natural Resource Technical Report. NPS/NCBN/NRTR—2010/378. National Park Service, Fort Collins, Colorado.
 - Cook, R. P., D. K. Brotherton, and J. L. Behler. 2010. Inventory of Amphibians and Reptiles at the William Floyd Estate, Fire Island National Seashore. Natural Resource Technical Report. NPS/NCBN/NRTR—2010/380. National Park Service, Fort Collins, Colorado.
 - Cook, R. P., D. K. Brotherton, and J. L. Behler. 2010. Inventory of amphibians and reptiles at Sagamore Hill National Historic Site. Natural Resource Technical Report. NPS/NCBN/NRTR—2010/379. National Park Service, Fort Collins, Colorado.
 - Gates, J. E., and J. B. Johnson. 2010. Bat Inventory of Assateague Island National Seashore. Natural Resource Technical Report NPS/NCBN/NRTR—2010/284. National Park Service, Fort Collins, Colorado.
 - Orr, R. 2010. Inventory of selected arthropods at Assateague Island National Seashore: 2005-2007 survey. Natural Resource Technical Report NPS/NCBN/NRTR—2010/327. National Park Service, Fort Collins, Colorado.
 - Cooper, K. R., and M. Borjan. 2010. Northeast Coastal and Barrier Network assessment of contaminant threats: George Washington Birthplace National Monument. Natural Resource Technical Report NPS/NCBN/NRTR—2010/330. National Park Service, Fort Collins, Colorado.

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- Cooper, K. R., and M. Borjan. 2010. Northeast Coastal and Barrier Network assessment of contaminant threats: Gateway National Recreation Area. Natural Resource Technical Report NPS/NCBN/NRTR—2010/339. National Park Service, Fort Collins, Colorado.
 - Cooper, K. R., and M. Borjan. 2010. Northeast Coastal and Barrier Network assessment of contaminant threats: Fire Island National Seashore. Natural Resource Technical Report NPS/NCBN/NRTR—2010/332. National Park Service, Fort Collins, Colorado.
 - Cooper, K. R., and M. Borjan. 2010. Northeast Coastal and Barrier Network assessment of contaminant threats: Assateague Island National Seashore. Natural Resource Technical Report NPS/NCBN/NRTR—2010/348. National Park Service, Fort Collins, Colorado.
 - Cooper, K. R., and M. Borjan. 2010. Northeast Coastal and Barrier Network assessment of contaminant threats: Sagamore Hill National Park. Natural Resource Technical Report NPS/NCBN/NRTR—2010/344. National Park Service, Fort Collins, Colorado.
 - Cooper, K. R., and M. Borjan. 2010. Northeast Coastal and Barrier Network assessment of contaminant threats at Thomas Stone National Historic Site. Natural Resource Technical Report NPS/NCBN/NRTR—2010/343. National Park Service, Fort Collins, Colorado.
 - Cooper, K. R., and M. Borjan. 2010. Northeast Coastal and Barrier Network assessment of contaminant threats: Colonial Historical National Park. Natural Resource Technical Report NPS/NCBN/NRTR—2010/355. National Park Service, Fort Collins, Colorado.

Vital Signs Monitoring

Forest health monitoring (*GEWA, THST, SAHI*)

- Monitoring was conducted for the third consecutive year at GEWA and THST, and for the second year at SAHI in collaboration with the Northeast Temperate and Mid-Atlantic networks. The three networks shared biological technicians to collect data and will continue to do so annually in these three network parks.

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

- Monitoring continued with both fall and spring surveys at FIIS, GATE, ASIS, and CACO following the network's *NCBN Geomorphological Monitoring Protocol-Phase I Shoreline Position*. This protocol, along with a prototype annual report for FIIS, was peer reviewed and published in FY10. A draft annual report on shoreline monitoring for GATE (2006-2007) was recently submitted to the network.
- In October, NCBN cooperators developing the NCBN geomorphological monitoring protocols visited a number of NCBN parks, including CACO, to review the implementation and data analysis procedures of the protocol. Field observations of geologic conditions unique to each park helped the authors refine the protocol (and future coastal change SOPs)

to make the data more relevant to management. As a result of a site visit to CACO, the monitoring area was expanded to include Cape Cod Bay shorelines.

- NCBN cooperator, Dr. Norb Psuty, completed a template for the analysis of high tide shoreline monitoring data at CACO. In 2011, CACO will follow this template to create a data summary and analysis report for high tide shorelines collected from 2007-2010.
- NCBN cooperator, Dr. Norb Psuty, developed a prototype trend report for shoreline monitoring at ASIS.

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

- Collaboration continued with scientists from Rutgers University to develop the second phase of protocols for monitoring shoreline and beach and dune topography. The first draft of the topography protocol has recently been submitted for review to the NCBN. Installation of the Spatial Network of Survey Monuments for all the units of GATE, and creation of Field Booklets and GIS Databases were completed. The 2-D monitoring program was initiated at GATE by collecting beach profiles throughout all units of GATE in fall 2009 and spring 2010. Fall and spring topographic surveys were also run at Sandy Hook, Great Kills, and Plumb Beach as part of testing the methodology for developing the 3-D monitoring program. As a component of the coastal topography monitoring program, two GeoCorps interns were hired and stationed at Sandy Hook, GATE to work on NCBN coastal monitoring projects.
- CACO staff, with the assistance and cooperation of Mark Borrelli of the Provincetown Center for Coastal Studies (PCCS), tested data collection methods for the NCBN draft shoreline topography monitoring protocol in a variety of CACO locations.
- CACO cooperated with PCCS geomorphologist Graham Giese in an ongoing study of 120 years of coastal change based on a 1988 U.S. Coastal Survey dataset. In 2010, bathymetry data were analyzed, and depths were extracted from LiDAR data (USGS, ACOE). Dr. Giese and Mark Adams, CACO GIS, worked with a Geoscientist-in-the-Park (GIP) to format transect data and prepare analyses in MatLab software.

LiDAR (*ASIS, FIIS, GATE, CACO*)

- The USGS Coastal and Marine Geology (CMG) Program in collaboration with NCBN and the Northeast Region, conducted an airborne LiDAR survey in November/December 2009 in response to the Nor'easter (Nor'Ida) at FIIS, GATE, ASIS, and Cape Hatteras National Seashore. The survey, which was co-funded by USGS and NPS, took seven survey days to complete and resulted in the acquisition of 130 Gigabytes of raw laser and digital photography (RGB and CIR) data. Another survey was conducted at ASIS in March 2010 as

part of the springtime biannual survey along barrier island national parks in the northeast. These products will be published as a USGS Data Series Report

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

- Monitoring was conducted at CACO (nekton only), COLO (vegetation only), ASIS, GEWA, and Sandy Hook (GATE). This was the second year of data collection at ASIS, COLO, and GEWA—which were all sampled for the first time in 2008. Three marshes at GATE-Sandy Hook were sampled for the first time. One University of Louisiana at Monroe graduate student and three URI undergraduate students hired through the Student Temporary Employment Program (STEP) were stationed at ASIS and completed the sampling at all parks. CACO sampling was accomplished by the park’s CCEM program staff and a Student Conservation Intern. CACO estuaries sampled in 2010 included: East Harbor, Moon Pond, Hatches Harbor, and Nauset Marsh. Following the method implemented in 2009 to increase pools suitable for nekton sampling, Hatches Harbor was sampled during spring tides as the high tide receded to avoid the problem of dry pools. All data for the 2010 field season are entered and are currently undergoing quality control procedures and analysis for annual reports. A report of CCEM nekton monitoring data in East Harbor and Moon Pond for years 2004-2009 was prepared as part of CACO’s annual East Harbor restoration report. Annual data reports for COLO, ASIS, GEWA, FIIS, William Floyd Estate unit of FIIS (WIFL), and SAHI were published in the NR Technical Report Series.

