
**ANNUAL ADMINISTRATIVE REPORT FOR INVENTORIES AND VITAL SIGNS
MONITORING
FY2011
NORTHEAST COASTAL AND BARRIER NETWORK (NCBN)**

Approval Signatures

George E. Price, Jr. Superintendent, Cape Cod National Seashore (BOD Representative) Date:

John Karish, NER I&M Program Manager Date:

Sara Stevens, NCBN Program Manager Date:

Executive Summary

Northeast Coastal and Barrier Network (NCBN) FY 2011 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 ecosystems and potential 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 impacts. 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. CCEM began developing 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 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 FY11 on inventory and monitoring projects being developed, implemented, and completed by the NCBN (including CACO CCEM) program. In FY11, the network received a total of \$1,123,200. The NCBN received a total of \$802,000 in Vital Signs Monitoring funding to continue implementing monitoring in the coastal parks, \$86,500 from the NPS Water Resources Division to assist with the network's estuarine water quality monitoring program, and \$13,200 in additional funds set aside in FY11 to assist networks with scanning and uploading reports and documents to the new IRMA system. This money was shared between NCBN and MIDN. In FY11, an additional \$200,000 was also transferred to NCBN for the implementation of the North Atlantic Coastal Parks strategy for enhanced monitoring in light of rapid climate change. This funding is shared among three Networks; NCBN, Northeast Temperate Network (NETN), and the National Capital Region Network (NCRN). Only coastal parks from these networks were included in the strategy. At the end of the fiscal year, the network received an additional \$21,500 from regional funds. In addition, Cape Cod National Seashore

received \$702,400 for the park's CCEM program.

Summary

In FY10, 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.

In FY11, the NCBN began implementing this new monitoring strategy. The following are the highest priorities from the plan that were funded and implemented in FY11:

1. NCBN Sediment Elevation Monitoring Program-Expansion of an 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. Climate and Weather Data Synthesis and Reporting-Expansion of the 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. Marsh Bird Monitoring-Expansion of 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 have initiated collaborative efforts among the three I&M Networks, Southeast Coast Network (SECN), USFWS, National Oceanic and Atmospheric Administration (NOAA),

and the United States Geological Survey (USGS).

In addition to implementing new monitoring projects, the NCBN continued to complete inventory projects and to format and publish park reports in the NPS Technical Report Series. All reports are available on 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>).

Vegetation maps for COLO, GEWA, SAHI, GATE, and FIIS were completed prior to FY11 and made available on the USGS Vegetation Characterization Program (VCP) website (<http://biology.usgs.gov/npsveg/products/parkname.html>). In FY11, the NCBN data manager delivered all CACO products to NC State University for uploading to the USGS VCP website (<http://biology.usgs.gov/npsveg/caco/>). Report and data product reviews for THST were completed, and the report is currently being formatted for publication in the NPS Natural Resource Technical Report series. The formatted report and final data products will be delivered to NCSU for uploading to the USGS VCN website in early FY12. NatureServe continued work on the final report and vegetation map products for ASIS. The project is currently in the data analysis phase, and final products are anticipated in FY12.

Vital Signs Monitoring continued in FY11 with cooperative agreements being developed between the NCBN and the University of Rhode Island (URI) for marsh bird monitoring implementation and protocol development, and between 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 GEWA, ASIS and FIIS. SeagrassNet monitoring occurred at ASIS during three sampling periods in 2011, and a fourth year of seagrass monitoring was completed at FIIS with the assistance of Dr. Brad Peterson from SUNY Stony Brook.

Three of the Network's monitoring protocols were distributed for external peer review; Salt Marsh Vegetation, Nekton, and Coastal Topography monitoring. All comments have been returned and the authors are currently working on revising them (See protocol development table for timelines). A prototype trend report was completed for ASIS this year for Ocean Shoreline monitoring. Ocean shoreline position monitoring continued during both fall 2010 and spring 2011 at FIIS, GATE, ASIS, GEWA, and CACO, following the network's published protocol. The protocol was implemented for the first time this year at SAHI by NCBN staff member Dennis Skidds, and will be implemented at COLO starting in 2012 at the request of park managers.

One STEP student, one University of Rhode Island student, and one Biological Science Tech, managed by the NCBN Salt Marsh monitoring lead, Erika Patenaude, were hired and stationed at FIIS for the summer of 2011 to collect vegetation and nekton data at FIIS and SAHI as part of the network's salt marsh monitoring program. A third STEP student was hired to assist the Network with information transfer and upload to the IRMA database.

Shouldn't you have a similar write-up as above for the CACO program?

I. Program Accomplishments

Inventories

- Report and data product reviews for THST were completed, and the report is currently being formatted for publication in the NPS Natural Resource Technical Report series.
- NatureServe continued work on the final vegetation classification and mapping report and associated products for ASIS. The project is currently in the data analysis phase, and final products are anticipated in FY12.
- A URI cooperator conducted a first-ever moth inventory at SAHI.
- Inventory of terrestrial reptiles –CCEM staff at CACO conducted inventories for Eastern box turtles and eastern hog-nosed snakes through incidental encounters. Inventory work included marking for future recognition, collecting data on size, weight, age, sex, and location, and photo-documentation. In FY11 there were 59 incidental box turtle records, plus 7 encountered during monitoring surveys conducted in collaboration with MA Natural Heritage Program. As a result of this work, CACO region has been designated a “core area” in MA Box Turtle Conservation Plan.

Inventory products

- FIIS Biotic Synthesis report was completed and formatted for publication into the NPS technical report series.
- In FY11, the NCBN data manager delivered all CACO vegetation classification and mapping products to NC State University for uploading to the USGS VCP website (<http://biology.usgs.gov/npsveg/caco/>).
- A database and vouchered species collection of the moth species inventoried at SAHI
- Amphibian and reptile reports were published for FIIS, WIFL, and SAHI in the NR Technical Report Series.

Vital Signs Monitoring

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

- A four-person field crew shared with the MIDN implemented the fifth year of forest vegetation monitoring in two NCBN parks (GEWA, and THST). Data are currently being finalized and a report will be prepared on the first recensus. The NCBN and MIDN Program Managers met for 3 days at COLO to plan implementation of Forest Health Monitoring at COLO, and 16 new plots were established..
- The NCBN quantitative ecologist collaborated with MIDN to update and refine our reference condition criteria for all forest health metrics being monitored in NCBN and MIDN parks. This is part of the Connect the Dot condition tables below.

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

- 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*.
- SAHI was monitoring for the first time this year following a request for this information from park staff.
- Conducted 1D, 2D, and 3D surveys at GATE in Fall 2010 and Spring 2011.
- Maintained survey monuments throughout GATE.
- NCBN cooperators from Rutgers gave onsite workshops on the application of NCBN-developed coastal monitoring protocols at Rachel Carson Wildlife Refuge, Parker River Wildlife Refuge, Monomoy Wildlife Refuge, Long Island Complex Wildlife Refuge, Edwin Forsythe Wildlife Refuge, Cape May Wildlife Refuge, Prime Hook Wildlife Refuge, Chincoteague Wildlife Refuge, and Eastern Shore Wildlife Refuge.
- NCBN and Rutgers cooperators held a joint NPS/FWS training workshop on the application and implementation of the NCBN Shoreline position monitoring protocol. FWS refuge biologists attended from NE coastal refuges.

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 was reviewed by the NCBN staff and sent out for external peer review. The comments have been returned to the authors for protocol revision. This protocol will be published in FY12.
- As a component of the coastal topography monitoring program, five GeoCorp interns were

hired and stationed at Sandy Hook, GATE, ASIS, and CACO to work on NCBN coastal geology monitoring projects.

- The network quantitative ecologist developed a set of analysis scripts that greatly improved the efficiency of analyzing our coastal topography data. One version of this function with detailed documentation was provided to ASIS to assist with their backlog of Coastal Topography data that has not been analyzed. Also, NCBN analyzed the last 5 years of ASIS data (10 monitoring periods) and created profile plots of all monitored transects from the last 3 years of data (6 monitoring periods).
- A second version of this set of analysis scripts was developed for our network cooperator at Rutgers University to assist his work in analyzing Coastal Topography data from other NCBN parks.
- The NCBN data manager began database development in support of the NCBN Coastal Topography Monitoring program.

Salt marsh vegetation and nekton monitoring (FIIS, SAHI, CACO)

- This was the second year of data collection at FIIS and SAHI—which were sampled for the first time in 2009. One East Carolina University graduate student—hired through the Student Temporary Employment Program (STEP)—and two other technicians were stationed at FIIS and completed the sampling under the supervision of NCBN staff. FIIS provided housing as well as vehicle and boat support for the summer. All data entry for the 2011 field season has been completed. Data are currently undergoing quality control procedures and analysis for annual reports.
- All data from the 2010 sampling season at FIIS and SAHI were summarized. Improvements to the annual reporting document were made so that network reporting includes all metrics that are used to determine salt marsh condition shown in the Connect the Dots tables for each network park.
- CACO sampling was accomplished by the park's CCEM program. CACO estuaries sampled in 2011 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. CCEM staff participated in the internal review of the NCBN Salt Marsh Nekton Protocol and began working with NCBN to develop research and management questions for the nekton dataset. They will continue working together to analyze the data and publish results.
- At CACO, annual salt marsh vegetation monitoring was conducted in East Harbor. This is the only marsh monitored every year at this time. All data for the 2011 field season were

entered and are currently undergoing quality control procedures and analysis for annual reports.

- Mitigation of salt marsh dieback due to herbivory by burrowing crabs at CACO continues through experimentation with various types of erosion control fabric. Various material types, configurations and manipulations are being assessed in four salt marsh systems that are experiencing severe vegetation dieback.

