



The Temperate Times

Newsletter of the Northeast Temperate Network

Volume 6, Issue 4 - Fall 2011

Creating a Climate of Change

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. 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 67% increase in the amount of water falling during very heavy precipitation events has been documented over the period spanning 1958 to 2007.

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 regarding how to direct their natural resource programs.

climate, cont. page 3.



Fall evening view from Vermont’s Marsh-Billings-Rockefeller NHP. Ed Sharron photo.

Rock-solid! Saugus Iron Works Geologic Map is Out.

Quite literally, geology is at the very foundation of park ecosystems and provides important data needed for park managers to make better-informed decisions. Based out of Denver, Colorado, the Geologic Resource Inventory (GRI) team helps parks make that connection and understand the role that geology plays in the landscape and environment. Recognizing the interrelationships between the physical (geology, air, and water) and biological (plants and animals) components of the Earth is vital to understanding, managing, and protecting natural resources. The GRI provides more than 270 parks with a geologic scoping meeting, digital geologic map data, and a park-specific geologic report.

Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. For NETN parks, geologic features

include mountains, minerals, rocks, fossils, caves, beaches, dunes, and faults.

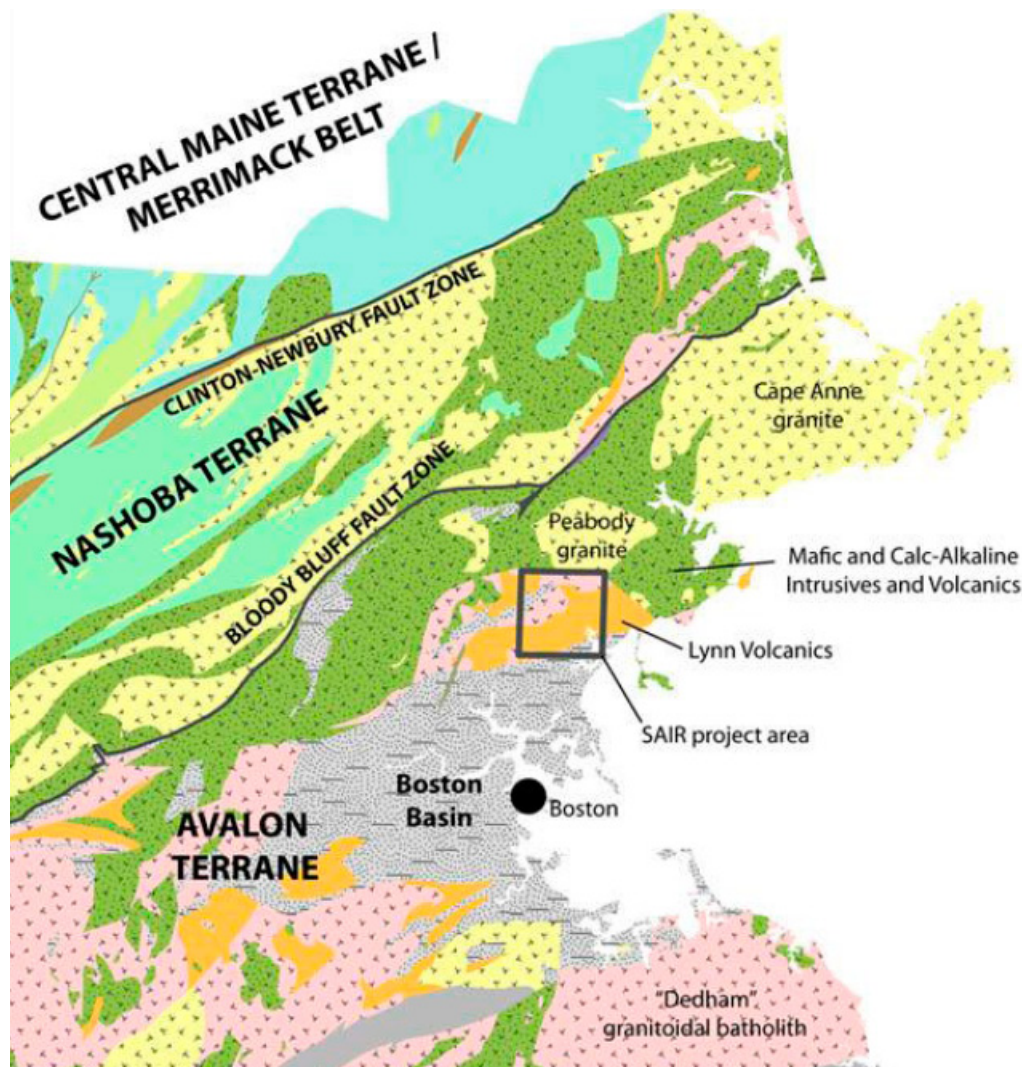
The GRI recently completed a digital geologic map and report for Saugus Iron Works National Historic Site (SAIR). This map is provided in full GIS coverage and can be found on the Integrated Resource Management Applications (IRMA) website at: *Digital Bedrock Geologic Map of Saugus Iron Works National Historic Site and Vicinity, Massachusetts*. The map has also been posted for easy viewing on SAIR's Google Earth module, and can be viewed and downloaded from NETN's Google Earth Park Maps webpage.

