



Monitoring During a Climate of Change

Long-term monitoring documents ecological and physical responses to climate change

Background

In a 2010 interview, National Park Service Director Jon Jarvis stated that climate change is “the greatest threat to the integrity of the National Park System that we’ve ever faced.” Climate impacts related to human activities are being felt across the planet, and the Northeast is no exception. Since 1970 the annual average temperature in the Northeast has increased by 2°F, with winter temperatures rising twice as much. This warming has resulted in many other climate-related changes, including more summer days with temperatures above 90°F, more winter precipitation falling as rain, earlier snow melt resulting in earlier peak river flows, and rising sea surface temperatures and sea level in coastal states.¹

Heat influences many aspects of Earth’s hydrologic systems, such as precipitation, snow, ice, and permafrost, which in turn affects plant and animal life and natural processes such as fire, phenological cycles, and the severity of weather events. A warm atmosphere holds significantly more moisture than a cool one. Depending on weather conditions, much of this moisture eventually makes its way to the earth in the form of rain or snow. Heavy downpours have increased in frequency and intensity in the Northeast, where a 71% increase in the amount of precipitation falling in very heavy events (defined as the heaviest 1% of all daily events) has been documented over the period spanning 1958 to 2012.²

In order to continue to fulfill its mission of leaving parks “unimpaired for the enjoyment of future generations” the National Park Service is looking at new ways to think about and plan for the effects of climate change. Monitoring natural resources in our national parks is an important aspect of this planning and helps park managers understand how ecological systems react and respond to a changing climate. With this relevant and long-term information at hand, better informed managers can make better informed decisions about how to direct their natural resource programs. The Northeast Temperate Network (NETN) of the Inventory & Monitoring (I&M) Program has many ongoing and expanding monitoring, data management, and other well-established projects that are important for tracking the current and future effects of climate change.

NETN Climate-related Programs

HISTORIC & CURRENT WEATHER DATA

NETN is currently compiling decades of climatic data for network parks. Data for all units show that temperatures have increased in the Northeast, and often the amount of precipitation has changed.

FRESHWATER MONITORING

Freshwater habitats are diverse and productive ecosystems providing habitat for aquatic plant, invertebrate, and vertebrate species. Water resources in the temperate northeast are projected to be profoundly influenced by climate change. Long-term projections indicate a substantial range reduction for some cold-water fish species due to increasing water temperatures. The network’s ongoing water quality and quantity monitoring will continue to provide valuable data on hydrological changes in network parks. Current and developing projects include:

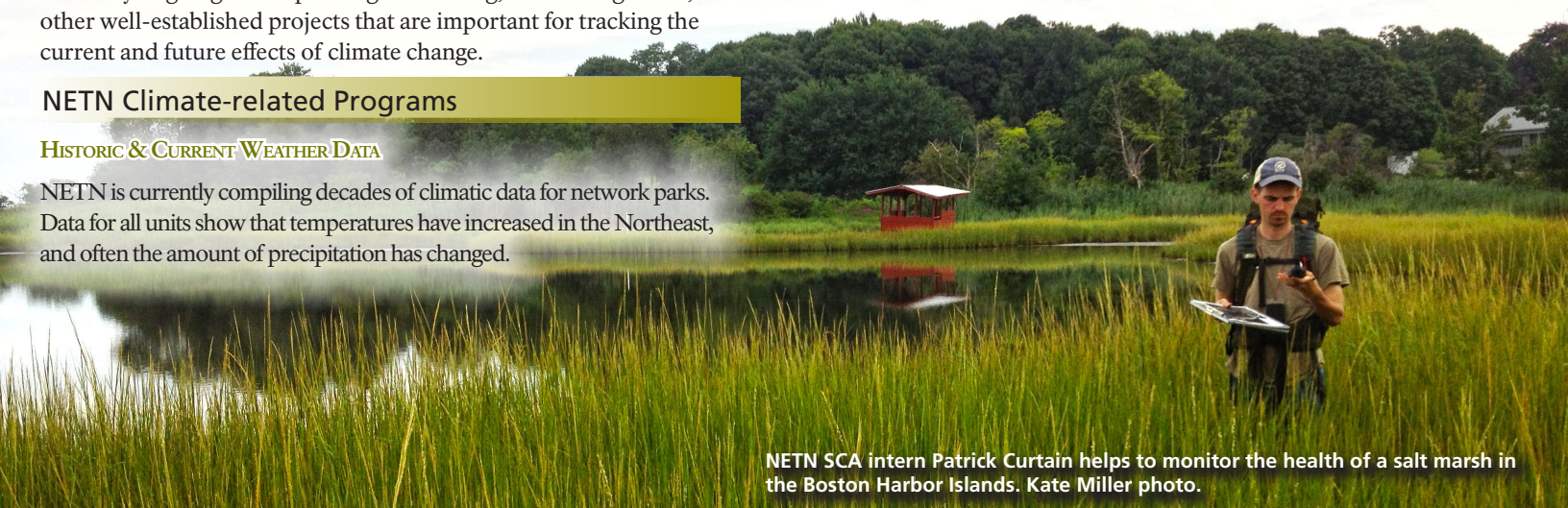
- Timing and quantity of flows at continuous stream / river gauging stations in Acadia NP and Saugus Ironworks NHS.
- Installation of continuous water level, temperature and conductivity sensors at many pond and stream sites.
- Installation of a continuous water quality monitoring buoy at Jordan Pond in Acadia NP.
- Freshwater wetland monitoring at Acadia NP in collaboration with the EPA that includes temperature and water-level loggers.