Salt marsh elevation monitoring (CACO, GATE, FIIS, ASIS, COLO) (See the *Climate Change Monitoring Section below to read about further enhancements accomplished in FY11 due to additional funding*)

- James Lynch, a new addition to the NCBN, continued salt marsh elevation monitoring (accretion and elevation change) and other related activities at over 110 salt marsh surface sediment elevation table (SET) installations at NCBN, NETN, and NCRN wetlands.
- Over 70 SET monitoring stations at 4 NCBN parks (GATE, FIIS, CACO, ASIS) were sampled in the fall of 2010 and 2011. In addition, selection of 12 new SET installations at COLO began in 2011 with a site visit by NCBN staff and Dr. Donald Cahoon, a USGS cooperator. Wetland sites were scouted out and study designs and permitting were discussed with COLO staff. Installation will take place in FY12.
- In collaboration with USGS, the collection of elevation data using Trimble GPS survey equipment (RTK and/or VRS) began at SET sites at GATE, FIIS, and ASIS.
- NCBN SET Biologist and ASIS GIS coordinator, Neil Winn, collaborated with the University of Rhode Island Environmental Data Center staff in a Height Modernization GPS Survey of 5 new geodetic benchmarks installed at CACO in 2011. This work is part of a larger effort in the NER to install geodetic benchmarks in or near wetlands to assist in the accurate monitoring of salt marsh elevations.
- NCBN submitted a proposal to the NPMP program this year to further our understanding of the relationship between climate change and trends in sediment elevation in the salt marshes. This proposed work will fund our network's collaboration with USGS to analyze and synthesize data from multiple sources to develop models of these complex ecological relationships.
- In addition, the network's quantitative ecologist developed statistical analysis model scripts for analyzing SET data for all parks in a consistent manner and completed analysis of all ASIS data (2009 – 2011). Discussions with researchers in this area such as USGS, James Morris have lead to development of new criteria for determining condition of salt marsh elevation. Development of these criteria is ongoing.
- SET measurements were collected in fall by CACO staff and in the spring by NCBN staff

at CACO. From Spring 2011 on, NCBN will be measuring all 22 established SET sites in three CACO estuaries: Hatches Harbor, Herring River/Wellfleet Bay, and Nauset Marsh. Elevation data collected last spring were incorporated into a draft of a comprehensive report for Hatches Harbor and Herring River. Elevations of each 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.

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)

- 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* concentrations of surface water grab samples as a means of detecting seasonal and inter-annual changes in trophic status. Processed summer 2010 and spring 2011 water samples for anions and nutrients in Atlantic Research Center's analytical lab (420 samples).
- Conducted a preliminary assessment of water level/temperature data from the 10 primary kettle ponds to better track seasonal and annual trends in pond water level and temperature, and began analysis of long-term dataset using software developed by USGS with NPS funds.
- Continued a comprehensive QA/QC review of kettle pond water quality monitoring data. This included analysis of a multi-decadal long data set, which required several method comparison experiments. The review and comparative studies will continue into FY12 and should be completed by summer 2012. Conducted methodology research and testing in support of refining the protocol and completed an initial revision for internal review.

Hydrology and ground water quality monitoring (CACO)

- 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.
- With assistance from an AmeriCorps member, CCEM staff collected streamflow data from eight stream gage sites. Four of the eight sites are tidally influenced. Continuous water level loggers were deployed in Fall of 2010 to collect continuous stage measurements while collecting streamflow data weekly. This data will be sent to NPS Water Resources Division to develop a stream discharge rating curve for each site.

-
- Analyzed all 10 years of groundwater level and pond stage data. An internal report was written and presented to staff.
 - Continued discussions of database design and management for CACO hydrology data with NPS WRD.
 - To determine the sampling effort needed to continuously monitor kettle pond water levels, HOBO water level loggers were deployed at the 10 primary kettle ponds. Analysis of these data determined that sampling at five ponds (Gull, Spectacle, Ryder, Snow, and Dyer) is sufficient to represent water levels changes in all CACO kettle ponds.
 - Final draft of the Long Term Hydrologic Monitoring of Coastal Ecosystems Protocol in Oakley et al., 2002 format was submitted for review in Fall 2011. Publication in the NPS technical report series is expected by the end of 2011.

Vernal pool and dune slack wetland vegetation monitoring (CACO)

- Forested vernal pond vegetation was re-surveyed in 2011.
- Progress of *Gallerucella* beetle control of purple loosestrife in Great Pond, Province Lands was monitored.
- Results of 2009 dune slack vegetation monitoring were published as an NRTR.
- Completed draft report analyzing changes in kettle pond vegetation from 1995 to 2010. A completed and NRTR published report is anticipated by the end of FY12.
- 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 2012.

Amphibian monitoring (CACO)

- CCEM staff conducted the eighth 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.
- Collected and entered hydrology data (pond stage) monthly at all 40 vernal ponds being monitored.
- Entered and proofed all 2011 data, and performed preliminary tabulation and trend

analysis of all long term data on egg mass counts. Calling survey data have been tabulated and files for analysis with program PRESENCE have been created. .

Aquatic turtle monitoring (CACO)

- Continued to monitor spotted turtles through incidental encounters. Two individuals were recorded, including one originally marked in 2005.

Dune grassland vegetation (CACO)

- CCEM staff resurveyed dune grassland permanent plots, and data were entered into the project's database.

Coastal forest vegetation monitoring (CACO)

- In 2011, this protocol was revised to Oakley et al. standards and published in the NPS technical report series.

Land bird monitoring (CACO)

- CCEM staff received a partial report a University of Massachusetts cooperator on landbird point count surveys and work c continued to facilitate completion of report and protocol. Any estimated completion date?

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

- CCEM staff continued to implement the meteorologic and atmospheric monitoring program and served as site operators 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. Weekly precipitation data were collected at the Belfort Rain Gage located adjacent to Duck Pond.
- CACO Physical Scientist provided logistical and field support to the USGS and EE-MS contractor on the install, and weekly sample collection and submission of the co-located NADP-NTN sample collector at "MA01" for Water Year 2011. The objective is for the USGS to compare the new NTN N-CON collector to the standard AeroChem collector at our NADP site "MA01" for one year and ascertain the performance of the new N-CON collector in a coastal environment with wind driven precipitation.
- CACO Physical Scientist submitted an annual summary report for air quality related

monitoring at CACO which includes providing a broader context for interpreting spatial and temporal trends in air quality data for informing Park management.

- In FY11, MA DEP added two additional CACO kettle ponds to their long-term monitoring program for biannual sampling and tracking of fish mercury levels over time. This summer, contractors for MA DEP sampled Slough and Dyer ponds for mercury in fish and a suite of 23 other water chemistry related parameters. Data are expected from MA DEP by summer 2012.

Cover-type change monitoring (CACO)

- CACO has been cooperating with U Mass to test methods for creating a repeatable land cover change map. A report on results of supervised classification using the Random Forests method for landcover change analysis was received, reviewed, and is undergoing revision. A manuscript on this project has been submitted to the journal “Remote Sensing of the Environment”.

Coastal Climate Change Monitoring

Marshbird monitoring (NCBN, NETN, NCRN coastal parks)

- The Network hired a permanent Biological Science Technician (GS7) to lead the NCBN Marshbird monitoring efforts and develop a citizen science program.
- NCBN modified an existing CA with the University of Rhode Island to continue collaboration on adapting a USGS marshbird monitoring protocol to the NCBN program and needs. This protocol will also be implemented in coastal NETN and NCRN parks.
- Marshbird monitoring was conducted by a combination of volunteers, park staff, and partners at over 35 points in ASIS, GATE, FIIS, CACO in conjunction with a regional partnership effort investigating marshbird populations throughout the northeast (SHARP, <http://www.tidalmarshbirds.org/>).
- NCBN worked with cooperator Carol Trocki to draft a sampling plan that will allow us to share data with a larger nationwide marsh bird monitoring program that is in development (SHARP).

Regional expansion of salt marsh elevation monitoring (NCBN Parks-CACO, GATE, FIIS, ASIS, COLO, NETN Parks-BOHA, ACAD, NCRN Parks-GWMP, NACE)

- In FY11, NCBN, NETN and NCRN hired a permanent biologist to coordinate the existing SET monitoring as well as expand the NCBN program to additional parks and networks.

-
- Salt marsh elevation monitoring (accretion and elevation change) was expanded to additional NCBN, NETN and NCRN park wetlands and 111 SET installations were sampled.
 - Selection of 12 new SET installations at COLO began in 2011. Wetland sites were scouted out and a study design and permitting were discussed with COLO staff. Installation will take place in FY2012. SETs and rods for installation were purchased.
 - With the purchase of new RTK GPS equipment, the collection of elevation data began at SET sites at GATE, FIIS, and ASIS. This work will continue until all SET sites have been surveyed.
 - NCBN purchased continuously recording water level recorders for deployment at all SET sampling sites to help in accurately characterizing the local tidal regime at each of these marshes. This additional equipment will greatly improve the information that the networks will be able to provide to park managers.
 - Ten SETs installed at BOHA in 2010 were read by the NCBN biologist.
 - NCBN staff, USGS collaborators, and ACAD staff assisted in the installation of 12 SETs in three ACAD salt marshes (Bass Harbor, Thompson Island, and Schoodic Peninsula). In addition, permission was obtained to install 3 additional SETs at a wetland site owned by the Maine Coast Heritage Trust (Babson Creek). Initial readings of these SETs occurred in September 2011.
 - The NCBN SET biologist assisted NCRN in reading the 9 SETs installed at GWMP (Dyke Marsh). In addition, the 10 SET's installed at NACE (Kenilworth Gardens, Kingman Island) were visited to assess conditions of the sampling platforms prior to resuming sampling in FY2012. Accurate elevation measurements were collected at both GWMP and NACE sites in 2011 with survey quality GPS equipment.
 - Assisted NETN with enhancing rocky intertidal monitoring sites to ensure that data will be compatible with monitoring effects of climate change and sea level rise. NCBN and ASIS staff surveyed monitoring plots with RTK-GPS equipment and assisted with the installation and surveying of additional points along vertical transects at 6 monitoring sites (3 at Acadia NP and 3 at Boston Harbor Islands NRA).
 - Work began in FY11 on revising an original protocol developed for CACO (Cahoon et al., 2006) to develop a SET monitoring protocol for North Atlantic coastal parks. The new protocol will incorporate new and updated methodologies for installing, monitoring, and analyzing elevation and accretion data collected at the SET sampling stations. A conference call was held with NPS, USGS, USFWS and NOAA personnel to discuss plans for this document and to solicit assistance and comments.

