



The Temperate Times

Newsletter of the Northeast Temperate Network

Volume 9, Issue 1 - Winter 2015

Phenomenal Phenology: Parks Looking for Citizen Scientists to Help Track Long-term Seasonal Change

Sometimes referred to as “Nature’s Calendar”, phenology refers to the timing of seasonal or periodic biological events and is a key indicator of the pace of climate change. Phenological events are critical to both people and the functioning of ecosystems and provide one of the most fundamental ways people relate to nature. In the Northeast, phenological events mark the coming of spring with the emergence of the first leaves and butterflies, the sounds and activities of birds and frogs, and the flowing of maple sap. Likewise, leaf color change, southerly bird migration, and crop harvest mark the onset of autumn. Almost every ecological relationship and process—including predator-prey and plant-pollinator interactions, the spread of disease, pest outbreaks, and water and carbon cycling—depends on the timing of phenological events. Scientists are finding that many of these ecological relationships and processes have already been affected by climate change, and more change is inevitable. By monitoring phenology in their parks, NPS staff and volunteers can play a key role in helping to understand the consequences of these changes.

There are several ways a “citizen scientist” can help NETN parks gather information on the phenological processes taking place there. Taking a stroll on Marsh-Billings-Rockefeller NHP’s

Phenology, cont. page 2.

Early Detection of Invasive Species Update

“Invasive species” are alien species that cause or are likely to cause harm to the environment, economy, and/or human health, and are considered to be one of the leading threats to the biodiversity and integrity of ecosystems worldwide. In broad terms, they are organisms that have been introduced deliberately or unintentionally into an environment where they did not evolve, are capable of establishing self-sustaining populations in “untransformed ecosystems”, and have no natural controls to limit their reproduction and spread. These are among the reasons why early detection of invasive species was identified as a priority “vital sign” by several Inventory and Monitoring networks including NETN.

2014 was the 5th year of the invasive species early detection (ISED) monitoring program in Network parks. Park and NETN staff and other groups help to find and report invasive species within park borders. Because the NETN forest crew often ventures beyond the front-country paths and roads of parks, they have helped to detect new target invasive species that may have otherwise gone unnoticed.

The main goal of NETN’s ISED program is to detect invasive species while still in the early stages of establishment when the cost of eradicating them is relatively low. This is accomplished

Invasives, cont. page 4.

Trees and Shrubs *Deciduous (with pollen)*



Species: Acer rubrum
Common Name: red maple
Nickname: red maple- pony pasture
Site: Asters and Maples
Year: 2015
Observer: Leaf Ericson

Directions: Fill in the date and time in the top rows and circle the appropriate letter in the column below.
y (phenophase is occurring); n (phenophase is not occurring); ? (not certain if the phenophase is occurring).
Do not circle anything if you did not check for the phenophase. In the adjacent blank, write in the appropriate measure of intensity or abundance for this phenophase.

	Date: 5/5/15	Date: 5/12/15	Date:	Date:	Date:	Date:	Date:	Date:
Do you see...	Time: 7:45 AM	Time: 8:00 AM	Time:	Time:	Time:	Time:	Time:	Time:
Breaking leaf buds	y n ? <u>Y</u>	y n ? <u>Y</u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>
Leaves	y n ? <u>N</u>	y n ? <u>Y</u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>
Increasing leaf size	y n ? <u>N</u>	y n ? <u>Y</u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>
Colored leaves	y n ? <u>N</u>	y n ? <u>N</u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>
Falling leaves	y n ? <u>N</u>	y n ? <u>N</u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>
Flowers or flower buds	y n ? <u>Y</u>	y n ? <u>N</u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>
Open flowers	y n ? <u>Y</u>	y n ? <u>N</u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>
Pollen release	y n ? <u>Y</u>	y n ? <u>N</u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>
Fruits	y n ? <u>N</u>	y n ? <u>N</u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>
Ripe fruits	y n ? <u>N</u>	y n ? <u>N</u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>
Recent fruit or seed drop	y n ? <u>N</u>	y n ? <u>N</u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>	y n ? <u> </u>
Check when data entered online:	☒	☐	☐	☐	☐	☐	☐	☐

An example data sheet (above) for a red maple tree during the spring. Paper data sheets can either be filled out or data can be entered directly through the use of a smart phone app. Phenophases of red maple trees are pictured below.

Breaking flower buds. Beth Bisson photo.