Geology is fascinating, but it is also composed of a very specific language filled with descriptions of epochs, orogenies (not a dirty word - really - it essentially means: mountain building event), and with words like NeoProterozoic. For us geology nerds out there, it all makes for fascinating reading, for the other 98% of the public, it can be a little overwhelming. As an example, the

following is a snapshot of part of the report:

The park sits at southern end of rocky uplands that form the northern border of the topographic and geological feature in eastern Massachusetts known as the Boston Basin. In the context of regional geology it is located in a belt of late Proterozoic volcanic, meta-sedimentary and batholithic rocks that are typical of the northern portion of the Avalon terrane (a group of Proterozoic through Cambrian rocks extending along the length of the northern Appalachians) in Massachusetts. The terrane formed in the middle latitudes along the margin of Gondwana during the NeoProterozoic (the last era of the Proterozoic which lasted from about 1.0 billion to 542 million years ago). It was accreted to the margin of Laurentia (proto-North America) in the Paleozoic during the Acadian and/or Alleghenian orogenies; a topic that is still under lively debate in geologic circles.

For all the rest of the gory details, you'll have to download the report!



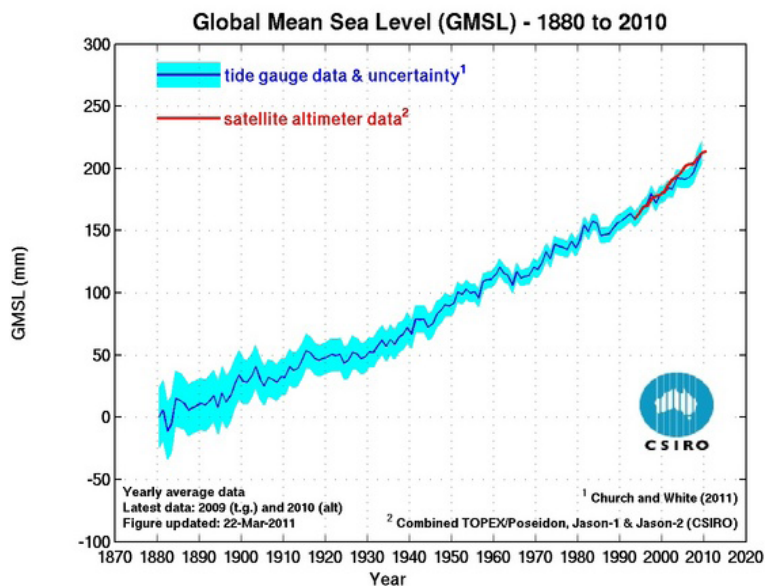
One example of a geologic map produced for Saugus Iron Works by the Geologic Resources Inventory.

climate, from page 1.