Weather and climate data compilation and synthesis

-
- A weather and climate project was initiated and a database, analytical procedures, and detailed SOP's for reporting weather and climate status and trends were produced. Reports will be prepared for NETN, NCBN, and selected NCRN parks in FY12

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 FY11. 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)

- NCBN cooperators from Stony Brook U conducted the FIIS water quality monitoring and this was completed over a five week period.
- FIIS ENE data will be uploaded into the NCBN ENE database, fall 2012.
- The monitoring index period at GEWA occurred during the four week period of July 18 through August 10, 2011 and was conducted by NCBN's cooperator, Dr. Ken Moore. Chlorophyll samples were sent to Cape Cod National Seashore North Atlantic Coast Laboratory for analyses. Results were returned to VIMS. Digital copies of all data were created. All data collected at GEWA were submitted to the NCBN Estuarine Nutrient Enrichment Database on September 26, 2011. A continuous water quality monitoring station, using a NPS-owned YSI 6600 Multi-Parameter Water Quality Logger upgraded with two wiped LiCor PAR sensors, was deployed and maintained by VIMS staff during this index period. This instrument was retrieved, cleaned, calibrated and re-deployed approximately two weeks after the original deployment. During the cleaning and re-deployment procedure the continuous monitoring station was without an instrument for less than 24 hours.
- The NCBN completed a preliminary analysis of available water quality data for COLO in order to provide data summaries, interpretation, and insight to the Natural Resource Condition Assessment effort at COLO.
- NCBN staff began working on an estuarine water quality analysis and synthesis project funded through an accepted NPMP grant proposal. The project working group has met and developed a working plan that will result in completing this year's goals, including getting all NCBN water quality data certified to data quality standards specified in the network

protocol and developing new water quality data analysis and summary tools.

- Substantial revisions were made to the Estuarine Nutrient Enrichment Water Quality Monitoring database to reflect input from academic and NPS stakeholders following a meeting hosted by the NCBN. Enhanced query capabilities for QA/QC and reporting were developed in conjunction with USGS and EPA cooperators.
- 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 the NCBN staff and cooperators from SUNY Stony Brook, VIMS, and USGS.
- 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.
- CACO Aquatic Ecologist became a member of Northeast Coastal and Barrier Network Estuarine Nutrient Enrichment Monitoring Technical and Science Advisory Committee.
- In April 2011, NCBN cooperator, Dr. Bradley Peterson was asked to present the results of the 2008 and 2010 NCBN Jamaica Bay water quality monitoring project to the New York City Department of Environmental Conservation and the Hudson River Foundation science advisory committee. These groups are working on oyster reef restoration in both Jamaica Bay and the Hudson River.
- NCBN cooperator, Dr. Bradley Peterson was asked to give testimony to the NY Committee on Environmental Conservation by Senator Sweeney regarding the impact of submarine groundwater entering the estuaries of Suffolk County, NY. Data from the NPS water quality monitoring project was used.

Seagrass monitoring (CACO, ASIS, FIIS)

- June 2011 the FIIS permanent seagrass monitoring site was visited to locate and replace buoys marking the permanent transect markers. August 2011 FIIS SeagrassNet permanent transects were monitored by NCBN cooperators from Stony Brook University. NCBN cooperators found that *Ruppia* had expanded since the last monitoring trip, all *Zostera* was absent from the transects.
- To better evaluate the cause and effect of stressors, especially those related to climate change, additional SeagrassNet surveys were conducted at FIIS by Stony Brook cooperators.
- NCBN cooperator, Dr. Ken Moore from Virginia Institute of Marine Science travelled to ASIS and successfully performed a fall, spring, and summer SeagrassNet survey. The fall

survey occurred on October 5, 2010, the spring survey on April 20-21, 2011 and the summer survey on June 28, 2011. Biomass samples were collected and processed. TidbiT (Onset, Inc.) temperature loggers were retrieved and new ones deployed. Sediment and voucher specimens were also collected. An additional trip was conducted on February 7, 2011 in order to switch out the TidbiT temperature loggers. A continuous water quality monitoring station was also deployed and maintained by the Assateague Island National Park Service staff during each of the survey periods. All data have been added to the SeagrassNet data base.

- NCBN quantitative ecologist has analyzed and summarized available network data to determine seagrass condition in ASIS and FIIS and data from ASIS and COLO was also aggregated from state and university sources to determine trends in seagrass distribution in park and surrounding estuaries.
- Monitoring by CCEM staff continued at CACO in Pleasant Bay and Duck Harbor for the ninth consecutive year following the NCBN protocol. All 2011 data were entered into the NCBN database.
- In November, NCBN cooperator, Dr. Bradley Peterson from Stony Brook U. was invited to present the results of the 2007 and 2009 FIIS seagrass and water quality monitoring project to the Army Corp of Engineer' Seagrass Workgroup. The task of this workgroup was to determine what role the ACOE might play in light and sediment mitigation in Great South Bay and the Forge River.
-

Monitoring products

- NCBN Coastal Topography protocol being revised by authors following peer review.
- NCBN Salt Marsh Vegetation protocol being revised by authors following peer review.
- NCBN Nekton protocol being revised by authors following peer review.
- Annual salt marsh vegetation and nekton monitoring reports published in the NR Technical Report Series for ASIS and GATE.
- Plan developed for installation of 12 SETs at COLO
- A prototype trend report was completed for ASIS Ocean Shoreline Monitoring and will be published in FY12 in the NRTR series.
- Initiated Climate and Weather Data Synthesis and Reporting –a joint effort among NCBN, NETN, and NCRN.
- A technical report on dune slack wetlands vegetation monitoring was published by CCEM staff.

-
- CCEM's coastal forest monitoring protocol was published.

NCBN Data Management, Information Transfer, and Support to Park Management and the Public

- NCBN internet and intranet websites were 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.
- A STEP student from the University of Rhode Island was hired and stationed at URI in 2011 to aid Network parks in entering reference records into the NRInfo portal using current IRMA standards. Managed by the NCBN and MIDN data managers, the student 1) created reference records for documents pertaining to park natural resources; 2) verified the records' relevance to the park; and 3) communicated with park staff to obtain/scan/upload digital versions of reports. In addition, the NCBN data manager completed his term as an initial member of the national I&M Program's NRInfo Reference Application Steering Committee in FY 11.
- The NCBN quantitative ecologist taught a graduate level statistics course at the University of Rhode Island in the spring of 2011 that focused on statistical methods for ecological research.
- The NCBN network quantitative ecologist lead a Bayesian study group webinar in September of 2011 as part of an ongoing collaborative effort with the quantitative ecologist for the South Florida Caribbean Network.
- The NCBN network quantitative ecologist completed an extensive body of statistical analyses of water quality data for ACAD.

II. Public Interest Highlights

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 five student interns and stationed three at Gateway National Recreation Area, Assateague Island

National Seashore, and Cape Cod National Seashore for the summer of 2011. The interns at GATE 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 some coastal USFWS refuges in the Northeast. This program has been very successful for the NCBN and the interns. Two interns have extended their stay at the park, working for the Network through December, 2011.

NORTHEAST COASTAL AND BARRIER NETWORK HOLDS TRAINING FOR NORTH ATLANTIC COAST USFWS BIOLOGISTS ON COASTAL SHORELINE CHANGE MONITORING

The Northeast Coastal and Barrier Network (NCBN) along with collaborators from Rutgers University, held a two day shoreline change monitoring training, March 23-24, at the University of Rhode Island, for USFWS staff. This effort was a result of recent discussions between NCBN and Regional USFWS staff to expand and share Vital Signs monitoring protocols and efforts along the North Atlantic coast. The NCBN has been monitoring shoreline change in its coastal parks for a number of years. As part of the NCBN Vital Signs program, the network developed a long-term monitoring protocol that the Northeast Region USFWS coastal parks will be adopting and implementing on at least 13 refuges during 2012.

ESTUARINE NUTRIENT ENRICHMENT MONITORING WORKSHOP

On April 13, the Northeast Coastal and Barrier Network (NCBN) hosted an Estuarine Nutrient Enrichment Monitoring Workshop at the University of Rhode Island Bay Campus. The meeting brought together federal and academic cooperators from the USGS, NCBN parks (ASIS, CACO, FIIS, GATE), Stony Brook University, and the Virginia Institute of Marine Science to share lessons learned from the implementation of the network's water quality and sea grass monitoring programs, as well as to discuss ways in which data collection and processing methods can be enhanced going forward. The group was joined by Michael Lizotte, Application Engineer for YSI Integrated Systems & Services, who provided valuable, up-to-date information concerning the proper care, calibration, use, and maintenance of the multiparameter sondes used for this monitoring protocol.