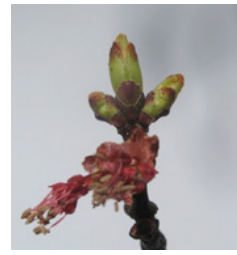
Blooming female flowers. Annakatrin Rose photo



Blooming male flowers. Annakatrin Rose photo



Leaf buds form after flowering. Beth Bisson photo.



Leaves form in spring and persist until fall. Beth Bisson photo.



Fruits form in summer and drop off in fall. Beth Bisson photo.



Phenology, from page 1.

Phenology Trail (other parks may also be creating trails in the future) allows for one-time observations to be made by visitors passing through the park. Those who want to get more involved can help parks by hooking up with the USA National Phenology Network’s (USA-NPN) robust volunteer monitoring program, where it is possible to select one or more of several “core species” within a park near you and visit it throughout the seasons. For example, red maple trees have been selected by all parks as a core species since they are widely distributed and will allow for an apples-to-apples comparison across parks and nation-wide. Many phenological processes, or “phenophases” take place within a red maple tree throughout the year. A phenophase is a specific seasonal life history stage or behavior with a measurable duration, such as the length of time a white wood aster has open flowers, or the period during which male Ovenbirds can be heard singing their territorial song. In the case of the red maple, in spring male and female flower buds form and then bloom on the tree, leaf-buds burst open, and foliage grows by the day. In the autumn, fruits mature and drop

off, and leaves begin to change color and eventually completely fall of the trees by late November. If a citizen scientist selected red maples to monitor within a park, they could relate all this information to park resource managers. Over time, data such as this will be very useful to scientists who are tracking the pace of climate change.

NETN’s monitoring methods were developed together with the USA-NPN, and utilize *Nature’s Notebook*, USA-NPN’s online plant and animal phenology observation program. Organized in 2007, USA-NPN is a nation-wide partnership among federal agencies, schools and universities, citizen volunteers, and others to monitor and understand the influence of seasonal cycles on the nation’s biological resources.

“Status monitoring”, as defined by USA-NPN, is the evaluation of the phenological status of a species over the course of a year using the carefully defined phenophases of that species. For volunteers interested in helping to make repeat observations, training sessions are held annually at each participating NETN park. Training includes a brief introduction to phenology, locations of designated monitoring sites, descriptions of monitored species and phenophases, and directions for submitting data online.

Some phenology monitoring has already occurred in most network parks including Acadia NP, the Appalachian NST, Boston Harbor Islands NRA, Marsh-Billings-Rockefeller NHP, Morristown NHP, the Roosevelt-Vanderbilt NHS’s, Saugus Iron Works NHS, Saratoga NHP, and Weir Farm NHS. Two core habitats (vernal pools and northern hardwood forest) have been identified by NETN and can be monitored at all parks except the Boston Harbor Islands and Saugus Iron Works - the two network parks that do not contain those habitats. At each participating park, at least three sites are selected for phenology monitoring within each monitored habitat. Fifteen plant and 12 animal species (see page 3) that inhabit the two core or optional park habitats have been selected as possible subjects for monitoring. Citizen scientists who want to try their hand

Phenology, cont. page 3.

Phenology, from page 2.

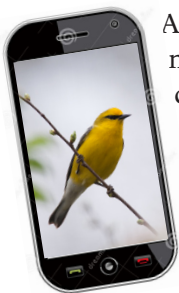
at phenology monitoring in a network park this year should contact NETN Science Communication Specialist Ed Sharron at ed_sharron@nps.gov for more details.^{TT}

Table of potential plant and animal species for phenology monitoring in NETN parks. Core species and habitats are in bold.