Salt marsh elevation monitoring (CACO, GATE, FIIS, ASIS, COLO)

- In accordance with the salt marsh sediment monitoring protocol developed for CACO (Cahoon et al., 2006), salt marsh accretion, erosion, and relative elevation were measured in fall 2009 and spring 2010 at established salt marsh surface sediment elevation table (SET) sites at CACO, GATE, ASIS, and FIIS. Dr. Don Cahoon, USGS cooperator, collected data at all sites twice during the year, CACO monitoring was conducted by CCEM staff in three CACO estuaries: Hatches Harbor, Herring River/Wellfleet Bay, and Nauset Marsh. At CACO, elevations of the 22 SET sites and the surrounding area were measured with a Real Time Kinematic Trimble unit to document where in the tidal range each marsh surface occurs in order to assess the vulnerability of each system to sea level rise. A first draft of a comprehensive report for Hatches Harbor and Herring River SET monitoring was written. A new periodic monitoring element, SET mount elevations, was discussed with CACO staff due to potential for changes in the mount elevations to occur via ice or other physical damage. Elevations of the SET sites and surrounding marshes at FIIS, GATE, and ASIS will be collected over the next couple of years by network staff with the assistance of CACO.

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- With FY10 funding provided to NCBN, NETN, and the NCRN for the development of the North Atlantic Coast enhanced monitoring strategy, an interagency agreement was established with Dr. Don Cahoon from USGS Patuxent for the installation and initial data collection of salt marsh elevation tables (SETs) at ACAD, BOHA, and COLO. This project will take place over a one-year period.
 - Funding provided in FY10 to NCBN, NETN and the NCRN for the development of the North Atlantic Coast enhanced monitoring strategy was also used to develop a cooperative agreement with the University of Rhode Island Environmental Data Center for the installation of geodetic benchmarks for monitoring salt marsh capital. Monitoring salt marsh capital was identified early in the planning process as a high priority for understanding the effects of climate change on salt marsh ecosystems. This agreement is part of a larger project developed by the Northeast Region science program, in cooperation with URI, to create a backbone of geodetic benchmarks in each of the coastal parks. Elevation data is key to a better understanding of the effects sea level rise will have on marshes, and geodetic markers are a critical part of this data collection effort.

Salt marsh bird monitoring (All parks)

- A cooperative agreement was developed between URI (Dr. Peter Paton and Carol Trocki) and the NCBN to conduct a feasibility study for monitoring marsh birds in each of NCBN park. The Network has adopted the Protocol and Standard Operating Procedures for Monitoring Tidal Marsh Birds in the Bird Conservation Region 30 developed by Greg Shriver, University of Delaware, Stephanie Schmidt, Manomet Center, and Ozvaldo Dahmen, University of Delaware. The URI PIs will investigate all possible ways for implementation of this protocol in NCBN parks, including the use of a citizen science program.

Note: The following monitoring protocols have been developed by the CCEM. Funding for this portion of the NCBN monitoring program is solely supported through the CCEM budget.

Kettle pond monitoring (CACO)

- The CACO Kettle Pond Water Quality Protocol is being revised and formatted to meet national program standards (Oakley et al.) and will be sent for external peer review in FY11.
- Water quality data were collected from 20 kettle ponds following the existing protocol. Chlorophyll a concentrations of surface water grab samples were monitored as a means of detecting seasonal and inter-annual changes in trophic status. CY 2009 and spring 2010

water samples (420) were processed for anions and nutrients in the Atlantic Research Center's analytical lab.

- A comprehensive review of kettle pond water quality monitoring data was completed, with a particular focus on pH and temperature in regard to detecting climate change related trends.
- Experiments were conducted to evaluate the relative effectiveness of the different methods to determine chlorophyll a concentrations that have been used throughout the past 15 years of chlorophyll monitoring in CACO kettle ponds. These experiments were critical since KPWQ protocol methods have been updated over the years as more sensitive detection methods have become available. These experiments allow for the normalization of the data to a singular method, so that we can proceed with a time-series data comparison.
- Water level/temperature loggers in the 10 primary kettle ponds were deployed in efforts to better track seasonal and annual trends in pond water level and temperature.

Hydrology and ground water quality monitoring (CACO)

- CCEM staff drafted the hydrology protocol according to Oakley et al. format and continued protocol review with Larry Martin (NPS Hydrologist). It was determined that a full re-write of the stream gage portion and an update of suggested site monitoring for pond stage and water level sections was needed.
- CCEM staff continued implementation of the ground water and pond stage portion of the hydrology monitoring protocol (McCobb and Weiskel, 2003), including the eight wetland observation wells that were added in FY07 at CACO. HOBO water level loggers were placed in the 10 primary kettle ponds to supplement monthly pond stage data. Water level data were provided for two municipal water supply projects (Eastham and Wellfleet).
- With assistance from an Americorps member, CCEM staff collected stream flow data from six stream gage sites; five of the six are recommended sites from the original protocol and one has been added for CACO specific studies. Three of the six sites are tidally influenced and the appropriate tidal sampling window was determined by deploying HOBO water level loggers at each tidally influenced site.
- CCEM staff initiated a GIS-based investigation of a decade's worth of water level and pond stage data.

Vernal pool and dune slack wetland vegetation monitoring (CACO)

- Two outside peer reviews of the kettle pond vegetation monitoring protocol were received and the protocol is being revised accordingly. The protocol is projected to be finalized in 2011
- Kettle pond vegetation was re-surveyed by a seasonal technician and student intern under the plant ecologist's supervision. Some minor revisions to the methodology and the spatial

scale of sampling were made. This information will be included in the Kettle Pond Vegetation Monitoring Protocol.

Amphibian monitoring (CACO)

- CCEM staff conducted the seventh year of long term amphibian monitoring. Egg masses of spotted salamanders and wood frogs were counted three times at each of 40 vernal ponds over a six week period in early spring. Data on within-pond habitat structure were also collected. Adjacent landscape habitat data from within a 1000 m buffer were extracted via GIS. Thirty ponds park-wide were sampled for calling anurans one night/week on 16 occasions, from mid-spring until mid-summer.
- Water samples were collected from all 64 amphibian monitoring sites and analyzed at the Atlantic Research Center's analytical lab for pH, alkalinity, conductivity, color, chloride, and sulfate.
- Hydrology data (pond stage) were collected monthly at all 40 vernal ponds being monitored.
- All 2010 data were entered into a database and quality checked. Preliminary tabulation and trend analysis of all long term data on egg mass counts and estimated site occupancy rates for anurans through 2010 were conducted.