**CLIMATE CHANGE FUNDING ALLOWS ENHANCEMENT OF NCBN VITAL SIGNS
MONITORING OF SALT MARSH SURFACE ELEVATION**

The "Surface Elevation Table" (SET) and marker horizon technique have been used over the past 20 years to accurately monitor elevation change and deposition in tidal wetland environments. The use of SETs in the Northeast Region and National Capital Region of the NPS began in 1998 with the installation of SETs at Cape Cod National Seashore. SETs have since been installed in all coastal parks and some freshwater tidal sites.

In addition to elevation monitoring with the SET, the NCBN has recently begun to incorporate continuously operating water level recorders to characterize the local flooding conditions at each of the SET sites. The use of accurate GPS surveying or leveling is being used to link the elevation of the marsh surfaces and the tidal patterns recorded by these devices. Knowledge of the relationships between marsh elevation and the local hydrology are particularly important processes to understand in wetland ecosystems. Wetland habitats have adapted to the affects of sea level rise by trapping sediment and accumulating biomass to maintain their elevation. Climate change could lead to dramatic changes in the rate of sea level rise which could have important impacts on these ecosystems in the future. A better understanding of these relationships will help managers to better assess the vulnerability of these wetland ecosystems to climate change.

NEW MARSH BIRD MONITORING PROGRAM IMPLEMENTED IN NCBN PARKS

Birds that nest in tidal marshes are generally secretive and difficult to detect. Population trends for these species are often unknown, but many are thought to be declining and are therefore recognized as species of conservation concern. Northeast Coastal and Barrier Network (NCBN) parks are known to provide important feeding, nesting, and roosting habitat for tidal marsh birds. Flooding is one of the major threats to the reproductive success of marsh-breeding species. With predictions of rapid sea level rise, increased frequency of storm surges, and increased marsh inundation, these species have become an important indicator of tidal marsh health.

In 2011, the NCBN expanded Vital Signs monitoring to include marsh birds as a result of additional funding provided to three North Atlantic coast networks for enhanced climate change mentoring.

During the summer of 2011, the Network implemented marshbird monitoring in 4 parks in collaboration with the SHARP project (<http://www.tidalmarshbirds.org/>), a large, regional partnership effort funded by the USFWS investigating marshbird populations throughout the Northeast. With the help of volunteers, park staff, and partners, over 35 points were sampled in NCBN parks as part of this regional effort. As part of the network's enhanced monitoring plan, a permanent marshbird monitoring coordinator has been hired to continue the development and implementation of this program.

NCBN AND NER STAFF OFFER ADVANCED SPATIAL ANALYSIS COURSE

The NPS's NCBN Data Manager and NER GIS Coordinator developed and 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 2011 semester. The course offered a hands-on introduction to the use of GPS for navigation and data-collection and culminated with a multi-day "SWAT Team" event at Cape Cod Natural Seashore, during which the class collected actual data in support of the park's natural and cultural resource monitoring programs.

NEW MONITORING TECHNOLOGY IN SEAGRASS BEDS MAY HELP TRACK CLIMATE CHANGE

As a result of a network-wide Estuarine Nutrient Enrichment Protocol Workshop held in spring 2011, two water quality instruments equipped with a pCO₂ sensor were deployed at CACO in summer 2011 in Pleasant Bay. The monitoring system allows for the continuous monitoring of key water quality parameters related to biological production, including dissolved oxygen, pH and pCO₂. Recent improvements in water quality due to increased tidal flushing caused by the formation of a new tidal inlet in 2007 has allowed for the expansion of eelgrass distribution and density throughout the bay. The positive effects of eelgrass on water quality in regards to water filtration, nutrient sequestration, removal of dissolved CO₂ via photosynthesis, and sediment stabilization are widely recognized. Increased atmospheric CO₂, a driver of climate change, is also known to affect estuarine water chemistry. However, the contribution of eelgrass to CO₂ dynamics is poorly understood.

These data not only provide preliminary information on the physical and biological processes

controlling CO₂ dynamics in this system, but the addition of a pCO₂ sensor to the YSI *in situ* sondes for continuous monitoring provides a powerful ecological monitoring tool that allows more complete understanding of environmental dynamics and process.

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 effects 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.

CACO DESIGNATED AN EASTERN BOX TURTLE “CORE AREA”

Released in 2011 by the MA Natural Heritage Program, the “Eastern Box Turtle Conservation Plan for Massachusetts” is an in-depth analysis of the historic and current distribution and status of this terrestrial species, which is declining throughout the Northeast due to development and habitat fragmentation. Based in large part on current records, many of which were provided by the CACO I&M Program, an analysis of occurrences, amount of appropriate habitat, and land protection status shows that Cape Cod National Seashore is one of the top two sites for box turtles in Massachusetts. Northern populations of box turtles are constrained by winter mortality, which they avoid by burrowing. Cape Cod’s easy to burrow in sandy soils and mild winters make it naturally ideal for box turtles. These natural factors combine with the relatively large, undeveloped landscape of forest and open patches protected within the Seashore to provide one

of the most important remaining areas for box turtles in the region.

KETTLE POND TEMPERATURE PROFILES SHOW WARMING EFFECTS

Cape Cod National Seashore's deepwater kettle ponds undergo annual cycles of stratification and turnover, based on seasonal changes in water temperature and the relationship of water temperature and density. As pond water warms in the spring, its lower density causes it to remain at the surface while cooler water remains below. Eventually "summer stratification" results in the formation of separate layers with little mixing or exchange of gases. This can lead to low levels of oxygen in the lower layer. Preliminary analysis of CACO's kettle pond temperature-depth profile data show that ponds are now stratifying approximately two weeks earlier than they did in the mid-1990s. Because prolonged summer stratification can lead to declines in habitat quality for oxygen sensitive fish, if not outright fish kills, these findings suggest that warming trends are altering the ecological integrity of the Seashore's deepwater kettle ponds.

RECORD YEAR FOR SPOTTED SALAMANDERS AT CACO VERNAL PONDS

Monitoring of pond breeding amphibians via vernal pond egg-mass counts began in 2002, and since 2004 a total of 40 ponds have been sampled annually. Spotted salamander egg mass counts (13,534) were an all time high in 2011. By all measures, the numbers of spotted salamander egg masses in CACO vernal ponds show an increasing trend. Spotted salamanders are long-lived, about 20 years, and females take about five years to reach breeding size. This increase may reflect relatively high water tables in the past few years and population recovery following low water levels that characterized the late 1990's and early 2000's.

NITROGEN INPUT MAY IMPACT CACO KETTLE PONDS

Although phosphorous (P) levels have long been considered the factor limiting plant growth in freshwater ponds, bioassays at Cape Cod National Seashore (CACO) suggest that nitrogen (N) levels may also influence plant growth. Nutrient enrichment bioassays, coinciding with analyses of surface water nutrients, N and P, were conducted using water samples collected from ten freshwater lakes (kettle ponds) of CACO. Algal biomass developing in each treatment was assessed by quantifying chlorophyll *a*. In both July and August, strong responses of a unicellular green alga, *Chlamydomonas* sp., to N+P and N enrichments were observed in all water samples, while P alone (or control treatments) had virtually no stimulatory effect. These results indicate that N inputs to these waterbodies can fuel the growth of certain phytoplankton species and management of N inputs should be considered a management priority for CACO.

III. Staffing

NCBN Board of Directors

Trish Kicklighter, ASIS
George Price, CACO
P. Daniel Smith, COLO
Chris Soller, FIIS
Linda Canzanelli, 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)
James Lynch-NCBN Biologist (SET)
Dana Filippini-NCBN Biological Science Technician (Marsh birds)
Vacant, NCBN Biologist (Science Communication)
Trisha Towanda, NCBN Biological Science Technician (STEP student)
Joshua Borgoyne, NCBN Biological Science Technician (STEP student)
3 Seasonal Biological Technicians, Salt Marsh Monitoring
5 GeoCorp Interns

Cape Cod National Seashore CCEM Staff

Megan Tyrrell, Research and Monitoring Coordinator
Robert Cook, Wildlife Ecologist
Stephen Smith, Plant Ecologist
Sophia Fox, Aquatic Ecologist
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 (1)
Student Conservation Association interns for: Vegetation monitoring, Amphibian monitoring (2), aquatic monitoring (3), aquatic monitoring (3)

NCBN Technical Steering Committees developed in FY11

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

Estuarine Water Quality Monitoring Members:

(first meeting held in April 2011)

Sophia Fox, CACO (Lead)

Kelly Medieros, CACO

Penelope Pooler, NCBN

Sara Stevens, NCBN

Dennis Skidde, NCBN

Hilary Neckles, USGS

Kenneth Moore, VIMS

Brad Peterson, SUNY

Brian Sturgis, CACO

SET Monitoring

(first conference call held, Aug 2011)

James Lynch, NCBN (Lead)

Sara Stevens, NCBN

Geoff Sanders, NCRN

Tony Curtis, SECN

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 (initial invitees)

(Group has not met yet)

Erika Patenaude, NCBN (Lead)