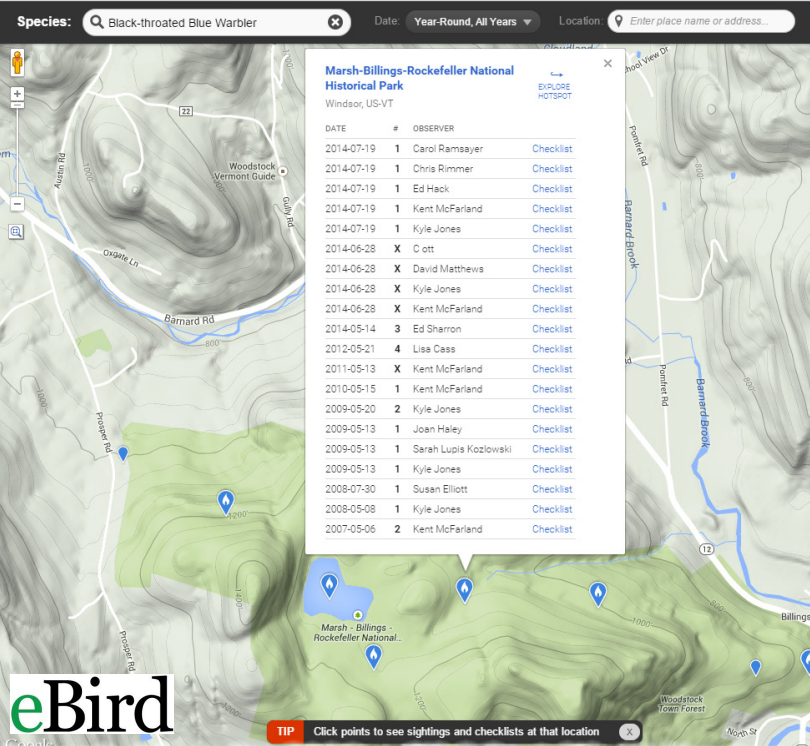
Plant species	Lifeform	Designated habitat
Garlic mustard (<i>Alliaria petiolata</i>)	Forb (herb)	Northern hardwood forest
White wood aster (<i>Eurybia divaricata</i>)	Forb (herb)	Northern hardwood forest
Red maple (<i>Acer rubrum</i>)	Broadleaf tree or shrub	Northern hardwood forest
Sugar maple (<i>Acer saccharum</i>)	Broadleaf tree or shrub	Northern hardwood forest
Marsh marigold (<i>Caltha palustris</i>)	Forb (herb)	Permanent freshwater wetland
Purple loosestrife (<i>Lythrum salicaria</i>)	Forb (herb)	Permanent freshwater wetland
Bunchberry (<i>Cornus canadensis</i>)	Forb (sub-shrub)	Spruce-fir forest Alpine and Subalpine
Painted trillium (<i>Trillium undulatum</i>)	Forb (herb)	Spruce-fir forest Alpine and Subalpine
Hobblebush (<i>Viburnum lantanoi-des</i>)	Broadleaf tree or shrub	Spruce-fir forest Alpine and Subalpine
Balsam fir (<i>Abies balsamea</i>)	Conifer	Alpine and Subalpine Spruce-fir forest
Common milkweed (<i>Asclepias syriaca</i>)	Forb (herb)	Grassland
Rough-stemmed goldenrod (<i>Solidago rugosa</i>)	Forb (herb)	Grassland
Beach pea (<i>Lathyrus japonicus</i>)	Forb (herba-ceous vine)	Coastline
Beach rose (<i>Rosa rugosa</i>)	Broadleaf tree or shrub	Coastline
Rockweed (<i>Ascophyllum nodosum</i>)	Seaweed	Coastline

Animal species	Lifeform	Designated habitat
Spotted salamander (<i>Ambystoma maculatum</i>)	Amphibian	Vernal pools
Spring peeper (<i>Pseudacris crucifer</i>)	Amphibian	Vernal pools
Wood frog (<i>Rana sylvatica</i>)	Amphibian	Vernal pools Permanent freshwa- ter wetland
Common loon (<i>Gavia immer</i>)	Bird	Permanent freshwa- ter wetland Coastline
Herring or Greater black- backed Gull (<i>Larus smithsonianus</i> or <i>marinus</i>)	Bird	Coastline

Endless opportunities for the digitally connected to help parks track natural resources.



As more and more agencies, non profits, and other natural resource based groups become increasingly digitally savvy, a bevy of opportunities for the amateur naturalist or citizen scientist to contribute “crowd sourcing” information to these groups continues to emerge. Armed with a smartphone or an internet connection, people from all backgrounds and ages can contribute valuable information on a whole range of topics of interest to scientists across the globe. Breeding bird populations, plant and animals species sightings, invasive species, and phenological events all have “apps” that allow people to send real-time information to parks and other groups with the click of a button. Programs such as eBird, iNaturalist, What’s Invasive?, and the National Phenology Network have all created apps and websites that are greatly increasing the mass of natural resource information available for park resource managers to include in their decision making processes. Below are a few examples that an increasing number of National Parks use to help them track their natural resources. Give one of them a try on your next foray into a park!



An example of the number of sightings of Black-throated Blue Warblers at one of the eBird Hotspots set up in Marsh-Billings-Rockefeller NHP.