Aquatic turtle monitoring (CACO)

- Spotted turtle monitoring continued through incidental encounters. Two individuals were recorded, including one from a site previously not known to support this species.

Coastal forest vegetation monitoring (CACO)

- In 2010, this protocol finally received a second outside review and revisions will be made by the plant ecologist during 2011. The protocol is in Oakley et al. format and is projected to be finalized in 2011
- There was continued coordination and technical assistance with NETN forest monitoring activities.

Land bird monitoring (CACO)

- CCEM staff received a partial report from Mark Faherty, U Mass, Amherst, on landbird point count surveys. The staff continued to work with Faherty and Dr. Curt Griffin, U Mass, Amherst, to facilitate completion of report and protocol.

Meteorologic, atmospheric deposition, and air quality monitoring (CACO)

- CCEM staff continued to implement the meteorologic and atmospheric monitoring program in cooperation with program partners and cooperators. Program partners and cooperators include: the USGS, the 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 of CACO. For all partnerships, CCEM staff served as site operators and/or site supervisor for participation, communication, and collaboration. Data were collected locally by CCEM staff and sent to program partners for uploading into national or state databases associated with each programs. Wet deposition data for sulfate, nitrate, ammonium, mercury are in the CACO resource condition summary table along with the haze index (from IMPROVE) and the number of 8 hour exceedances for ozone. Weekly precipitation data were collected by CCEM staff at the Belfort Rain Gage located adjacent to Duck Pond, Wellfleet, MA. A summary report of air quality monitoring and precipitation trends for CCEM is being prepared by CACO's physical scientist.

Cover-type change monitoring (CACO)

- CACO has been cooperating with U Mass PhD student Brad Timm to test methods for creating a repeatable land cover change map. Additional field observations and training sites were collected in 2010 to extend map coverage to upland shrub and forest communities in Wellfleet. Most habitat types represented in CACO's 2000 photogrammetric vegetation map will now be represented in the analysis, with the goal of producing a Seashore-wide remotely-sensed land cover map in 2011-2012. A report on methods and accuracy analysis is due in 2011.

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 FY10. 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 (CACO, GATE, ASIS, COLO)

- ENE monitoring was conducted at GATE under a cooperative agreement with Dr. Brad Peterson, Seagrass Ecology Lab, SUNY Stony Brook, and at ASIS and COLO under cooperative agreement with Dr. Ken Moore, Virginia Institute of Marine Science (VIMS). Spatial and continuous water quality monitoring was conducted in three CACO systems, Nauset Marsh, Pleasant Bay, and the kettle hole strata, by CACO CCEM staff. CACO staff,

with the assistance of the network Data Manager, entered a backlog of CACO water quality data for 2007-2010 into the NCBN ENE database. Quality checks of the data have been implemented. Analysis of spatial data for trends has been initiated. CACO staff processed and analyzed all of the NCBN chlorophyll a samples (350 samples total) at the Atlantic Research Center Laboratory.

- Suggestions for changes to the water quality instrumentation, calibration, and maintenance portions of the ENE protocol (including data management and field data sheet changes) were compiled by CCEM staff for dissemination to NCBN staff and cooperators at SUNY Stony Brook, VIMS, and USGS. A meeting will be held (Dec 2010) with the protocol authors and CACO and NCBN staff to discuss changes to the protocol based on these suggestions.
- Additional water samples were collected for CACO and will be analyzed in order to assess nutrients at each sampling site for each of the four-week index periods in Pleasant Bay and Nauset Marsh and the surrounding kettle ponds. Samples will be analyzed for total nitrogen as nitrate, total phosphorus as orthophosphate, dissolved inorganic nitrate, dissolved inorganic ammonium, and dissolved inorganic phosphate as orthophosphate.
- The NCBN Data Manager updated the NCBN ENE water quality database and user guide to facilitate data uploads to STORET. Metadata was also created along with automated data export queries for the network's NPSTORET database version. The network Data Manager also worked closely with USGS cooperator, Hilary Neckles to develop quality assurance / quality control procedures to evaluate the network's Chlorophyll a and other sampling data.

Seagrass monitoring (CACO, ASIS, FIIS)

- VIMS personnel traveled to ASIS and successfully performed the winter (January 19-20), spring (April 19), and summer (June 24) SeagrassNet seagrass surveys. Biomass samples were collected and processed. TidbiT (Onset, Inc.) temperature loggers were retrieved and new ones deployed, and sediment and voucher specimens were collected. A continuous water quality monitoring station was also deployed and maintained by ASIS staff during this survey period. All data from June, 2009 through April, 2010 have been added to the SeagrassNet database.
- In May, the tier 3 high resolution monitoring transects in FIIS were visited by Dr. Peterson (SUNY Stony Brook) to locate and replace buoys marking the permanent transect markers. In June, these transects were sampled and the 2010 data were immediately uploaded to the NCBN seagrass monitoring database.
- Monitoring continued at CACO in Pleasant Bay and Duck Harbor for the eighth consecutive year following the NCBN protocol. CCEM's aquatic ecology technician was trained in

implementing and carrying out all aspects of the eelgrass monitoring, and sampling was accomplished under the guidance of Drs. Hilary Neckles (USGS) and Fred Short (SeagrassNet founder). All 2010 data were entered into the NCBN seagrass monitoring database.

- Bay-wide eelgrass sampling occurred in CACO's Pleasant Bay, a monitoring program still in development by NCBN cooperators. The sampling was conducted again this year with guidance from USGS scientist Hilary Neckles following methods implemented by Neckles and Kopp (unpublished) in 2005, 2007, and 2008. The CCEM Aquatic Ecology Technician was trained on implementing the program.

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 - Nayegandhi, Amar, Vivekanandan, Saisudha, Brock, J.C., Stevens, Sara, Wright, C.W., Bonisteel-Cormier, J.M., Nagle, D.B., Yates, Xan, and Klipp, E.S., 2010, EAARL Coastal Topography-Gateway National Recreation Area, New Jersey and New York, 2009: U.S. Geological Survey Data Series 525, 1 DVD.
 - Patenaude, E. L., and P. S. Pooler. 2010. Salt marsh vegetation and nekton community monitoring at Assateague Island National Seashore: 2008 summary report. Natural Resource Data Series. NPS/NCBN/NRTR—2010/065. National Park Service. Fort Collins, Colorado.
 - Patenaude, E. L., and P. S. Pooler. 2010. Salt marsh vegetation monitoring at Colonial National Historical Park: 2008 summary report. Natural Resource Data Series. NPS/NCBN/NRDS—2010/066. National Park Service. Fort Collins, Colorado.
 - Patenaude, E. L., and P. S. Pooler. 2010. Salt marsh vegetation and nekton community monitoring at Sagamore Hill National Historical Site: 2009 summary report. Natural Resource Data Series. NPS/NCBN/NRDS—2010/067. National Park Service. Fort Collins, Colorado.
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NCBN Data Management, Information Transfer, and Support to Park Management and the Public