Sara Stevens, NCBN

Dana Filippini, NCBN

Charles Roman, NPS CESU

Mary-Jane James-Pirri, URI

Megan Tyrell, CACO

Cathleen Wigand, EPA

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

-
- 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 Duhaime, 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. Donald Anderson, Woods Hole Oceanographic Institution (red tide research)
- Rachel Bolus, University of Massachusetts, Amherst (common yellowthroat communication)
- Dr. Mark Bertness, Brown University (salt marsh die-back)
- Dr. Barbara Brennessel, Wheaton College, (diamondback terrapin ecology and genetics)
- Scott Buchanan, Montclair State University (hog-nosed snake ecology)
- Dr. Raymond Clarke, Sarah Lawrence College, (box turtle use of powerlines)
- Dr. John Colman, US Geological Survey (nutrient loading to Nauset marsh)
- Richard Couse, Antioch College of New England (hog-nosed snake behavior and ecology)
- Dr. Julie Ellis, Tufts University Veterinary School (common eider die-off)
- Lori Erb, Massachusetts Natural Heritage Program (box turtle monitoring and radio-telemetry)
- Mark Faherty, University of Massachusetts, Amherst (landbird point-count protocol)
- Dr. Graham Giese, Provincetown Center for Coastal Studies (geomorphology and tides)
- Dr. Howard Ginsberg, USGS, PatuxentWRC (lyme disease ecology and vectors)
- Dr. Curtice Griffin, University of Massachusetts, Amherst (landbird point-count protocol)
- Dr. Rebecca Harris, Massachusetts Audubon Society (tern staging behavior and habitat)
- Dr. Mary Jane James-Pirri, URI (horseshoe crab ecology and movements)
- Dr. Larry Martin, NPS Hydrologist (hydrology monitoring)
- Dr. Kevin McGarigal, University of Massachusetts, Amherst (spadefoot toad ecology study)
- Dr. Hilary Neckles, USGS (seagrass surveys and ENE Protocol)
- Dr. Christopher Neill, Marine Biological Laboratory (nutrient cycling in dune habitats)
- Dr. Allan O'Connell, USGS, Patuxent WRC (meso-mammal protocol)
- Dr. Peter Paton, University of Rhode Island (analysis of anuran calling surveys)
- Jane Rose, MA Dept. Environmental Protection (mercury in fish monitoring)
- Dr. Jeffrey Spendelow, USGS Patuxent WRC (staging of roseate terns)
- Carol Trocki, URI-NCBN (marsh bird monitoring)
- Dr. Rachel Thiet, Antioch College of New England (soft-shell clams, dune crusts)
- Brad Timm, University of Massachusetts, Amherst (spadefoot toad ecology, landcover change)
- Dr. Todd Tupper, Northern Virginia CC (anuran calling surveys, chytrid fungus surveys)
- Dr. Betsy Von Holle, Univ. Central Florida (nitrogen fixation, ant-Corema interaction)
- Greg Wetherbee, USGS (atmospheric deposition monitoring)

IV. Reports, Publications, and Presentations (FY11)

NCBN

- Comiskey JA, Wakamiya SM. 2011. Mid-Atlantic Network forest vegetation monitoring: 2007 to 2010. National Park Service, Natural Resource Stewardship and Science. Fort Collins, Colorado. Natural Resource Technical Report. NPS/MIDN/NRTR—2011/471. Published Report-2173037.
- Ellsworth, A.C., P.S. Pooler, W. Gauley. 2011. Quality Air and Water at Arcadia National Park: An Historical Perspective. George Wright Society Biennial Conference on Parks, Protected Areas, and Cultural Sites, New Orleans, Louisiana, March 2011.
- Neckles, H.A., J.M. Caldwell, P.S. Pooler, D. Skidds. 2011. Integration of Estuarine Water-Quality Data in Northeast Coastal and Barrier Network Parks at Local and Regional Scales. George Wright Society Biennial Conference, New Orleans, Louisiana, March 2011.
- Neckles, H.A., B.S. Kopp, B.J. Peterson, P.S. Pooler. 2011. Integrating Scales of Seagrass Monitoring to Meet Conservation Needs. *Estuaries and Coasts*. DOI: 10.1007/s12237-011-9410-x
- Patenaude EL, Pooler PS. 2010. Monitoring salt marsh vegetation at Colonial National Historical Park: 2010 summary report. National Park Service, Natural Resource Program Center. Fort Collins, Colorado. Natural Resource Data Series. NPS/NCBN/NRDS—2010/120.
- Patenaude EL, Pooler PS. 2011. Monitoring salt marsh vegetation and nekton at Gateway National Recreation Area's Sandy Hook Unit: 2010 summary report. National Park Service, Natural Resource Program Center. Fort Collins, Colorado. Natural Resource Data Series. NPS/NCBN/NRDS—2011/132.
- Patenaude EL, Pooler PS. 2011. Salt marsh vegetation and nekton community monitoring at George Washington Birthplace National Monument: 2010 summary report. National Park Service, Natural Resource Program Center. Fort Collins, Colorado. Natural Resource Data Series. NPS/NCBN/NRDS—2011/133.
- Patenaude EL, Pooler PS. 2011. Monitoring salt marsh vegetation and nekton at Assateague Island National Seashore: 2010 summary report. National Park Service, Natural Resource Stewardship and Science. Fort Collins, Colorado. Natural Resource Data Series. NPS/NCBN/NRDS—2011/312.
- Peterson, B. J. and A. M. Stubler. Cumulative impacts of multiple stressors on *Zostera marina* populations in New York estuaries. New England Estuarine Research Society Meetings, Pt. Jefferson, NY.
- Peterson, B. J. The impact of positive interaction between organisms and seagrass populations in New York south shore estuaries. Department of Environmental Science, University of Virginia.
- Peterson, B. J., E. Bricker, S. J. Sterling, J. M. Carroll, B. T. Furman, A. M. Stubler and M. Waycott. In review. Genetic diversity and gene flow in *Zostera marina* populations surrounding Long Island, New York USA: No evidence of inbreeding, genetic degradation or population isolation. *Aquatic Botany*.
- Pooler, P.S., M.C. Tyrrell, K.A. Lellis-Dibble, H.K. Bayley, S.M. Stevens. 2011. Invited Workshop Presenter. Modeling Trends in Northeast Coastal Salt Marshes: A Comparison of Bayesian Hierarchical and Multivariate Nonparametric Approaches. George Wright Society Biennial Conference, New Orleans, Louisiana, March 2011.
- Psuty, N.P. and T.M. Silveira, 2011. Tracking Coastal Geomorphological Change: An

-
- Application of Protocols to Collect Geotemporal Data Sets at the National Level in the US. *Journal of Coastal Research*, Special Issue 64, pp 1253-1257.
- Psuty, N.P., and T.M. Silveira, 2011. Monitoring Shoreline Change Along Assateague Barrier Island: The First Trend Report. *Journal of Coastal Research*, Special Issue 64, pp. 800-804.
- Psuty, N.P., D. Soda, A. Spahn, and A. Love, July 2011. Monitoring Shoreline Changes, Sandy Hook Unit, Gateway National Recreation Area, July 1997 – December 2010: Report on Survey Period 2010. Submitted to David Avrin, Chief, Division of Natural and Cultural Resources, NPS, 24 p.
- Psuty, N.P. and T.M. Silveira. Tracking Coastal Geomorphological Change: An Application of Protocols to Collect Geotemporal Data Sets at the National Level in the US. International Coastal Symposium 2011, Szczecin, Poland, May 9-14. AWARD for best presentation at the International Conference.
- Psuty, N.P., T.M. Silveira, S. Stevens, and D. Skidds. 2011. Geotemporal Dimensions of Change: Two-Dimensional Coastal Geomorphological Monitoring in the Northeast Coastal and Barrier Network. George Wright Society 2011, New Orleans, March 14-18.
- Psuty, N.P., and A. Spahn. 2011. Geotemporal Dimensions of Change: Two-Dimensional Coastal Geomorphological Monitoring. Webinar co-ordinated through Fish & Wildlife Service Region 5, Coastal Network, August 23. Presentation of the NCBN protocol.
- Psuty, N.P., and A. Spahn, 2011. Regional Seamless Network Monitoring: A Multi-scale Monitoring Program to Measure Rates of Coastal Change. Jacques Cousteau National Estuarine Research Reserve Review, Tuckerton, New Jersey, August 18.
- Psuty, N.P., 2011. Tracking Coastal Geomorphological Change: Collecting Geotemporal Data Sets in the National Parks and Wildlife Refuges, Northeastern USA. Public Lecture, Liverpool Hope University, February 23.
- Skidds, D.E., 2011. GPS Data Collection Using ESRI ArcPad. Joint NPS – FWS Coastal Shoreline Change Monitoring Training, Narragansett, RI.
- Skidds, D.E., 2011. GPS Data Post Processing and Data Management. Joint NPS – FWS Coastal Shoreline Change Monitoring Training, Narragansett, RI.
- Skidds, D.E., 2011. GPS Equipment and Initial Settings. Joint NPS – FWS Coastal Shoreline Change Monitoring Training, Narragansett, RI.
- Skidds, D.E., 2011. Overview of the Northeast Coastal and Barrier Network Geomorphological Monitoring Program. Joint NPS – FWS Coastal Shoreline Change Monitoring Training, Narragansett, RI.
- Silveira, T.M., and N.P. Psuty. 2011. Monitoring Shoreline Change Along Assateague Barrier Island: The First Trend Report. International Coastal Symposium 2011, Szczecin, Poland, May 9-14.
- Silveira, T.M., and N.P. Psuty. 2011 An Integrated Monitoring Network to Understand Coastal Changes: Northeast Coastal and Barrier Network, USA. MEC, Laboratorio Nacional de Engenharia Civil, Lisbon, February 3-4.
- Silveira, T.M., N.P. Psuty, C. Schupp, N. Winn, and C. Zimmerman. 2011 Rates and Trends of Shoreline Change along Assateague Barrier Island, 2005-2010. George Wright Society 2011, New Orleans, March 14-18.
- Sneddon, L. A., Zaremba, R. E., and M. Adams. 2010. Vegetation classification and mapping at Cape Cod National Seashore, Massachusetts. Natural Resources Technical Report NPS/NER/NRTR—2010/147. National Park Service. Philadelphia, PA.
- Spahn, A., 2011. Regional Seamless Network Monitoring. National Estuarine Research Reserve
-