The Northeast Temperate Network has many ongoing and expanding monitoring, data management, and other projects important for tracking the current and future effects of climate change. This newsletter article is a sneak-peak at a forthcoming NETN publication on climate change that will explore in detail how NETN monitoring activities will help the National Park Service follow and understand these climate changes, and look at how people have become the primary driver in changing the Earth's climate.

When scientists talk about climate, they are talking about long-term trends. What do the past 10, 50, or 100 years show in terms of average temperatures, precipitation patterns, and storm events? NETN is currently compiling decades worth of climatic data for network parks. Saratoga NHP will be the first to have a report released in the next few months. Long-term trends (1895-2010) show that not only has the parks' average maximum temperature been increasing over the past century, but the average low temperatures have been increasing even faster.

Water resources in the temperate Northeast are projected to be profoundly influenced by climate change. Freshwater habitats are diverse and productive ecosystems providing habitat for a myriad of aquatic plants, amphibians, and insects. Long-term projections indicate a substantial range reduction for some cold-water loving fish species like brook trout due to increasing water temperatures. NETN's ongoing water quality and quantity monitoring will continue to



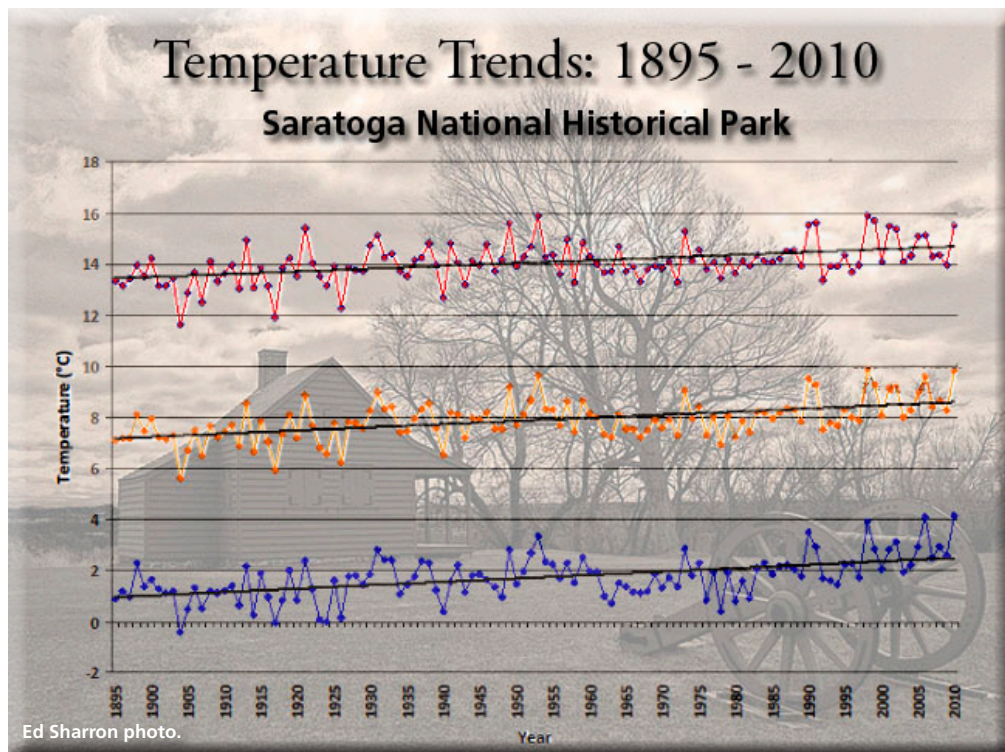
Sea-level rise composite image composed of several papers from the Australian CSIRO (Commonwealth Scientific and Industrial Research Organisation) Marine and Atmospheric Research group.

provide valuable data on hydrological changes in network parks.