- A network Sharepoint website site was created to enhance cooperation among NCBN and park staff. The site is now used by multiple staff members to track salt marsh data management, analysis, and reporting tasks, as well as protocol development.
- NCBN internet and intranet websites continue to be updated and revised. A new “Monitoring Products” page was created, and individual monitoring-products tables were added to applicable vital signs pages in the NCBN internet website (<http://science.nature.nps.gov/im/units/ncbn/>).
- Information on all NCBN monitoring protocols, including draft protocols and protocol summaries, were updated and uploaded to the NPS Protocol database.
- Data management staff represented the NCBN at Natural Resource Condition Assessment meetings at COLO and SAHI and collaborating with University of Maryland and URI cooperators to provide all available park inventory and monitoring datasets. The NPSpecies database was also used to generate species information for URI cooperators working on the CACO Natural Resource Condition Assessment report.
- The NCBN data manager completed a one-week detail at CACO, working closely with park natural resource and GIS staff to dramatically improve the usability of the NCBN salt marsh ENE water quality databases at CACO. This work led to enhanced data entry functionality, improved QAQC procedures, and better synchronization of network and CACO database versions. Network data management staff also continued to participate in park, NPS, and other DOI-agency meetings, presenting information on the NCBN’s latest inventory and monitoring projects, as well as how the collected data are organized, stored, and made publicly available

through national NPS data repositories.

- Data management staff worked with natural resource staff at each park in order to update parks' existing references in the NRInfo portal, conferring with all parks regarding outstanding needs for digitizing, and entering new references as part of the National I&M Program's needs assessment project. The NCBN data manager trained network and park staff in the use of the new NRInfo Reference services and served as an initial member of the national I&M Program's NRInfo Reference Application Steering Committee.

II. Public Interest Highlights

National Park Service Inventory and Monitoring Data Used to Determine the Effects of Brown Tide on Seagrass Beds within Fire Island National Seashore and Great South Bay, Long Island, NY.

Recently, the NCBN multi-tiered monitoring approach for bay-wide seagrass monitoring was used to reveal the mechanism driving seagrass spatial changes in Great South Bay, NY. In 2008, the most intense bloom of *A. anophagefferens*, or brown tide, ever recorded in Great South Bay occurred, persisting for more than seven months. Because a previous study found a 40% loss of seagrass coverage within the bay following a brown tide of similar density, a comparable impact was expected. Using data from the NCBN tier-2, rapid seagrass monitoring conducted in 2007 and 2009, the negative effects of brown tide on *Zostera marina* were examined. Unlike the previous brown tide event, significant losses were not sustained; in fact, significant gains in coverage and biomass were observed throughout the bay. Two potential hypotheses were suggested for this increase in coverage. Under stressful conditions, plants commonly increase their seed production as a means of dispersal from a poor environment. If seagrass species responded similarly, then the increase in coverage could be a result of this increased seed production. The alternative is that the light availability was enhanced despite the brown tide event. This may be possible as algal biomass is usually only responsible for approximately 10% of light attenuation. While the NCBN tier-2 sampling revealed significant increases in both species of seagrass, *Z. marina* and *Ruppia maritima*, across the bay, the seagrass vital signs monitoring (tier-3) provided insight into the mechanism of this expansion. At the high resolution site, there was a similar expansion of *R. maritima* coverage at the shallow transect. However, reductions in *Z. marina* coverage occurred at both the middle and lower transects, though *Z. marina* had modest coverage at these transects initially. The important

aspect of the tier-3 monitoring was that there was a significant expansion of the deep edge of the bed, which argues that light availability increased between 2007 and 2009. Subsequent analysis using the NOAA Wave Exposure Model (WeMO) revealed that the average wind speeds were reduced over the growing season in 2008. The reduction in wave energy is likely to have reduced sediment re-suspension in this shallow coastal lagoon, thus again suggesting increased light penetration to the sediment surface.

The NCBN multi-tiered monitoring in Great South Bay uncovered both an expansion of seagrass coverage when one was not expected and gave insight into the mechanism of this expansion. The synergy of the two monitoring tiers directed park managers and local management agencies to look for other causes that might have affected light levels within the bay and offered a potential explanation for the changes in spatial coverage.

GeoCorps America Program Provides a Unique Opportunity for Students to Work on Vital Signs Monitoring

As part of the GeoCorps America Program, Geoscientists-in-the-Parks program, the network hired two student interns and stationed them at Gateway National Recreation Area for the summer of 2010. The students worked under the guidance of Dr. Norb Psuty, Rutgers University, who has been collaborating with the NCBN on developing coastal geomorphologic monitoring protocols. Each of the interns was involved with the ongoing development of the 1D, 2D and 3D NCBN geomorphological monitoring protocols. They also learned data collection methods and used them throughout the park, as well as at one USFWS refuge. Once trained in field data-collection methodology using the monitoring protocols, each was responsible for doing 2D and 3D topographic surveys for specific shoreline portions at GATE throughout the season. Daniel Soda, GeoCorps intern commented on his experience and the program following work for the NCBN, *“This summer internship at Sandy Hook as a GeoCorps member will absolutely help me prepare for a career as a geologist, GIS specialist or anything in a related environmental field. I have already gained a significant amount of real world GIS application experience as well as surveying and environmental field method experience, which will be used in any entry-level geologist job.”*

The Northeast Coastal and Barrier Network Conducts Salt Marsh Monitoring through the Student Temporary Employment Program

The Northeast Coastal and Barrier Network continued to use the NPS Student Temporary Employment Program (STEP) to provide opportunity for university-level students to experience the advantages and challenges of working for the National Park Service. This is a great opportunity for students to earn money and continue their education, and to train with scientists from the NPS Inventory and Monitoring Program as well as live in a park. Stationed at the University of Rhode Island in Kingston, RI, the Northeast Coastal and Barrier Network staff have a unique opportunity to interact and work with students from the Natural Resources Science Department, Biological Sciences Department, and the School of Oceanography at the university. This year, four STEP students were hired and stationed at Assateague Island National Seashore to assist the network in conducting salt marsh vegetation and fish monitoring.

The Northeast Coastal and Barrier Network, Coastal Topography Monitoring Program Provides Crucial Data to Evaluate Effects of the 2009 “Nor’Ida” Storm.

In the fall of 2009, Tropical Storm Ida battered Northeast Coastal and Barrier Network parks and caused significant beach and dune erosion. As a result of climate change, increases in the number and intensity of tropical storms such as Ida are predicted to continue to create severe beach erosion, overwash deposition, and island breaching within coastal parks. As part of the biennial LiDAR data collection by the Northeast Coastal and Barrier Network in conjunction with the USGS St. Petersburg Coastal and Marine Science Center, the network has been able to provide a critical long-term baseline dataset that is being used by park managers and scientists to put the effects of storms such as Ida into context, providing a long-term baseline for comparison of tropical storm impacts to beach-dune systems within network parks.