Birds: eBird (<http://ebird.org/>)

eBird is a real-time, online checklist program and is probably the most successful example of a citizen scientist based natural resource monitoring program out there to date. Started in 2002 by the Cornell Lab of Ornithology and National Audubon Society, eBird’s goal is to make the vast numbers of bird observations made each year by recreational and professional bird watchers easily available to everyone interested in bird populations. It is fast becoming one of the largest biodiversity data resources in existence, with millions (in May 2013, 5.6 million observations from 169 countries were submitted) of bird observations added monthly.

Citsci, cont. page 5.

Invasives, from page 1.

by first developing a modest list of target insect pest and exotic plant species that are specific to each park and recognizable to non-experts. The target list includes species that are either present in the park at low levels and of concern if new populations are detected, or not yet present in the park but threaten ecosystem health and function in the region.

In addition to NETN field crews being trained to search for and report invasive species, park visitors are also being enlisted in the effort to control their spread. Through the use of the *What's Invasive!* app (see page 5) visitors can help parks find and track invasive species.

It is also hoped that the app could prove to be an effective way of engaging younger visitors. Incidental observations generated through the app are important because they allow park managers to focus their survey efforts on specific areas instead of trying to utilize a “needle in a haystack” approach of looking everywhere in the park all at once. Program wide, early detection species were found in 11 different locations among reporting NETN parks during 2014. Below are updates from parks that reported ISED activity during the field season.

Updates by Park

Acadia National Park. Red Pine Scale (*Matsucoccus resinosae*) has been found within park borders, and though not on the park ISED list, its detection illustrates the need for awareness of new species and allows the park to decide what actions (if any) should be taken in response to a new invasion. The park will continue to monitor the extent and rate of its spread, educate the public about the species, and pay special attention to changes in the landscape in the wake of an infestation (e.g. species spikes like woodpeckers on dead/dying trees, new tree regeneration, and hazard tree potential).

Possible new candidates for the park's ISED list include autumn olive (*Elaeagnus umbellata*), which is commonly spread by birds and has the potential to show up in early successional habitat and along roadsides. Another potential new species

Invasives, cont. page 7.

Record Snowfall and Prolonged Cold Snaps in the Northeast? Let's Talk Global Warming!

As the Northeastern winter of 2014-2015 continues to notch new records for snowfall and has proven to be one of the coldest in recent memory, not many people in the region are thinking about a warming world. In fact it is often during weather events like these when some news media outlets run stories with photos of huge snowbanks with titles like “What Global Warming?” or “Northeast Prepares for Another 3 Feet of Global Warming”. And the person who has just shoveled out from the third major blizzard in as many weeks may indeed be wondering how this recent weather relates to a warming climate. Well, as cold and snowy as it has been in the Northeast this year, the opposite end of the country has been experiencing a record-breaking warm winter. In Seattle flowers are blossoming and temperatures have climbed northward of 60 degrees. Nearly all ski resorts in western Washington have partially or completely closed their operations due to lack of snow. Disparate weather situations like these offer some of the best times to engage with people about the phenomenon of “global” warming.



Often when there is a cold snap or major snowfall event in a U.S. city during winter, the above question comes up in some news broadcasts.

Weather and Climate Defined

Before getting into finer detail, defining a couple of commonplace but key terms is critical to laying the groundwork for a discussion about global warming. The first and perhaps most important word is *weather*. Weather can be defined as the state of the atmosphere at a given time and place. It is very specific, local, and ephemeral - a snapshot in time, much like a photograph. This is in contrast to *climate*, which is made up of long-term weather patterns with average

temperatures and precipitation totals (including the typical occurrences of weather extremes) that are used to characterize a particular region. Think of climate more like a documentary movie. It takes many thousands of weather ‘photos’ put together to see the climate ‘movie’ and to tell its story. Much in the same way that trying to use a single frame from a reel of an Alfred Hitchcock movie to figure out the whole story would be fruitless, so is using one isolated weather event in one very specific part of the world to try to understand global climate. The distinction is very important because it is often misplaced references to weather events that are used to either bolster or weaken supposed evidence of climate change. Recent events perfectly illustrate this point: as the specific location of Boston, Massachusetts was breaking records for cold and snow at the specific time of 6:07 PM on February 15th, 2015 (a weather photo), nationally the past few months have been one of the warmest winters on record and much of the western half of the nation remains locked in a multi-year drought. The previous year of 2014 was the warmest year on record for the planet as a whole and was part of the warmest decade on record (climate movie).