Observed sea level rise is tracking at the upper range of the IPCC (Intergovernmental Panel on Climate Change) projections. The estimated sea level rise by 2100 is expected to be somewhere between 2.5 to 6.5 feet. This sea level rise will create problems for island and coastal communities and ecosystems around the world. For NETN, it creates the potential for increasingly saline marshes at Saugus Iron Works NHS, plus the submergence of salt marshes and the

loss of coastal habitat in both the Boston Harbor Islands and Acadia National Park. 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. There are several coastal monitoring strategies currently being developed by NETN. In collaboration with USGS, NOAA, the Northeast Coastal and Barrier I&M

climate, cont. page 5.



In a common trend throughout the region, average minimum temperatures (blue) are increasing faster than average maximum temperatures (red) for Saratoga NHP.

Fall Harvest Time! Vegetation Maps for NETN Parks Continues to Grow

A new vegetation map and report for Marsh-Billings-Rockefeller National Historical Park (MABI) was completed at the end of September. The report is published on both NETN's and the Integrated Resource Management Applications (IRMA) websites and includes descriptions of the local and global expressions of each vegetation association, a field key to the vegetation associations, a plant species list derived from the plot and accuracy assessment data collection, an index to association photographic documentation, and more.

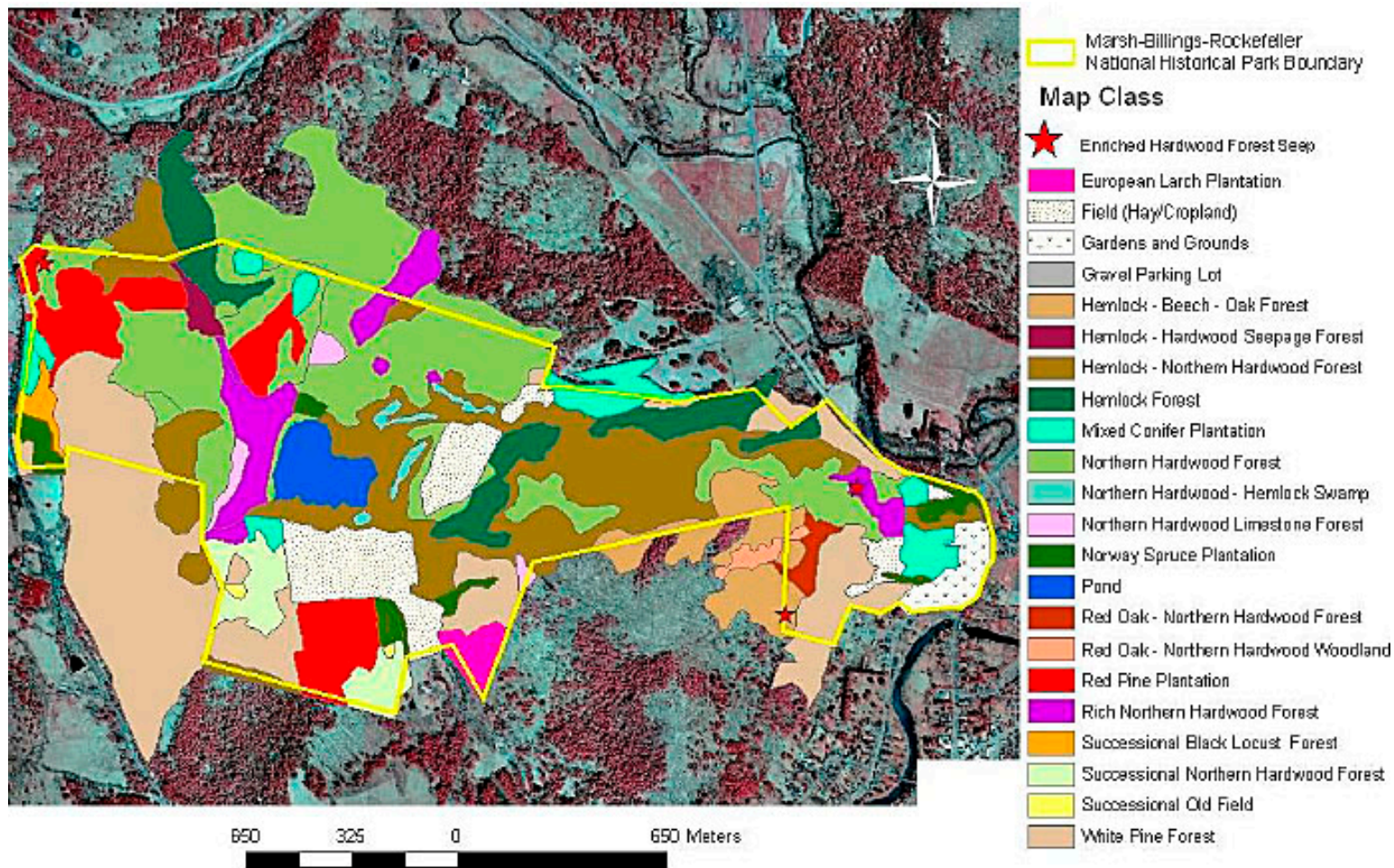
The Vegetation Mapping Inventory program is an effort by the National Park Service to classify, describe, and map detailed vegetation communities in more than 270 national parks across the United States with the primary objective being the production of high-quality, standardized maps and associated data sets of vegetation and other land cover occurring within parks. The inventory of these resources helps park managers conserve plant biodiversity, manage challenges such as exotic species, insect outbreaks, and diseases, and understand resources and processes such as and wildlife habitat relationships and wildland fires.