-
- Managers Meeting, Tuckerton, New Jersey, June 7.
- Stevens, S., B. Mitchell, M. Brown, P. Campbell. 2010. Strategy for enhanced monitoring of natural resource condition in North Atlantic coastal parks to address the effects of rapid climate change. Natural Resource Report NPS/NCBN/NRR—2010/272. National Park Service, Fort Collins, Colorado.
- Stevens, S.M., Nov. 2010. Northeast Coastal & Barrier Network Inventory and Monitoring Program: Student Opportunities with the National Park Service. Natural Resource Science Class, University of Rhode Island, Kingston, RI.
- Stevens, S.M., 2011. Colonial National Historical Park Vital Signs Monitoring. NCBN meeting at Colonial National Historical Park.
- Trocki CL. 2011. Biotic synthesis of Fire Island National Seashore. National Park Service, Natural Resource Program Center. Fort Collins, Colorado. Natural Resource Report. NPS/NCBN/NRR—2011/292.

CCEM

- Bayley, H.K. and S.E. Fox. Recovery of an estuarine nekton community following partial restoration of tidal flow. New England Estuarine Research Society Meeting, Provincetown, MA, October 2010.
- Bayley, H.K. and F.T. Short. Response of genetically distinct eelgrass (*Zostera marina*) populations to increased sediment organic matter content and reduced light. Atlantic Research Center Research Symposium, Truro, MA, August 2011.
- Clark, R. A., Rubino, V., Thiet, R., Smith, S.M., and K.D. Lee. The Effect of Soft Shell Clams on Macroalgal Blooms in Restored Salt Marshes of Coastal Massachusetts, USA. Cape Cod Museum of Natural History Conference Presentation. March 2011.
- Colman, J.A., Lee, K.D., Batdorf, C., Pancorbo, O. 2011. Mercury in Atmospheric Deposition, Sediment Cores, and Fish on the East and West Coasts of North America, and in the Southern Hemisphere: Effects of Regional and Global Atmospheric Emissions. The 10th International Conference on Mercury as a Global Pollutant (ICMGP) Presentation. July 2011.
- Cook, R.P. 2010. Amphibian and Reptile Restoration at Gateway NRA. Herbert Johnson Lecture Series, Jamaica Bay Wildlife Refuge, Gateway NRA. November 10, 2010.
- Cook, R.P. 2011. Anuran Monitoring at Cape Cod National Seashore: Effect of Time and Temperature on When and How Often to Sample. Cape Cod Natural History Conference, Cape Cod Community College. March 12, 2011.
- Cook, R.P. 2011. Vernal Pond Wildlife. Field Trip for CACO employees and family. April 14, 2011
- Cook, R.P. 2011. Vernal Pond Monitoring at Cape Cod National Seashore. North American Benthological Association. Cape Cod National Seashore. May 27, 2011.
- Cook, R.P. and S. Buchanan. 2011. Herpetology of Cape Cod National Seashore. Field Trip with scientists of The Conservation Agency, 6/7/2011.
- Cook, R.P. 2011. Vernal Pond Monitoring at Cape Cod National Seashore. Science in the Seashore. Cape Cod National Seashore. August 23, 2011.
- 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 Sagamore Hill National Historical Site. Natural Resource Technical Report NPS/NCBN/NRTR—2010/379. 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. Saugus Iron Works National Historic Site Amphibian and Reptile Inventory: March – September 2001. Natural Resource Report NPS/NETN/NRR—2010/248. National Park Service, Fort Collins, Colorado.
- Cook, R.P., T. Tupper, P.W.C. Paton, and B. Timm. 2011. Effects of temperature and temporal factors on anuran detection probabilities at Cape Cod National Seashore: Implications for Long-Term Monitoring. *Herpetological Conservation and Biology* 6(2):25-39.
- Cook, R. P., D. K. Brotherton, B. Timm, and J. L. Behler. in press.. Inventory of Amphibians and Reptiles at Minute Man National Historic Site. Natural Resource Technical Report NPS/NCBN/NRTR—2011/XXX National Park Service, Fort Collins, Colorado.
- Cook, R. P., D. K. Brotherton, B. Timm, and J. L. Behler. in press.. Inventory of Amphibians and Reptiles at Saratoga National Historic Site. Natural Resource Technical Report NPS/NCBN/NRTR—2011/XXX National Park Service, Fort Collins, Colorado.
- Doshas, A., Thiet, R., Smith, S.M. and K.D. Lee. Effects of Biological Soil Crusts on Germination and Seedling Health of Key Successional Dune Plants *Deschampsia flexuosa* and *Myrica pennsylvanica* on Cape Cod, MA. Cape Cod Museum of Natural History Conference Presentation. March 2011.
- Fifty Years of Science at Cape Cod National Seashore (public programs and exhibitions held to celebrate 50th Anniversary of CACO establishment: Poster Exhibition at Salt Pond Visitor Center, Month of September – 15 different posters on CACO natural resources and the insights into them gained from I&M were created and displayed at the Salt Pond Visitor Center Exhibition Room the entire month of September.
- Fox, S.E., Y.S. Olsen, and I. Valiela. 2010. Controls acting on benthic macrophyte communities in a temperate and a tropical estuary. In *Coastal Lagoons: Critical habitats of environmental change*. Kennish, M. and H. Paerl (editors). Taylor and Francis.
- Fox, S.E., Y.S. Olsen, and A. Spivak. 2010. Effects of bottom-up and top-down controls and climate change on estuarine macrophyte communities and the ecosystem services they provide, p. 129-145. In P.F. Kemp [ed.], *Eco-DAS VIII Symposium Proceedings*. ASLO. [doi:10.4319/ecodas.2010.978-0-9845591-1-4.129].
- Fox, S.E., Y.S. Olsen, and I. Valiela. 2010. The effects of warmer temperatures on *Spartina alterniflora* and sediment characteristics. New England Estuarine Research Society Meeting, Provincetown, MA, October 2010.
- Fox, S.E., and H.K. Bayley. 2011. Long-term water quality monitoring programs at Cape Cod National Seashore. Water Quality Instrumentation Workshop, Truro, MA, March 2011.
- Fox, S.E., Y.S. Olsen, M. Teichberg, and I. Valiela. 2011. The relative roles of seagrass and macroalgae as habitat and food in Waquoit Bay estuaries with different nitrogen loading rates. Waquoit Bay National Estuarine Research Reserve Research Exchange and Funding Opportunities, Woods Hole, MA, April 2011.
- Fox, S.E., M. Adams, K.C. Medeiros, and M.C. Tyrrell. 2011. Climate change in Cape Cod National Seashore. CACO Alumni Weekend. Provincetown, MA, September 2011.
- Fox, S.E., Y.S. Olsen, and I. Valiela. 2011. The effects of warmer temperatures on *Spartina*
-

-
- alterniflora and sediment characteristics. Abstract submitted, Coastal and Estuarine Research Federation, Daytona Beach, FL, November 2011.
- Fox, S.E., M. Teichberg, L. Heffner, and I. Valiela. In revision. The relative role of nutrients, grazing, and predation as controls on macroalgal growth in a temperate estuary. *Estuaries and Coasts*.
- I&M and Science Exhibit and Demonstration, SPVC Lobby. All day demonstrations and exhibits on 12 different aspects of CACO I&M/Science program, staffed by CACO I&M staff were held at Salt Pond Visitor Center on September 10, 2010.
- Lee, K.D. 2011. Cape Cod National Seashore Air Quality Monitoring Summary Report. In review.
- Olsen, Y.S., S.E. Fox, M. Teichberg, M. Otter, and I. Valiela. 2011. $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ reveal differences in carbon flow through estuarine benthic food webs in response to the relative availability of macroalgae and eelgrass. *Marine Ecology Progress Series* 421:83-96.
- Roman, C.R., K. Medeiros, D. Cahoon, and J. Lynch. 2001. Monitoring Salt Marsh Elevation Change in the Northeast: Anticipating Habitat Responses to Sea Level Rise. George Wright Society Conference on Parks, Protected Areas, and Cultural Sites. New Orleans, LA.
- Rubino, V., Thiet, R., Smith, S.M., and K.D. Lee. 2011. Soft Shell Clam Re-Establishment as a Potential Mechanism for Macro-Algal Blooms in a Partially Restored New England Salt Marsh. M.S. Thesis-Antioch College. In review
- 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
- Smith, S.M. and M. Tyrrell. 2010. The potential for vegetation restoration in salt marsh dieback areas using erosion control fabric. New England Estuarine Research Society Meeting, Provincetown, MA, October 2010.
- Smith, S.M. and M. Tyrrell. 2011. The potential for vegetation restoration in salt marsh dieback areas using erosion control fabric. George Wright Society Conference on Parks, Protected Areas, and Cultural Sites. New Orleans, LA. March 2011.
- Smith, S.M. 2011. Salt marsh die-back and revegetation at Cape Cod National Seashore. Lifetime Learning Series, Snow Library, Orleans, MA.
- Smith, S.M., J. Wheeler, and A. Thime. 2010. Dune slack wetlands vegetation monitoring, Cape Cod National Seashore, 2009. Technical Report NPS/NER/NRTR—2010/150. National Park Service. Philadelphia, PA.
- Smith, S.M. and K.D. Lee. 2011. Nitrogen-stimulated growth of algae in surface water samples collected from freshwater kettle ponds of Cape Cod National Seashore (Massachusetts, U.S.A.). *Journal of Freshwater Ecology*. In press
- Smith, S. M., V. Decker, and C. Phillips. 2011. Coastal Forest monitoring Protocol, Cape Cod National Seashore. Natural Resource Report NPS/NER/NRR—2011/388. National Park Service, Fort Collins, Colorado.
- Smith, S. M. in review. Monitoring Protocol for Kettle Pond Vegetation of Cape Cod National Seashore, Massachusetts. Natural Resource Technical Report. NPS/NER/NRTR—201X/XXX. National Park Service, Fort Collins, Colorado.
- Smith, S.M. in review. Trends in kettle pond vegetation at Cape Cod National Seashore between 1995 and 2010 and an assessment of current methodologies. NPS Technical Report. Wellfleet, MA
- Smith, S.M., K.C. Medeiros, and H.K. Bayley. 2011. Water temperature as a limiting factor in
-