COASTAL & SALTWATER RESOURCES

With a warming climate comes sea level rise, creating the potential for the submergence of salt marshes and the loss of coastal habitat. There is increasing evidence in the northeastern U.S. that some marsh sites may already be at the early stages of wetland submergence and projected sea-level rise will greatly alter intertidal and estuarine habitat.

At the intersection of terrestrial, freshwater, and marine systems, estuaries and marine wetlands serve a number of important functional roles and are important areas of ecological productivity and exchange. These areas provide nursery habitat for a variety of important fisheries, serve as a resource for migrating birds, and act as natural hydrologic, nutrient, sediment, storm, and wave energy buffers. Coastal monitoring strategies being implemented by NETN include:

- In collaboration with Northeast Coastal and Barrier I&M Network (NCBN), USGS, NOAA, and the Southeast Coast I&M



NETN SCA intern Patrick Curtain helps to monitor the health of a salt marsh in the Boston Harbor Islands. Kate Miller photo.

Network, Surface Elevation Table (SET) and Marker Horizon Method monitoring programs were initiated at Boston Harbor Islands NRA and Acadia NP in 2009 and 2010. The monitoring method measures accretion and erosion by repeated sampling of the height of the marsh relative to a fixed point and depth to artificial marker horizon plots.

- The rocky intertidal monitoring program at Boston Harbor Islands NRA and Acadia NP includes sea-temperature loggers, vertical transects for documenting shifts of cover species, zone-specific photo plots for monitoring cover vegetation and snail species abundance, annually scraped plots for tracking barnacle recruitment, and tidepool transects for documenting sea star and sea urchin abundance.
- Salt marsh vegetation monitoring based on NCBN's draft protocol began in brackish marshes at Acadia and Boston Harbor Islands in 2010.
- Estuarine water quality monitoring at Acadia NP is slated for future implementation.

FAUNA & FLORA MONITORING

Heat stress and decreased soil moisture related to a warming climate will likely negatively affect the productivity of several tree types in the Northeast.¹ Common northeastern stalwarts such as maple, birch, and beech as well as spruce and fir trees could experience a significant northward shift in their growing region. As changes in climate continue to affect distribution and quality of plant and wildlife habitat in both the interior and coastal regions of the Northeast, careful and accurate monitoring of key species will provide vital data on the ways ecosystems are being affected by climate change. Monitoring projects include:

- Since 2006, tracking presence and relative abundance of breeding bird species in forest (most parks), grassland (Saratoga NHP), coastal (Boston Harbor Islands NRA), and mountain (Appalachian NST) habitat.
- Since 2011, monitoring Acadia NP freshwater wetland condition at 10 intensive index sites (in collaboration with EPA) and 40 randomly located rapid assessment sites.
- Since 2006, monitoring forest health in network parks. Data gathered includes tree growth, mortality, regeneration, and understory species presence/abundance. In addition, rare plant species and community monitoring along the Appalachian Trail will detect changes in known occurrences.
- Since the late 1990's, the U.S. Forest Service (USFS) Forest Inventory and Analysis program has installed nearly 4,100 sampling plots near the Appalachian Trail. This collection of plots is part of a national network that the USFS uses to report on things such as tree health, growth, and mortality. NETN has developed a process to use the data to characterize the condition of forest resources around the Appalachian Trail. These data establish a meaningful baseline that should help detect and interpret climate-driven change that may affect the region in the future.

PHENOLOGY MONITORING

Phenology is the study of periodic plant and animal lifecycle events and how they are influenced by seasonal and inter-annual variations

in climate, and is a key indicator of the pace of climate change. NETN partnered with the USA National Phenology Network, Appalachian Mountain Club, University of Vermont, Harvard University, and others to develop methods for monitoring phenology that could be used in areas beyond NETN parks. The monitoring protocol was completed in 2013, and current phenology-related projects and events in the network include:

- Phenology monitoring began in 2009 and continues in Acadia NP, Appalachian NST, Boston Harbor Islands NRA, Marsh-Billings-Rockefeller NHP, Saratoga NHP, and Weir Farm NHS.
- Staff or volunteers visit known plant individuals or locations regularly to record current phenophases of target species.
- Time lapse cameras or webcams photograph plants or forest stands and the resulting photos are analyzed to determine phenophases of target species.
- Audio recorders collect data on vocal phenology of breeding birds and amphibians.
- In 2010, NETN and Marsh-Billings-Rockefeller NHP collaborated with local teachers to produce a middle school and high school curriculum about phenology.



The NETN forest monitoring crew at work in the spruce-fir forests of Acadia National Park. Kate Miller photo.

More Information

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Links & Resources

NETN website: www.science.nature.nps.gov/im/units/netn/

¹ Climate Change in the U.S. Northeast, Union of Concerned Scientists, UCS Publications. 2006.

² Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp.



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