Eighteen U.S. National Vegetation Classification (USNVC) vegetation associations were described for MABI: eleven upland forest types (including five plantation types), two wetland forest types, one upland woodland type, two old-

field forest types, one upland herbaceous (old-field) type, and one wetland herbaceous type consisting of a very small patch wetland within an upland forest.

Hemlock - Northern Hardwood Forest and *Northern Hardwood Forest* form the dominant vegetation cover in the Park. Many of the historic plantations show signs of natural conversion to Northern Hardwood Forest, and are expected to continue unless there is direct management intervention, or long-term climate changes completely alter forest ecosystems. Invasive plant species and species considered uncommon in Vermont were noted where they occurred on or near the vegetation plots in the report. One variant of the *Rich Northern Hardwood Forest*, the *Northern Limestone Forest*, was pulled out as a unique map class because it is uncommon in Vermont and will likely be monitored by the park.

Detailed descriptions of the local and global expressions of each vegetation association, a field key to the vegetation associations, a plant species list derived from the plot and accuracy assessment data collection, metadata for the vegetation plot data, and an index to association photographic documentation are included as appendixes. You can also view the parks vegetation map and information by downloading MABI's Google Earth module on NETN's Google Earth Park Maps webpage.^{TT}



The final vegetation map for Marsh-Billings-Rockefeller NHP. So colorful it could be just another fall day in Vermont!



Phenology is the study of the seasonal timing of nature, from the blooming of flowers to the migrations of birds. Matthew Aldridge photo.

climate, from page 3.

Network, and the Southeast Coast I&M Network, Surface Elevation Table (SET) and Marker Horizon Method monitoring programs were initiated at Boston Harbor Islands and Acadia in 2009 and 2010. This monitoring method measures accretion and erosion of marshes 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 also continues to progress at Boston Harbor Islands and Acadia with sea-temperature loggers and additional permanent bolts placed along surveyed vertical transects in 2010 to document sea-level rise with more detail (see NETN's Education and Outreach webpage for resource briefs with more details about these programs).