Following Tropical Storm Ida, the Northeast Coastal and Barrier Network collaborated with the USGS, and park, regional, and national I&M program scientists to combine resources and efforts to collect post-storm LiDAR data for Assateague Island NS, Fire Island NS, Gateway NRA, and Cape Hatteras NS. By comparing the NCBN baseline datasets with the post-storm dataset, immediate post-storm beach conditions can be compared with earlier and later baseline conditions to better understand the nature, magnitude, and spatial variability of coastal changes. These data will continue to be used to further refine predictive models of coastal impacts from severe storms in light

of climate change.

Northeast Region I&M Networks begin Collaboration with NOAA National Estuarine Research Reserve Program

Staff from the Northeast Coastal and Barrier Network and the Northeast Temperate Network traveled to Silver Springs, Maryland to participate in a joint NPS/NOAA/USFWS/USGS meeting held in the offices of NOAA's Estuarine Reserve Division on February 4-5, 2010. The purpose of this meeting was to talk about ways to standardize salt marsh monitoring along the Atlantic coast by participating agencies. It is in the interest of all the agencies that a unified monitoring effort be developed in support of the National Network of Sentinel Sites being developed by NOAA and the NPS I&M Monitoring program. Areas of discussion included salt marsh elevation monitoring, salt marsh vegetation monitoring, fixed-station water quality monitoring, tide stations/water level monitoring, salt marsh soil monitoring, benchmark survey methodology, and database management. The meeting was a huge success and definitely a great jump start to future partnering between NPS I&M parks and NOAA National Estuarine Reserves.

Northeast Coastal and Barrier Network Staff meet with Northeast Region USFWS Staff to begin discussion on Inventory and Monitoring Collaboration

The staff of the Northeast Coastal and Barrier Network traveled to the Back Bay National Wildlife Refuge in NH on March 24, 2010 to meet with the USFWS Regional Refuge Biologist, Jan Taylor, and coastal refuge biologists and managers, to present the NPS Inventory and Monitoring program. The NCBN presented the network's coastal monitoring and data management program and discussed potential collaboration between the NPS I&M program and the newly developing USFWS I&M program in the Northeast. Action items include working towards sharing data management systems for our common monitoring programs, as well as sharing staff and positions to accomplish common program goals. Both NPS and USFWS staff agreed to continue discussions and meet on a regular basis. As new USFWS I&M staff are hired, NPS I&M staff will be meeting with them to share "lessons learned" and continue collaboration efforts.

Coastal Park Climate Change Monitoring workgroup meets at the University of Rhode Island to model, identify, and prioritize vital signs to enhance existing monitoring in light of rapid climate change

The Northeast Coastal and Barrier, Northeast Temperate, and National Capital Region networks

received I&M funding this year to begin planning the enhancement of their existing monitoring programs to assure monitoring appropriately addresses the impacts and effects of climate change. With the assistance of the non-profit agency, Foundations of Success, a small group of participants met for two workshops at the University of Rhode Island in March and June 2010 to develop conceptual models addressing climate change monitoring in the North Atlantic coastal parks. As a result, the networks modeled potential climate change impacts on coastal park ecosystems, identified and prioritized key vital signs, and developed a strategic plan, *Strategy for enhanced monitoring of natural resource condition in North Atlantic coastal parks to address the effects of rapid climate change*, which will be published in the NPS Technical Report Series and implemented starting in FY11.

Herring Cove Bathhouse construction informed by elevation data

A variety of coastal monitoring data was used to inform a management decision about replacement of CACO's beach bathhouse facility at Herring Cove in Provincetown. The existing building is sited within the 100-year flood zone (as designated on FEMA FIRM maps). However, FEMA flood information is limited by the poor resolution of previous elevation data. The Northeast Coastal and Barrier Network has acquired extensive LiDAR elevation coverage at much higher precision than was available to FEMA. LiDAR elevations show many areas within base flood elevations (critical areas between 10 and 20 feet MSL) that were not previously identified. As a result, the building location was moved inland and the parking configuration was modified. Also as a result of LiDAR data, additional emphasis will be placed on restoring coastal dunes and other features essential to absorbing storm surge wave energy and preventing storm run-up as sea level rises. LiDAR collected by the network and shoreline profiles collected by the park were essential data that had a direct impact on the management decisions about the Herring Cove Beach facility.

Kettle pond surface water temperatures show 2-7 °C rise from 1980's to present

An examination of surface water temperatures measured since 1980 as a part of CCEM showed a 2-7 °C increase in several of CACO's kettle ponds. This rate of temperature increase in the ponds may lead to degradation of pond water resources in future decades.

Cape Cod transportation planning utilizes CACO coastal monitoring data

Cape Cod National Seashore's coastal monitoring informed a regional transportation and climate change workshop held in Woods Hole, MA in July 2010 as part of a planning process for Massachusetts' transportation and preparedness infrastructure. Specific Cape Cod CCEM

mapping data about low-lying coastal resource areas were incorporated into the state's data for long-term planning to manage areas subject to storm flooding and inundation under various sea level rise scenarios. Maps resulting from this "expert elucidation" will be used at state-wide community planning workshops and will guide regional and state decisions about transportation to and through Cape Cod.

Nitrogen and Phosphorus inputs to kettle ponds require management

Nutrient-enrichment bioassays with resident pond phytoplankton were conducted in conjunction with the CCEM Kettle Pond Water Quality Monitoring Program. The results consistently demonstrated stimulation of primary productivity by nitrogen relative to phosphorus. Strong responses to nitrogen are not typically observed for freshwater systems, but CACO's kettle ponds are clearly different in this way. The information has far reaching implications for the management of nitrogen inputs to these systems.

Ozone monitoring and climate change

Many NPS units exceed the existing National Ambient Air Quality Standard (NAAQS) for ozone, prompting concerns for human health and vegetation. Affected parks typically issue human health advisories to visitors and employees on high ozone days due to potential adverse affects to lung tissue and related breathing problems such as asthma. Ozone is also an important ecosystem stressor and can reduce the ability of sensitive plant species to adapt to or withstand other environmental stresses that may be related to climate change such as temperature shifts and new or increased pest infestations. The Environmental Protection Agency (EPA) issued new, more stringent primary and secondary NAAQS for ozone in March 2008. The primary standard was lowered from 84ppb to 75ppb. From 2004-2006 and 2005-2007, monitoring results from MA DEP for CACO indicate that the park violated the new primary ozone standard for both of the 3-year average time periods. Only four other parks in the country had averages greater than CACO for those same time periods. There is a large body of scientific evidence showing adverse plant response to cumulative ozone exposures over a growing season. The cumulative exposure to high ozone concentrations coupled with temperature shifts and other ecological stressors brought about by climate change will need to be monitored closely in order to document and understand the degree and extent of damage to sensitive plant species at CACO and other NPS units.