Earth is Getting Warmer – Prepare for More Snow. Huh?

Climate scientists have been warning for decades now that a warming climate increases the odds for the Earth to experience more weather extremes including floods, droughts, hurricanes, and - perhaps a bit counter intuitively - record setting snowfall events in some parts of the world. Paradoxically, a warmer atmosphere can produce more snow than a very cold one. As human activity continues to warm the Earth and more moisture is absorbed into the atmosphere, we are steadily loading the dice in favor of more extreme storms in all seasons, including winter. Six of the 10 biggest recorded snow storms in Boston have occurred since 1997, and six of the ten snowiest winters on record there have occurred since 1993 (records began in 1872). Not coincidentally, all 10 of the warmest years globally have taken place since 1997. New England's current

Climate, cont. page 6.

Citsci from page 3.

A fun way to explore some of the data being compiled on the site is to view what scientists call “heat maps”: animated maps of bird sightings represented in shades of orange according to their density, moving through space and time across black maps. To date, more than 300 species have heat maps that show their movements throughout the course of a year.

All of NETN’s parks have had Hotspots set up in them for eBird, meaning that birders can enter their sightings in an ongoing database of bird information. You can also see recent eBird sightings in and near all NETN parks by going to each parks webpage from NETN’s main website where an eBird widget tracks all incoming bird sightings.

Invasive Species: EDDMapS (www.eddmaps.org); What’s invasive! (www.whatsinvasive.org); IPANE (www.eddmaps.org/ipane)

EDDMapS

Early Detection & Distribution Mapping System

EDDMapS is a web-based mapping system for documenting invasive species distributions. It began in 2005 when the Center for Invasive Species and Ecosystem Health at the University of Georgia originally designed it as a tool for state Exotic Pest Plant Councils to develop more complete distribution data of invasive species. Today EDDMapS is essentially an umbrella program that encompasses data from several other databases and organizations (including the ones listed below) as well as volunteer observations to create a national network of invasive species distribution data that is shared with educators, national park managers, conservation biologists, and others. EDDMapS’ goal is to maximize the effectiveness and accessibility of the large amounts of invasive species observations recorded each year and to broaden the understanding of invasive species distribution around the world. As of February 2015, EDDMapS had compiled over 2.6 million records.

One program falling under the EDDMapS umbrella is *The Invasive Plant Atlas of New England*. IPANE’s mission is to create a comprehensive web-accessible database of invasive/potentially invasive plants in New England that is continually updated by a network of professionals and trained volunteers. The database is intended to facilitate education and research that will lead to a greater understanding of invasive plant ecology and support informed conservation management. As with NETN’s Invasive Species Early Detection (ISED) program, an important focus of this project is the early detection of and rapid response to new invasions. IPANE is also available as an app allowing users to report sightings of invasive plants directly in the field.

Much like the other apps reviewed here, *What’s Invasive!* helps track, map and report invasive species in a specific area. Currently the app of choice for NETN’s ISED program, it displays local lists of invasive plants or animals that have been identified by National Park Service resource managers and other groups. Users can help experts pinpoint invasive species by locating them and providing land managers with GPS coordinates, accompanied by a photo and

notes about the observation. The geotagged observations and photos are used to alert park managers about the spread of potentially habitat-destroying species. Users also have the option to go online to whatsinvasive.org and set up their own site for invasive species data collection.



IPAlert is a smartphone based app (currently only available for iPhones) that allows user to download park specific invasive plant information for national parks. Users can also upload individual sightings to help keep track of these species. This program is still growing and only about 20 parks have signed up with Acadia NP being the only NETN representative for the time being.

Phenology: USA-National Phenology Network (www.usanpn.org)



The study of phenology has oft been cited as a great way to engage citizen scientists of all backgrounds and ages. See the article on page 1 for more details and to learn how you can help NETN collect this valuable information. One way to help add to the growing collection of phenology data, whether in a national park or your back yard, is through the USA-NPN’s *Natures Notebook* app. Nature’s Notebook is a website/app designed for citizen scientists to observe and record plant and animal life cycle events. It is recommend that users create an account, and register their location and the plants and animals they’ll be observing online at www.usanpn.org first, and then use this app for going out into the field to record observations through the seasons.