Phenology is the study of the seasonal timing of nature, whether it be the emergence of spring flowers, leaves changing color on trees, or Canada Geese heading south for the winter - and is a key indicator of the pace of climate change. NETN has several ongoing phenology related initiatives and has 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 suitable for use by organizations nation-wide. NETN and partners continue to be on target to complete a multi-method phenology monitoring protocol by the end of next year that features observational, acoustic, and photographic methods. Trained, citizen scientists are often used to observe phenophases of target plant and animal species, and automatic PlantCam® photography of selected trees and plants is used to help pinpoint leaf-out, foliage color change, and first bloom dates. Pilot phenology monitoring began in 2009 and continues in Acadia, along the Appalachian National Scenic Trail, Boston Harbor Islands National Park Area, Saugus Iron Works NHS, and Marsh-Billings-Rockefeller NHP.

If the so-called business as usual approach to our energy needs is pursued, by 2100 the Earth is expected to increase in temperature between another 5 to 10.4 degrees Fahrenheit. For NETN parks, these climatic changes will affect the distribution and quality of plant and wildlife habitat in both the interior and coastal regions of the Northeast. Careful and accurate *climate, cont. page 6.*

Sounds good to NETN!

Staff from the National Park Service's Natural Sounds and Night Skies Division (NSNSD) and NETN Program Manager Brian Mitchell discussed collaborative opportunities during a late September meeting in Fort Collins, CO. The NSNSD aims to "protect, maintain, or restore acoustical environments throughout the National Park System." They work in partnership with parks and other groups to increase scientific understanding and inspire public appreciation of the value and character of *soundscape*s (the human perception of the acoustical environment). What are considered 'acoustic resources' varies to include both natural sounds (wind, water, wildlife, vegetation) and cultural and historic sounds (battle reenactments, tribal ceremonies, quiet reverence).

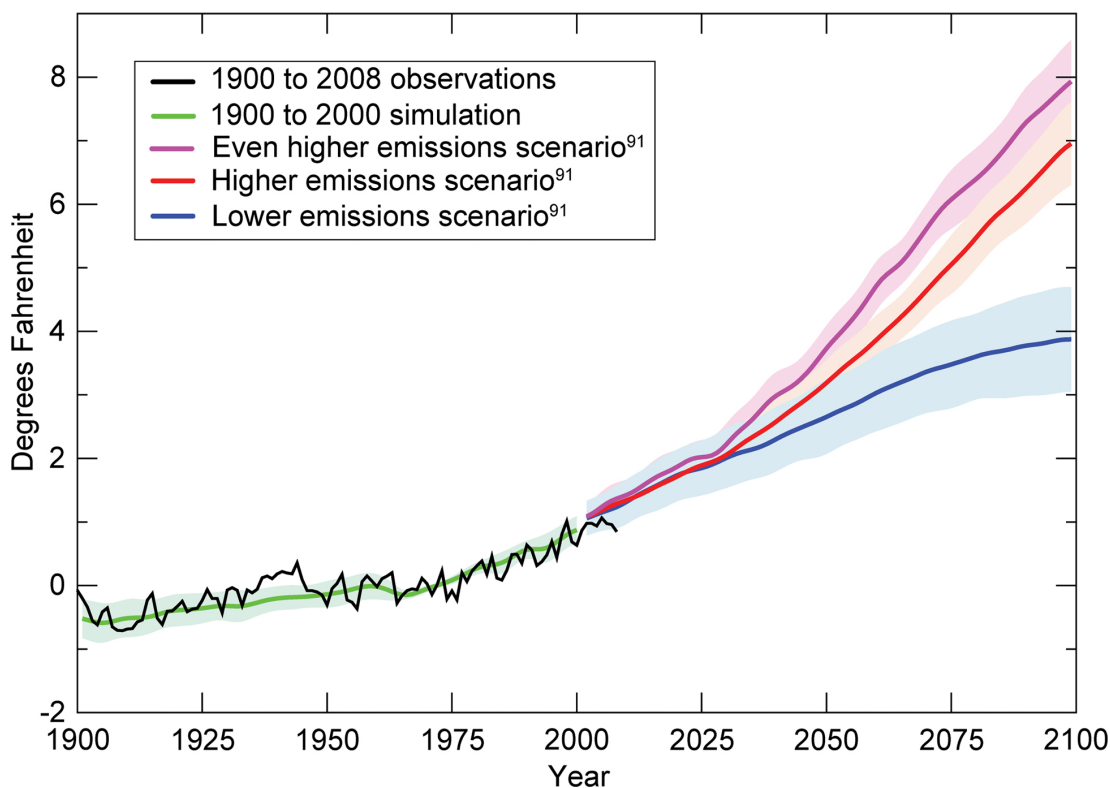
Through its pilot phenology monitoring program, NETN is gaining valuable experience utilizing acoustic equipment and data storage/analysis techniques. NETN and the NSNSD discussed technical issues that are limiting the expansion of acoustic monitoring of wildlife and soundscapes within the NPS as a whole, as well as the potential for increased citizen science-based acoustic monitoring.