High water table key to spadefoot toad emergence

The emergence and breeding of spadefoot toads (a MA threatened species) is generally thought

to be in response to heavy rainfall. However, monitoring of spadefoot toad activity, rainfall, groundwater table, surface water, and temperature in the Province Lands of CACO has shown that these activities are more associated with high groundwater table, which is reflected in the water level of dune slack wetlands, than with heavy rainfall. In early spring 2010, with water levels at a record high, the largest emergence of spadefoots on record occurred on a clear, warm night, six days after the last rainfall occurred.

Rainy spring and record egg mass counts; is there a connection?

The positive correlation between amphibian reproductive effort and breeding season rainfall is well established. In 2010, CACO vernal ponds were at record high water levels and counts of spotted salamander egg masses were also the highest on record. However, for 40 ponds monitored since 2004, the variation in late winter-early spring rainfall was not a significant factor in explaining the annual variation in spotted salamander egg mass counts and the significantly positive trend in egg masses may reflect a growing population.

III. Staffing

NCBN Board of Directors

Trish Kicklighter, ASIS
George Price, CACO
P. Daniel Smith, COLO
Chris Soller, FIIS
Barry Sullivan, GATE
Lucy Lawliss, GEWA/THST
Tom Ross, SAHI
Sara Stevens, NCBN Program Manager
Mary Foley, Chief Scientist Northeast Region
John Karish, I&M Program Manager Northeast Region

Northeast Coastal and Barrier Network Staff

Sara Stevens-NCBN Program Manager,
Dennis Skidds-NCBN Data Manager
Penelope Pooler-NCBN Quantitative Ecologist
Erika Patenaude-NCBN Biologist (Salt Marsh)
Vacant, NCBN Biologist (Science Communication)
Vacant, NCBN Geomorphologist
Vacant, NCBN Biologist (shared position with NETN, NCRN) (Salt Marsh Elevation)
Vacant, NCBN Biological Science Technician (Marsh Birds)
Robin Baranowski, NCBN Biological Science Technician (STEP student)

Trisha Towanda, NCBN Biological Science Technician (STEP student)
4 Seasonal Biological Technicians, Salt Marsh Monitoring

Cape Cod National Seashore CCEM Staff

Megan Tyrrell, Research and Monitoring Coordinator
Robert Cook, Wildlife Ecologist
Stephen Smith, Plant Ecologist
Sophia Fox, Aquatic Ecologist (Jan-June, Sept-Oct)
Kelly C. Medeiros, Hydrology technician
Lisa Nicholson, Budget technician
Krista Lee, Physical Scientist
Judith Oset, Physical Science technician
Holly Bayley, Aquatic Ecology technician
Seasonal technicians for: Estuarine Nutrient Enrichment, Vegetation monitoring, Amphibian monitoring (2)
Student Conservation Association interns for: Vegetation monitoring, Amphibian monitoring (2), aquatic monitoring (3)

NCBN Technical Steering Committees

Note: The original NCBN Technical Steering Committee has been disbanded and new “protocol” specific technical steering committees will be developed for: Shoreline monitoring, salt marsh monitoring, and water quality monitoring in FY11.

Key NCBN Contractors and Cooperators

- Rutgers University, Norbert Psuty, Institute of Marine and Coastal Sciences
- USGS, Don Cahoon, Patuxent Wildlife Research Center, Laurel, MD.
- USGS, Hilary Neckles, Patuxent Wildlife Research Center, Augusta, ME
- USGS, John Brock and Amar Nayagandhi, Center for Coastal Studies
- NASA, Wayne Wright, Wallops Flight Facility, Wallops Island, VA
- University of Rhode Island, Natural Resources Science Department (NRS), Peter Paton and Research Associate Carol Trocki
- University of Rhode Island, URI Environmental Data Center, Dr. Peter August (NRS faculty), Research Associates Charles LaBash, Roland Duhaim, Linda Fabre, and Greg Bonyng.
- State University of New York, Stony Brook, Dr. Brad Peterson, School of Marine and Atmospheric Science
- Virginia Institute of Marine Science-Dr. Kenneth Moore

Key CCEM Contractors and Cooperators

- Dr. Graham Giese, Provincetown Center for Coastal Studies (geomorphology)
- Dr. Larry Martin, NPS Hydrologist (hydrology monitoring)
- Mark Faherty, University of Massachusetts, Amherst (landbird point-count protocol)
- Dr. Curtice Griffin, University of Massachusetts, Amherst (landbird point-count protocol)

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- Dr. Kevin McGarigal, University of Massachusetts, Amherst (spadefoot toad ecology study)
 - Dr. Allan O'Connell, USGS, Patuxent Wildlife Research Center (meso-mammal protocol)
 - Brad Timm, University of Massachusetts, Amherst (spadefoot toad ecology study)
 - Dr. Todd Tupper, Northern Virginia Community College (Fowler's toad study, analysis of anuran calling surveys, chytrid fungus surveys)
 - Dr. Peter Paton, University of Rhode Island (analysis of anuran calling surveys)
 - Megan McLean, Antioch College of New England (spadefoot toad activity study)
 - Dr. Rachel Thiet, Antioch College of New England (spadefoot toad activity study)
 - Dr. Julie Ellis, Tufts University Cummings School of Veterinary Medicine (common eider die-off research)
 - Scott Buchanan, Montclair State University (hog-nosed snake ecology)
 - Lori Erb, Massachusetts Natural Heritage Program (box turtle surveys and disease screening)
 - Brian Bjorklund, USDA, APHIS (meso-mammal surveys and rabies screening)

IV. Reports, Publications, and Presentations (FY10)

Presentations and Posters

- Brisbin, S. J. and B. J. Peterson. Genetic diversity and gene flow in *Zostera marina* populations in Great South Bay, New York. 39th Benthic Ecology Meetings Wilmington, NC.
- Brunelle, M. E., B. J. Peterson and B. T. Furman. Morphological differences in deep edge seagrass in Great South Bay, New York. 2010 New York Marine Sciences Consortium meeting.
- Neckles, H. A., B. S. Kopp, B.J. Peterson, P.S. Pooler. 2009. Integrating scales of seagrass monitoring. Coastal and Estuarine Research Federation Biennial Conference, Portland, Oregon USA, November 2009
- Patenaude, E., 2010. Northeast Coastal & Barrier Network Salt Marsh Monitoring Program Overview. NCBN / FWS Refuge Biologists Meeting, Great Bay NWR, Newington, MA.
- Peterson, B. J., S. J. Brisbin and B. T. Furman. Effect of a prolonged brown tide (*Aureococcus anophagefferens*) on interannual *Zostera marina* densities within a New York estuary. 39th Benthic Ecology Meetings Wilmington, NC.
- Peterson, B. J., S. J. Brisbin and B. T. Furman. Effect of a prolonged brown tide (*Aureococcus anophagefferens*) on interannual *Zostera marina* densities within a New York estuary. 7th Biennial Fire Island National Seashore Planning, Science and Research Conference Patchogue, NY
- Peterson, B. J. and A. M. Stubler. Cumulative impacts of multiple stressors on *Zostera marina* populations in New York estuaries. 39th Benthic Ecology Meetings Wilmington, NC.
- Pooler, P.S., M.C. Tyrrell, K.A. Lellis-Dibble, H.K. Bayley, S.M. Stevens. 2010. Modeling Trends in Nekton and Associated Changes in Northeast Coastal Salt Marshes. 3rd United States Geological Survey Modeling Conference, Broomfield, Colorado, June 2010.
- Psuty, N.P., and T.M. Silveira, 2010. Monitoring Coastal Change in the Northeast Coastal and Barrier Network: A National Park Service Science-Based Program. Association of American Geographers Annual Meeting, Washington, D.C., April 14-18.
- Psuty, N.P., and T.M. Silveira, 2010. A National Park Service Program to Monitor Coastal