All species: iNaturalist (www.inaturalist.org/)



iNaturalist

iNaturalist began as the Master’s final project of a group of UC Berkeley’s School of Information students in 2008. Today it is a website/app where people can record just about anything they encounter in the natural world, get help with identifications, collaborate with others to collect information for a common purpose, or access observational data collected by other iNaturalist users. User groups include hikers, hunters, birders, professional land managers, and people who just like to learn about what they see outside. The founders want it to be an online social network of people sharing biodiversity information to help each other learn about nature. It’s also a crowd-sourced species identification system and an organism occurrence recording tool.

Though there are legitimate concerns about too much technology and electronics leading to a disconnect with nature, these apps and websites show the other side of the equation. Anyone with a smartphone or an internet connection has been empowered to not only learn more about the natural world around them, but to significantly contribute to the growing global database of natural history information that is becoming an increasingly important tool for scientists to understand and track changes in the environment. Pack your smartphone or tablet on your next outdoor adventure and become a citizen scientist in your neck of the woods! ^{TT}



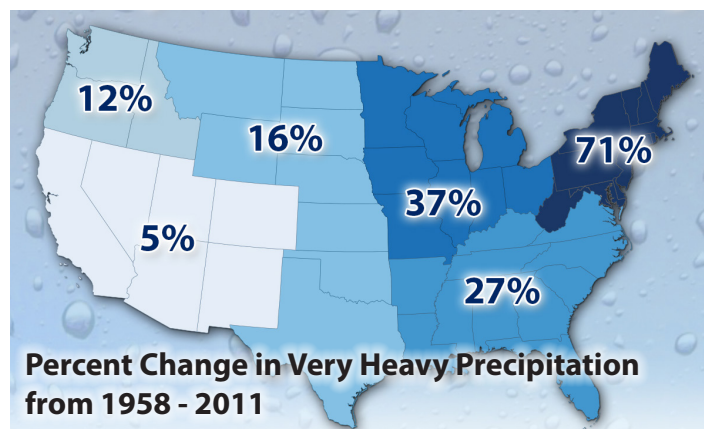
Climate, from page 4.

winter weather woes come as no surprise to scientists who study climate as many have stated that precipitation is likely to continue becoming more intense because of a warming climate, including winter storms.

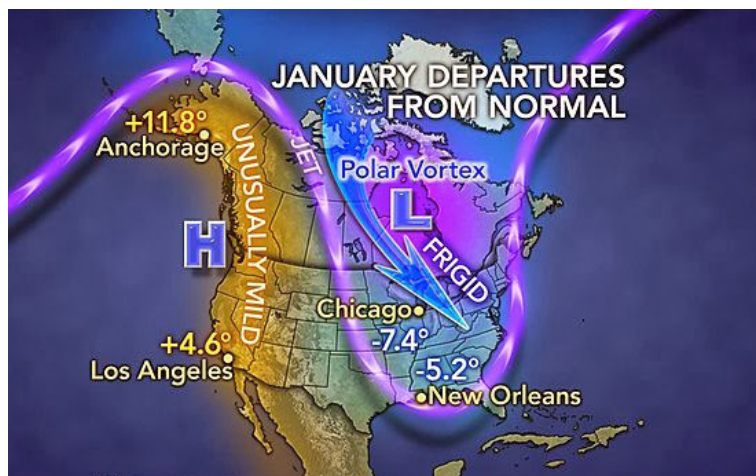
The Warmer the Ocean - the Wetter the Atmosphere

One key factor in this winter's weather is that sea surface temperatures off the coast of New England are experiencing an extreme warm anomaly - about 2°F warmer overall and as high as 21°F warmer than average in some locations. The National Oceanic and Atmospheric Administration has stated that this follows a trend in which sea surface temperatures have been higher during the past three decades than at any other time since observations began in 1880. The laws of physics governing the atmosphere allow for warmer air to evaporate and hold more water vapor, meaning winter storms feeding off of warm seas can produce large amounts of snow. For most conditions at sea level, the atmosphere can hold 4% more moisture per 1°F increase in temperature - which is why it makes sense that a record warm ocean off the east coast and record amounts of snow in Boston are happening simultaneously. The Nor'easters that have been pummeling much of New England this winter get their power from the contrast between cold land temperatures and these warmer surrounding waters. The most recent United Nations Intergovernmental Panel on Climate Change report warned that Nor'easters could grow stronger with climate change as this contrast becomes greater. The "Snowmageddon" event of February 2010 also took place during unusually high sea-surface temperatures in the Atlantic of about 3°F above average that led to large amounts of moisture being fed into the circulation of the storm and resulting in heavy snow amounts in the Washington DC area. Furthermore, this winter fits in to a trend for the Northeast that was highlighted in a recent U.S. National Climate Assessment report: during the period from 1958 to 2011, the region has seen a 71% increase in extreme precipitation. Summer and winter storms are not created by climate change, however they are made worse because of it.