-
- the colonization of a partially-restored coastal lagoon by a macroinvertebrate herbivore: implications for macroalgal control. *Ecological Restoration* 29:243-251.
- Smith, S.M. and R.S. Warren. 2011. Vegetation responses to tidal restoration. Chapter 4. In: C. Romand and D. Burdick (eds), *Restoring Tidal Flow to Salt Marshes: A Synthesis of Science and Management*. Island Press (in press).
- Smith, S.M., K.C. Medeiros, and M. Tyrrell. 2011. Hydrology, herbivory, and the decline of *Spartina patens* (Aiton) Muhl. in outer Cape Cod salt marshes (Massachusetts, USA). *Journal of Coastal Research* (in press).
- Smith, S.M and M.C. Tyrrell. 2011. Effects of mud fiddler crabs (*Uca pugnax*) on the recruitment of halophyte seedlings in salt marsh dieback areas of Cape Cod (Massachusetts, USA). *Ecological Research* (in press).
- Teichberg, M., S.E. Fox, Y.S. Olsen, I. Valiela, and Others. 2010. Eutrophication and macroalgal blooms in temperate and tropical coastal waters: nutrient enrichment experiments with *Ulva* spp. *Global Change Biology* 16:2624-2637.
- Timm, B.C., and K. McGarigal. In Review. Fine-scale remotely-sensed cover mapping of coastal dune and salt marsh ecosystems at Cape Cod National Seashore using Random Forests. *Remote Sensing of the Environment*.
- Tupper T. A., J. W. Streicher, S. E. Greenspan, B. C. Timm, and R. P. Cook. 2011. Detection of *Batrachochytrium dendrobatidis* in anurans of Cape Cod National Seashore, Barnstable County, Massachusetts, USA. *Herpetological Review* 42(1):62-65.
- Von Holle, B., C. Neill, E.F. Largay, K.A. Joseph, B. Ozimec, A. Copper, S.A. Clark, and K.D. Lee. In review. Ecosystem legacy of the introduced N-fixing tree, *Robinia Pseudoacacia*, in a Coastal Forest. *Oecologia*.

V. Status of monitoring protocols being developed by the Northeast Coastal and Barrier Network (see table following budget page)

VI. 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.

This year, NCBN staff spent a great deal of time and effort to revise and update these tables for each of the parks. Thresholds for each measure were carefully researched in the literature and discussed among experts in that particular field.

Link to NCBN park specific tables:

http://science.nature.nps.gov/im/units/ncbn/annual_report_FY11.aspx

VII. Budget - FY2011 Annual Report Narrative

This year the NCBN received a total of \$802,000 in Vital Signs Monitoring funding to continue implementing monitoring in the coastal parks, \$86,500 from the NPS Water Resources Division to assist with the network's estuarine water quality monitoring program, and \$13,200 in additional funds set aside in FY11 to assist Networks with scanning and uploading reports and documents to the new IRMA system. In FY11 an additional \$200,000 was also transferred to NCBN for the implementation of the North Atlantic Coastal Parks strategy for enhanced monitoring in light of rapid climate change. This funding is shared among three Networks; NCBN, Northeast Temperate Network (NETN), and the National Capital Region Network (NCRN). Only coastal parks from these networks were included in the strategy. At the end of the fiscal year, the Network received regional based funds of \$21,500. In total the Network received a total of \$1,123,200 in FY11. Approximately 30% of this funding was used to develop partnerships (via cooperative agreement/contracts) with 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 52% of the budget in FY11. Travel (3 %) and general operations, equipment purchases, and administrative/office support (15 %) rounded out NCBN expenditures for FY11.

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 FY11, 81.9% 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 8.7% of the budget. Approximately 2.5% of the budget was used for a contract with the University of Illinois for support of air quality monitoring and cation analysis of water samples. Travel to scientific meetings, workshops, and training accounted for 1.1% of the budget. Finally, the data manager position was vacant for FY11 and the salary lapse (5.8%) for this position was absorbed by the park in accordance with CACO policy.

NCBN Budget Summary - FY11 Admin Report

Category: 1_Income

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
	\$21,500.00	Park or Regional \$\$		
	\$802,000.00	I&M - VS Monitoring \$\$		
	\$13,200.00	I&M - Biol. Inventory \$\$		
	\$86,500.00	WRD - WQ Monitoring		
	\$200,000.00	Other Partners		
Subtotal	\$1,123,200.00			

Category: 2_Personnel

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
	\$589,050.00	I&M - VS Monitoring \$\$	NPS	
Subtotal	\$589,050.00			

Category: 3_Coop. Agreements

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
SUNY Stony Brook	\$34,571.00	WRD - WQ Monitoring	University-CESU	
Virginia Inst of Marine Science	\$51,113.00	WRD - WQ Monitoring	University-CESU	
GeoCorp Intern Program	\$21,500.00	Park or Regional \$\$	Other non-Federal	
University of RI-data mgt support	\$70,932.00	I&M - VS Monitoring \$\$	University-CESU	
Rutgers University	\$59,849.00	I&M - VS Monitoring \$\$	University-CESU	
University of Rhode Island-Marsh Bird Monitoring and protocol development	\$98,000.00	Other Partners	University-CESU	
Subtotal	\$335,965.00			

Category: 5_Operations/Equipment

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
Equipment-Office/Monitoring	\$60,838.00	I&M - VS Monitoring \$\$	Other non-Federal	
Vehicle Purchase for SET monitoring	\$24,237.00	Other Partners	Other non-Federal	
Water Level Loggers for SET monitoring	\$19,746.00	Other Partners	Other non-Federal	
Monitoring equipment	\$810.00	WRD - WQ Monitoring	Other non-Federal	

RTK GPS Equipment	\$57,335.00	Other Partners	Other non-Federal
Subtotal	\$162,966.00		

Category: 6_Travel

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
	\$33,181.00	I&M - VS Monitoring \$\$	Other non-Federal	
Subtotal	\$33,181.00			

Category: 7_Other

<i>Description</i>	<i>\$ Amount</i>	<i>\$\$ Source</i>	<i>Where \$ Went</i>	<i>Comments</i>
NER Assessment	\$2,038.00	I&M - VS Monitoring \$\$	NPS	
Subtotal	\$2,038.00			

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.-CESU</i>	<i>Univ_Non-CESU</i>	<i>Other non-Federal</i>
I&M - VS Monitoring \$\$	\$815,888	\$591,088			\$130,781		\$94,019
Other Partners	\$199,318				\$98,000		\$101,318
Park or Regional \$\$	\$21,500						\$21,500
WRD - WQ Monitoring	\$86,494				\$85,684		\$810
Totals	\$1,123,200	\$591,088			\$314,465		\$217,647

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 \$\$	\$815,888	\$589,050	\$130,781		\$60,838	\$33,181	\$2,038
Other Partners	\$199,318		\$98,000		\$101,318		
Park or Regional \$\$	\$21,500		\$21,500				
WRD - WQ Monitoring	\$86,494		\$85,684		\$810		
Totals	\$1,123,200	\$589,050	\$335,965		\$162,966	\$33,181	\$2,038

Expense Totals By Category

Category	SubTotal	Percent
2_Personnel	\$589,050	52.44%
3_Coop. Agreements	\$335,965	29.91%
5_Operations/Equipment	\$162,966	14.51%
6_Travel	\$33,181	2.95%
7_Other	\$2,038	0.18%
	\$1,123,200	

CCEM Budget Summary

Category:

1_Income

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

Category: 2_Personnel

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
SCA/Intern expenses	\$33,053.01	Prototype \$\$ - Park Base		
Personal Services	\$542,090.56	Prototype \$\$ - Park Base		
Subtotal	\$575,143.57			

Category: 3_Coop. Agreements

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
	\$0.00	Prototype \$\$ - Park Base		

Subtotal \$0.00

Category: 4_Contracts

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
NADP, Cation Analysis	\$17,633.00	Prototype \$\$	- Park Base	
Subtotal	\$17,633.00			

Category: 5_Operations/Equipment

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
Equipment, Supplies	\$61,138.27	Prototype \$\$	- Park Base	
Subtotal	\$61,138.27			

Category: 6_Travel

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
Travel	\$7,566.80	Prototype \$\$	- Park Base	
Subtotal	\$7,566.80			

Category: 7_Other

Description	\$ Amount	\$\$ Source	Where \$ Went	Comments
Salary Lapse	\$40,918.36	Prototype \$\$	- Park Base	
Subtotal	\$40,918.36			

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.-CESU</i>	<i>Univ_Non-CESU</i>	<i>Other non-Federal</i>
Prototype \$\$ - Park Base	\$702,400						
Totals	\$702,400						

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>
Prototype \$\$ - Park Base	\$702,400	\$575,144	\$0	\$17,633	\$61,138	\$7,567	\$40,918
Totals	\$702,400	\$575,144	\$0	\$17,633	\$61,138	\$7,567	\$40,918

Expense Totals By Category

<i>Category</i>	<i>SubTotal</i>	<i>Percent</i>
2_Personnel	\$575,144	81.88%
3_Coop. Agreements	\$0	0.00%
4_Contracts	\$17,633	2.51%
5_Operations/Equipment	\$61,138	8.70%
6_Travel	\$7,567	1.08%
7_Other	\$40,918	5.83%
	\$702,400	

Status of monitoring protocols being developed by the Northeast Coastal and Barrier Network (as of October 20, 2011).