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Science at the Seashore (public programs): Kelly Medeiros on Salt Marsh Elevation Monitoring, Mark Adams on Using GPS for Natural Resource Management, Robert Cook on Monitoring Vernal Pool Amphibians

V. Connect the Dots – Vital Signs Supporting Table for each Park

The “Connect the Dots” effort is a strategic, long-term framework (over a period of years to decades) for coordinating the efforts of the I&M Networks, Park Natural Resource Condition Assessments, park planning (e.g., Foundation Statement, General Management Plan, Resource Stewardship Strategy), park-funded monitoring and research relevant to assessing natural resource condition, and other research and monitoring efforts. As part of this effort, a Natural Resource Summary Table will eventually be developed for each park as part of the park's Resource Stewardship Strategy document. The Natural Resource Summary Table framework demonstrates the connection of science to management through the planning process. See [Connect the Dots Memo](#) and the [Connect the Dots Intranet Website](#) for more information and example documents.

Each I&M network is required to develop a Vital Signs Supporting Table for each park, which will feed into the larger Natural Resource Summary Table. The draft spreadsheets listed for each park below summarize the key measures of resource condition that the NCBN will routinely provide data for as part of core duty of measuring the condition of selected park resources. If a park Superintendent or Chief of Natural Resources requests assistance from network staff to populate additional rows and columns of the Natural Resource Summary Table, network staff will contribute data and expertise to the extent that data and staff time are available.

Links to NCBN park specific tables:

http://www1.nrintra.nps.gov/im/units/ncbn/monitor/VS_Tables/NCBN_VitalSignTable_CACO.xls

http://www1.nrintra.nps.gov/im/units/ncbn/monitor/VS_Tables/NCBN_VitalSignTable_ASIS.xls

http://www1.nrintra.nps.gov/im/units/ncbn/monitor/VS_Tables/NCBN_VitalSignTable_COLO.xls

http://www1.nrintra.nps.gov/im/units/ncbn/monitor/VS_Tables/NCBN_VitalSignTable_FIIS.xls

http://www1.nrintra.nps.gov/im/units/ncbn/monitor/VS_Tables/NCBN_VitalSignTable_GATE.xls

http://www1.nrintra.nps.gov/im/units/ncbn/monitor/VS_Tables/NCBN_VitalSignTable_GEWA.xls
http://www1.nrintra.nps.gov/im/units/ncbn/monitor/VS_Tables/NCBN_VitalSignTable_SAH1.xls
http://www1.nrintra.nps.gov/im/units/ncbn/monitor/VS_Tables/NCBN_VitalSignTable_THST.xls

VI. Budget - FY2010 Annual Report Narrative

This year the NCBN received a total of \$797,800 in Vital Signs Monitoring funding to continue implementing monitoring in the coastal parks, \$87,100 from the NPS Water Resources Division to assist with the network's estuarine water quality monitoring program, and \$7,900 from the Vegetation Mapping Program to complete mapping and report and data review. The network's original water quality funding allocation was assessed 1.6% by WRD in FY08 and that assessment has never been restored. In FY10 an additional \$200,000 was transferred to NCBN for the development of a strategy for enhancing existing monitoring in light of rapid climate change for North Atlantic coastal parks. This funding was shared among three networks; NCBN, Northeast Temperate Network (NETN), and the National Capital Region Network (NCRN). Including this additional climate change monitoring funding, the Network received a total of \$1,092,800. Approximately 49% of this funding was used to develop partnerships (via cooperative agreement/contracts) among the network, USGS, and a number of CESU universities for the development and implementation of monitoring protocols and data management support. Permanent and seasonal NPS personnel expenses constituted approximately 42% of the budget in FY09. Travel (3 %) and general operations, equipment purchases, and administrative/office support (5 %) rounded out NCBN expenditures for FY10.

In addition, the Cape Cod National Seashore CCEM program received their annual base of \$702,400. This funding was transferred directly to the park's base account for regular program expenses and operations. In FY2010, 80% of these funds were used to support permanent and seasonal staff of the CCEM in addition to stipends and housing for student conservation association interns. Expenses that fell into the operations and equipment category composed approximately 10.5% of the budget. Approximately 1.8% of the budget was used for a contract with the University of Illinois for support of air quality monitoring as well as minor expenditures to reimburse peer reviewers of the forest and kettle pond vegetation protocols. A cooperative agreement worth approximately \$7600 with the University of Massachusetts at Amherst supported an advanced doctoral student for several months of field work and reporting of a landcover change analysis. Finally, 1.1% of the budget went toward travel to scientific meetings, workshops, and training. The data manager position was vacant for FY2010 and the salary lapse for this position was absorbed by the park in accordance with CACO policy.

NCBN Budget Summary -FY10 Admin Report

Category: 1_Income

<i>Description</i>	<i>\$</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
Enhanced Climate Change Monitoring	\$200,000.00	I&M - VS Monitoring	\$\$	
Water Resources Monitoring	\$87,100.00	WRD - WQ Monitoring		
Vegetation Mapping Program	\$7,900.00	Veg. Mapping Program		
Vital Signs Monitoring	\$797,800.00	I&M - VS Monitoring	\$\$	
Subtotal	\$1,092,800.00			

Category: 2_Personnel

<i>Description</i>	<i>\$</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
N Atlantic Parks Climate Change Monitoring Personnel	\$28,596.00	I&M - VS Monitoring	\$\$	NPS
NCBN Staff	\$430,427.00	I&M - VS Monitoring	\$\$	NPS
Subtotal	\$459,023.00			