Climate change is likely not only impacting what's occurring in the Northeast, but also the natural disasters and extreme weather in other parts of the country. Long-term trends indicate that the dry are getting drier and the wet are getting wetter.



Increases in extreme precipitation have occurred in all regions of the continental U.S. and further changes are expected in the coming decades.



Accuweather graphic showing extreme troughs and ridges in the jet stream that have taken place in recent years.

The past couple of decades have shown more droughts in the Southwest and Southeast and more floods in the Midwest and Northeast. As for the future, climate change may also be behind why increasing snowfall will continue to happen not only in the next couple of years but possibly for decades to come albeit within a much shorter winter season for the Northeast. Today's 15 or 20 degree snowstorm in a couple of decades could be a 25 or 30 degree snowstorm - as long as it remains cold enough large snow events are likely to continue for some time.

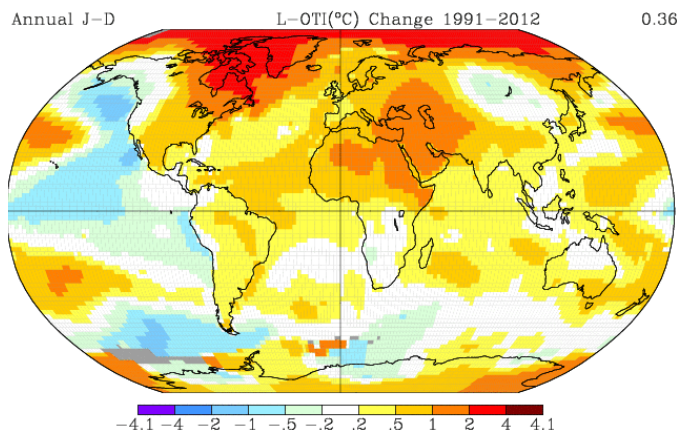
Lazy Jet Stream can lead to Weather Extreme

The prolonged cold snaps in the Northeast this year and last, the warm Western winter, California's drought, and freezing temperatures in the South all have one thing in common: they are being greatly influenced by the exaggerated meandering behavior of the atmospheric jet stream - the high-altitude, high-speed wind that blows around Earth at mid and polar latitudes and transports weather systems across North America. Similarly, early last year a huge, slow-moving swing in the jet stream that was stuck in a "blocking pattern" with a large dome of high pressure that sat across the eastern U.S. for more than a week led to a historic March heat wave that sent temperatures in the Midwest and Northeast up into the 80's. In the U.S., more than 14,000 warm-weather records (record-warm daytime highs and record-warm overnight lows) were set or tied during that month, as compared to about 700 cold records: a 20-to-1 ratio. The strength and location of the jet stream depends on the temperature gradient between the regions of cold and warm air - the greater the difference, the faster, straighter, and stronger the jet stream. This makes some sense to anyone who has ever cracked open the window of a 70 degree house to a world outside that is 10 below zero - there is a noticeable rush of air whooshing past you because of the large temperature gradient. Likewise, opening the window of a 70 degree house to an 80 degree summer's day results in little flow. There are an increasing number of scientists who believe warmer temperatures in the Arctic are causing more amplitude, or bigger waves, in the jet stream. Since the 1990's it has been varying more wildly and more often. Deep dips, or troughs, fill with frigid Arctic air and the places where it stays high in the Arctic (ridges) allows for warm air to settle in below it.

Climate, cont. page 7.

Climate, from page 6.

troughs are a normal part of jet stream activity, the unusual part is that they are lingering in the same place for months on end and have been more persistent in both magnitude, their projection to the south, and location - dipping further south and in the same areas. This reduced temperature gradient between northern and southern areas is causing the westerly component of upper-level winds to slow, especially during the fall when extra heating in the Arctic is at its strongest. These westerly fall winds have weakened by about 14% since 1979. Weaker westerly winds cause the big north/south swings in the jet stream to move more slowly from west to east, making weather conditions in a given location more persistent than they used to be. Instead of swirling around the world, winds more often reverberate back-and-forth in the same place.



Global temperature trend map that show disproportionately faster warming in the Arctic than when compared to the rest of the planet in recent decades. NASA image.