NETN and NSNSD staff will continue to work together to improve monitoring and develop interpretive publications and templates that will help highlight the importance of acoustic monitoring and disseminate project results to planners, park staff, and the public.



Battlefield reenactments and Fife & Drum Corps are as much a part of the acoustic landscape as howling coyotes or hooting owls. Samantha Decker photo.

climate, cont. on page 7.



Observed and projected changes in the global average temperature under three IPCC no-policy emissions scenarios. The shaded areas show the likely ranges while the lines show the central projections from a set of climate models. A wider range of model types shows outcomes from 2 to 11.5°F.⁹⁰ Changes are relative to the 1960-1979 average. Graphic is from *Global Climate Change Impacts in the United States*, Cambridge University Press, 2009.

climate, from page 5.

monitoring of key species is crucial to provide vital data on the ways ecosystems are being affected by climate change. 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 these data to characterize the condition of forest resources around the Appalachian Trail, and to establish a meaningful baseline that will help detect and interpret climate-driven change that will affect the region in the future. NETN's primary forest health monitoring program also does this for other network parks.

The challenges surrounding climate change are many, and can appear daunting at times. But climate scientists are clear: human activities are the leading cause of climate change, and we have yet to reach the point of no return when it comes to

the most catastrophic changes. This is good news. If climate change was being caused by some other phenomenon there would be little or nothing we could do to slow its progress. Today, the U.S. still generates half of its electricity via coal burning plants and is the world's largest emitter of greenhouse gases per person — how we choose to get our energy over the next several decades will have a huge influence in determining the ultimate degree of global climate change.

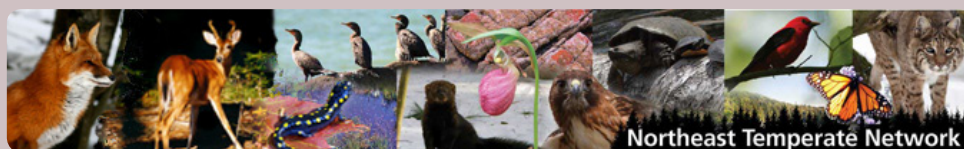
The NPS recognizes that climate change is a complex issue, and responding to it requires coordinated action in long-term planning and policy, and that collective action should promote national and global leadership. The I&M program

is a core part of this planning, and parks will continue to use the information they receive from monitoring activities to help guide their adaptation strategies.

With climate change, the Park Service faces an enormous challenge, but also an equally large opportunity to conserve park resources, lead by example, and provide for the enjoyment of those resources for current and future generations.

NETN Science Communication Specialist Ed Sharron may be available to come to network parks, communities, or schools to talk with park staff, the public, and students about climate change. He can offer a customized 45 minute to 2 hour presentation on climate change and what the NPS/NETN are doing on the mitigation/monitoring front. Plenty of time for questions and discussion are also built into the program. Please contact him at ed_sharron@nps.gov, or 802-457-3368 ex 23 to discuss the details or set up a possible visit.

Northeast Temperate Network
54 Elm Street
Woodstock, Vermont 05091
802-457-3368
<http://science.nature.nps.gov/im/units/netn/>



Northeast Temperate Network