Name of Protocol	Protocol Status – Dates for Actual/Expected Milestones			Comments on Protocol Status
	Draft Available	Submitted for Review	Approved by Regional Mgr.	
Coastal topography	July 2010	May 2011	February 2012 (anticipated)	Completed revisions anticipated in Feb 2012 with anticipated final approval in May 2012. Three years of pilot monitoring data collected and analyzed.
Estuarine nutrient enrichment			May 2009	Final peer review complete. Five years of monitoring data collected, analyzed. Annual, 5-yr trend reports forthcoming. 2008 resource brief available.
Forest vegetation			July 2009	(Adopted MIDN protocol ¹ .) Final peer review complete. Three years of monitoring data collected, analyzed, and reported. 2008-2010 Annual reports available.
Invasive species detection	May 2012 (anticipated)			Currently adapting ERMN protocol (Keefer et al., 2010 ²). Draft NCBN protocol anticipated May 2012.
Ocean shoreline position			March 2010	Final peer review complete. Five years of monitoring data collected and analyzed. Annual reports available or in development. ASIS 5-yr trend report in press. 2007 Resource brief available.
Salt marsh birds	October 2012 (anticipated)			Currently adapting Saltmarsh Habitat & Avian Research Program (SHARP) North American Marsh Bird Monitoring Protocols ³ . Draft NCBN protocol anticipated Oct 2012.
Salt marsh sediment elevation	May 2012 (anticipated)			Protocol under development with draft anticipated in May 2012. This is a collaborative effort and dependent on other agencies. Nine years of monitoring data collected and analyzed using CACO prototype protocol (Cahoon et al., 2007 ⁴).
Salt marsh nekton		May 2011	May 2012 (anticipated)	Currently undergoing peer review and revisions by the authors. Completed revisions anticipated in March 2012 with anticipated final approval in May 2012. Four years of monitoring data collected and analyzed. 2008-2010 annual reports available. 2008, 2009 resource briefs available.
Salt marsh vegetation		May 2011	May 2012 (anticipated)	Currently undergoing peer review and revisions by the authors. Completed revisions anticipated in March 2012 with anticipated final approval in May 2012. Four years of monitoring data collected and analyzed. 2008-2010 annual reports and 2008 resource briefs available.

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 Keefer, J. S., M. R. Marshall, and B. R. Mitchell. 2010. Early detection of invasive species: surveillance, monitoring, and rapid response: Eastern Rivers and Mountains Network and Northeast Temperate Network. Natural Resource Report NPS/ERMN/NRR–2010/196. National Park Service, Fort Collins, Colorado.

³ 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).

⁴ Cahoon, D. R., J. C. Lynch, and P. F. Hensel. 2007. Monitoring Salt Marsh Elevation: A Protocol for the Northeast Coastal and Barrier Inventory and Monitoring Network. National Park Service, Kingston, Rhode Island.

Status of monitoring protocols being developed by the CCEM program (as of October 20, 2011).

Name of Protocol	Protocol Status – Dates for Actual/Expected Milestones			Comments on Protocol Status
	Draft Available	Submitted for Review	Approved by Regional Mgr.	
Meteorologic and Atmospheric air quality			September 2001	Implementation is continuous. Anonymous 2001. Summary of Meteorologic and Atmospheric Monitoring Protocols for Cape Cod National Seashore. Long-term Coastal Ecosystem Monitoring Program, Cape Cod National Seashore
Coastal Forests			2011	Finalized in 2011 as Smith, S. M., V. Decker, and C. Phillips. 2011. Coastal Forest monitoring Protocol, Cape Cod National Seashore. Natural Resource Report NPS/NER/NRR—2011/388. National Park Service, Fort Collins, Colorado
Hydrology-groundwater		October 2011	September 2012 (anticipated)	Under review by NER I&M coordinator. Completion anticipated by end of FY2012
Colonial waterbirds			January 2003	Protocol completed and implemented annually. Erwin et al. 2003. Waterbird Monitoring Protocol for Cape Cod National Seashore and other Coastal Parks, Refuges, and Protected Areas. Long-term Coastal Ecosystem Monitoring Program, Cape Cod National Seashore
Kettle Pond WQ	November 2011			Expected to be submitted for review in spring 2012
Kettle Pond Vegetation		January 2011		Smith, S. M. in review. Monitoring Protocol for Kettle Pond Vegetation of Cape Cod National Seashore, Massachusetts. Natural Resource Technical Report. NPS/NER/NRTR—201X/XXX. National Park Service, Fort Collins, Colorado.
Dune Slack Pond Vegetation			November 2010	Protocol implemented every five years. Smith, S.M., J. Wheeler, and A. Thime. 2010. Dune slack wetlands vegetation monitoring, Cape Cod National Seashore, 2009. Technical Report NPS/NER/NRTR—2010/150. National Park Service. Philadelphia, PA.
Forested Vernal Pond Vegetation	June 2007			Protocol implemented every five years. Smith, S.M. 2007 Assessment of vegetation in forested vernal wetlands of Cape Cod National Seashore, 2006. NPS Technical Report. Cape Cod National Seashore, Wellfleet, MA
Pond breeding amphibians			2003	Protocol completed and implemented yearly. Paton, P. W., B. Timm, and T. Tupper. 2003. Monitoring pond breeding amphibians. A protocol for the long-term ecosystem monitoring program at Cape Cod National Seashore. U.S.D.I. 113 pp.
Dune grassland vegetation	February 2006			Protocol being implemented every five years. Smith S.M. 2006. Dune grassland vegetation monitoring - 2005. NPS Technical Report. Cape Cod National Seashore, Wellfleet, MA.
Coastal Heathlands	February 2008			Gwilliam, E. and T. Husband. 2008. Monitoring Protocol for Coastal Sandplain Heathlands and Grasslands of the Cape Cod National Seashore, Massachusetts

Name of Protocol	Protocol Status – Dates for Actual/Expected Milestones			Comments on Protocol Status
	Draft Available	Submitted for Review	Approved by Regional Mgr.	
Landbirds, point counts				Protocol is being written by Mark Faherty and Curtice Grffin, University of Massachusetts, Amhesrt. Draft anticipated by end of FY12.
Meso-mammals				Protocol is being written by Allan O'Connell, USGS. Draft anticipated by end of FY12.
Cover type mapping				Pilot site data collected and analyzed. Report on methods and pilot results anticipated by May 2012
Piping plovers			January 2003	Protocol completed and implemented annually. Erwin et al. 2003. Waterbird Monitoring Protocol for Cape Cod National Seashore and other Coastal Parks, Refuges, and Protected Areas. Long-term Coastal Ecosystem Monitoring Program, Cape Cod National Seashore.
Protocols Developed but Not Implemented				
Migrating waterbirds			January 2003	Protocol completed but not being implemented due to staff limitations. Erwin et al. 2003. Waterbird Monitoring Protocol for Cape Cod National Seashore and other Coastal Parks, Refuges, and Protected Areas. Long-term Coastal Ecosystem Monitoring Program, Cape Cod National Seashore.
Groundwater quality			July 2007	Protocol has been completed, but is not being implemented due to staff limitations. Colman, J.A., and Masterson, J.P., 2007, Monitoring ground-water quality in coastal ecosystems: U.S. Geological Survey Open-File Report 2007–1149, 94 p.
Small mammals			July 2006.	Protocol completed but not being implemented due to staff limitations. Cook, R. P., K. M. Boland, and T. Dolbeare. July 2006. Inventory of Small Mammals at Cape Cod National Seashore with Recommendations for Long-Term Monitoring. Technical Report NPS/NER/NRTR--2006/047. National Park Service. Boston, MA.
Aquatic turtles			July 2007	Protocol completed but not being implemented due to staff limitations. Cook, R. P., K. M. Boland, S.J. Kot, J. Borgmeyer, amd M. Schult. July 2007. Inventory of Freshwater Turtles at Cape Cod National Seashore with Recommendations for Long-Term Monitoring. Technical Report NPS/NER/NRTR--2007/091. National Park Service. Boston, MA.
Marshbirds			January 2003	Protocol completed but not being implemented due to staff limitations. Erwin et al. 2003. Waterbird Monitoring Protocol for Cape Cod National Seashore and other Coastal Parks, Refuges, and Protected Areas. Long-term Coastal Ecosystem Monitoring Program, Cape Cod National Seashore.

Note: The following NCBN protocols are being implemented at CACO either by CCEM or NCBN staff or cooperators. Estuarine Nutrient Enrichment-WQ, Salt marsh vegetation, Salt Marsh Nekton, Coastal Topography, Salt Marsh Sediment Elevation (SET), Ocean Shoreline Position, Marsh Birds