Category: 3_Coop. Agreements

<i>Description</i>	<i>\$</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
N Atlantic Parks Climate Change Monitoring U Maine Migratory Bird Monitoring	\$10,000.00	I&M - VS Monitoring	\$\$	University-CESU
N Atlantic Parks Climate Change Monitoring SET Monitoring- ACAD, BOHA, COLO	\$47,304.00	I&M - VS Monitoring	\$\$	USGS
N Atlantic Parks Climate Change Monitoring Marsh Birds + Elevation Work	\$55,000.00	I&M - VS Monitoring	\$\$	University-CESU
N Atlantic Parks Climate Change Monitoring-USGS Reg LiDAR Data Collection	\$10,000.00	I&M - VS Monitoring	\$\$	USGS
VIMS-ENE Monitoring COLO, ASIS	\$4,244.00	I&M - VS Monitoring	\$\$	University-CESU
Stony Brook University-ENE Monitoring GATE, FIIS	\$35,984.00	WRD - WQ Monitoring		University-CESU
VIMS ENE Monitoring COLO, ASIS	\$49,000.00	WRD - WQ Monitoring		University-CESU
LIDAR Data Collection FIIS,GATE, ASIS, CACO	\$92,326.00	I&M - VS Monitoring	\$\$	USGS
GeoCorps America Interns 2010-2011 ASIS, CACO, GATE	\$15,274.00	I&M - VS Monitoring	\$\$	Other non-Federal
Vegetation Map Product Review-THST/CACO	\$7,900.00	Veg. Mapping Program		Other non-Federal
URI-Marsh Bird Monitoring/Data Mgt Support	\$113,000.00	I&M - VS Monitoring	\$\$	University-CESU
Rutgers University-Shoreline Change Monitoring	\$55,143.00	I&M - VS Monitoring	\$\$	University-CESU
N Atlantic Parks Climate Change Monitoring Planning	\$40,000.00	I&M - VS Monitoring	\$\$	Other non-Federal
Subtotal	\$535,175.00			

Category: 4_Contracts

Description	\$	\$\$ Source	Where \$ Went	Comments
Moth Inventory SAHI	\$2,400.00	I&M - VS Monitoring \$\$	Other non-Federal	
N Atlantic Parks Climate Change Monitoring	\$660.00	I&M - VS Monitoring \$\$	NPS	Bee Study ACAD
Subtotal	\$3,060.00			

Category: 5_Operations/Equipm

Description	\$	\$\$ Source	Where \$ Went	Comments
GeoCorps America Intern Housing-GATE	\$2,000.00	I&M - VS Monitoring \$\$	NPS	
Monitoring Crew Vehicle Repair	\$1,300.00	WRD - WQ Monitoring	Other non-Federal	
N Atlantic Coastal Parks Climate Change Monitoring Equipment	\$2,640.00	I&M - VS Monitoring \$\$	NPS	
NCBN Equipment and Operations	\$49,328.00	I&M - VS Monitoring \$\$	Other non-Federal	
Salt Marsh Crew Housing-ASIS	\$2,717.00	I&M - VS Monitoring \$\$	NPS	
Subtotal	\$57,985.00			

Category: 6_Travel

Description	\$	\$\$ Source	Where \$ Went	Comments
NCBN & Park Staff Travel	\$29,588.00	I&M - VS Monitoring \$\$	NPS	Included SM Monitoring Crew
N Atlantic Coastal Parks Climate Change Monitoring-Travel	\$5,139.00	I&M - VS Monitoring \$\$	NPS	
Subtotal	\$34,727.00			

Category: 7_Other

Description	\$	\$\$ Source	Where \$ Went	Comments
Northeast Region Assessment	\$816.00	WRD - WQ Monitoring	NPS	
Northeast Region Assessment	\$2,014.00	I&M - VS Monitoring \$\$	NPS	
Subtotal	\$2,830.00			

Budget Analysis

Analysis of Expenses by Where \$ Went

<i>Funding Source</i>	<i>Total \$\$</i>	<i>NPS</i>	<i>USGS</i>	<i>Other Federal</i>	<i>Univ.-</i>	<i>Univ_Non-</i>	<i>Other non-</i>
I&M - VS Monitoring \$\$	\$997,800	\$503,781	\$149,630		\$237,387		\$107,002
Veg. Mapping Program	\$7,900						\$7,900
WRD - WQ Monitoring	\$87,100	\$816			\$84,984		\$1,300
Totals	\$1,092,800	\$504,597	\$149,630		\$322,371		\$116,202

Analysis of Expenses by Category

<i>Funding Source</i>	<i>Total \$\$</i>	<i>Personnel</i>	<i>Coop</i>	<i>Contracts</i>	<i>Operations/Equi</i>	<i>Travel</i>	<i>Other</i>
I&M - VS Monitoring \$\$	\$997,800	\$459,023	\$442,291	\$3,060	\$56,685	\$34,727	\$2,014
Veg. Mapping Program	\$7,900		\$7,900				
WRD - WQ Monitoring	\$87,100		\$84,984		\$1,300		\$816
Total	\$1,092,800	\$459,023	\$535,175	\$3,060	\$57,985	\$34,727	\$2,830

Expense Totals By Category

<i>Category</i>	<i>SubTotal</i>	<i>Percent</i>
2_Personnel	\$459,023	42.00%
3_Coop. Agreements	\$535,175	48.97%
4_Contracts	\$3,060	0.28%
5_Operations/Equipment	\$57,985	5.31%
6_Travel	\$34,727	3.18%
7_Other	\$2,830	0.26%
	\$1,092,800	

Cape Cod National Seashore CCEM Budget Summary-FY10 Admin Report

Category: 1_Income

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
	\$702,400.00	Prototype \$\$ - Park Base		
Subtotal	<i>\$702,400.00</i>			

Category: 2_Personnel

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
SCA rents, background checks	\$30,916.00	Prototype \$\$ - Park Base		
Personal Services	\$539,413.00	Prototype \$\$ - Park Base		
Subtotal	<i>\$570,329.00</i>			

Category: 3_Coop. Agreements

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
U Mass Amherst	\$7,599.00	Prototype \$\$ - Park Base		
Subtotal	<i>\$7,599.00</i>			

Category: 4_Contracts

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
NADP, peer reviews	\$12,576.00	Prototype \$\$ - Park Base		
Subtotal	<i>\$12,576.00</i>			

Category: 5_Operations/Equipment

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
	\$73,864.00	Prototype \$\$ - Park Base		
Subtotal	<i>\$73,864.00</i>			

Category: 6_Travel

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
	\$8,030.00	Prototype \$\$ - Park Base		

Subtotal \$8,030.00

Category: 7_Other

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
Assessed by Park-Lapsed I&M Salary	\$30,002.00		Prototype \$\$ - Park Base	
Subtotal	\$30,002.00			

Budget Analysis

Analysis of Expenses by Where \$ Went

Funding Source	Total \$\$	NPS	USGS	Other Federal	Univ.-CESU	Univ_Non-CESU	Other non-Federal
Prototype \$\$ - Park Base	\$702,400						
Totals	\$702,400						

Analysis of Expenses by Category

Funding Source	Total \$\$	Personnel:	Coop Agree.	Contracts	Operations/Equip.	Travel	Other
Prototype \$\$ - Park Base	\$702,400	\$570,329	\$7,599	\$12,576	\$73,864	\$8,030	\$30,002
Totals	\$702,400	\$570,329	\$7,599	\$12,576	\$73,864	\$8,030	\$30,002

Expense Totals By Category

Category	SubTotal	Percent
2_Personnel	\$570,329	81.20%
3_Coop. Agreements	\$7,599	1.08%
4_Contracts	\$12,576	1.79%
5_Operations/Equipment	\$73,864	10.52%
6_Travel	\$8,030	1.14%
7_Other	\$30,002	4.27%
	\$702,400	