Climate researchers at Rutgers and Wisconsin universities published a study this February that links the ultra-wavy north/south jet stream pattern to rapid warming in the Arctic - where the climate is warming faster than at Earth's middle latitudes due to a combination of human greenhouse gas emissions and unique feedbacks built into the Arctic climate system. Study authors predict this will lead to more extreme weather across the country - possibly for decades to come. The study notes that between 1995 and 2013 - the period when the Arctic began warming disproportionately fast - exaggerated waves over North America became 49% more common during the North American summer and 41% more common in the autumn than they were between 1979 and 1994, before the relatively faster Arctic warming began. The study also warns that future weather patterns, given projections showing that Arctic climate change is likely to accelerate in coming years, will likely increasingly be influenced by Arctic warming far beyond the North Pole for many years to come. In other words - buckle down Northeast. This winter may be one in a long series that packs some serious Nor'easter power and wild temperature swings. ^{TT}

Invasives, from page 4.

is alder buckthorn (*Rhamnus frangula*), which has been the subject of management concern for the past several years and is currently one of the biggest threats for the park.

Marsh-Billings-Rockefeller NHP: Five species on the ISED target list were found in or near the park by staff and cooperators in 2014. Two locations of autumn olive were found just outside the park where a recent timber harvest had occurred. They were located on or near skidder tracks and although the area was outside the park, there is a strong possibility that this shrub will spread into the park following open or disturbed grounds. Common barberry (*Berberis vulgaris*) was found in three locations, two of which were inside NETN forest health monitoring plots. The third location was near the northern boundary of the park. Garlic mustard (*Alliaria petiolata*) continues to persist in the eastern part of the park, despite annual treatment and removal efforts. Many sites are already known to the park, but two new locations were observed by park staff in 2014, including one occurrence inside an NETN forest health monitoring plot. There were one sighting each of multiflora rose (*Rosa multiflora*-observed along a park trail north of the Pogue) and Japanese knotweed (*Fallopia japonica*- reported on the "What's Invasive" app by park staff near the compost area where much of the park's landscape debris is dumped). There were no reports of invasive aquatic plants in the Pogue or elsewhere in the park. The Vermont Department of Forests, Parks & Recreation have confirmed Elongate Hemlock Scale (*Fiorinia externa*) in southeastern Windham County, approximately 60 miles south of park borders. Winter moth (*Operophtera brumata*) has not been detected yet in Vermont, but has been trapped not far from the border in Massachusetts. Other invasive pests that the state is concerned about invading the area around the park are: Red Pine Scale, Brown Spruce Longhorned Beetle (*Tetropium fuscum*) and Oak Wilt (*Ceratocystis fagacearum*).



The rapidly spreading and tenacious invasive Japanese knotweed was recorded within Marsh-Billings-Rockefeller NHP in 2014. NPS image.

Invasives, cont. page 8.

Minute Man NHP: No terrestrial early detection species were observed during 2014 in the park, neither were there any reports of invasive aquatic algae in the Concord River or elsewhere. A possible new ISED candidate is leafy spurge (*Euphorbia esula*) which has been sighted in two locations in the park, one in the forest and the other in a field near the parking lot at the visitor center. The invasive ranking (I-rank) for this species is High/Medium and it could have the potential to invade disturbed and even non-disturbed areas. Although not on the early detection list, signs of heavy defoliation from winter moth were observed in the late spring of 2014. A majority of broad-leaved trees in and around the park were affected. Future forest health conditions, including tree growth rates and mortality, may be affected especially with consecutive years of winter moth outbreaks. Emerald Ash Borer (*Agrilus planipennis* - EAB) continues to expand its range eastward and northward. Since late 2013, new observations have been confirmed in New Hampshire and North Andover, Massachusetts leading to quarantines of Essex County in May of 2014. That said, there is good news to report this year for Asian Longhorned Beetle (*Anoplophora glabripennis* - ALB) control in Massachusetts. After discovery of ALB in Boston in 2010, rapid response efforts have led the USDA's Animal and Plant Health Inspection Service to announce its eradication from the Boston area as of May of 2014.

Morristown NHP: Several current and past early detection species and locations were managed in the park in 2014. Around a ½ acre each of the ISED target species porcelainberry (*Ampelopsis brevipedunculata*) and black swallow wort (*Cynanchum louiseae*) were treated by park staff. Approximately 2 acres each of former ISED species, Oriental photinia (*Photinia villosa*) and siebold viburnum (*Viburnum sieboldii*) were removed, as well as about an acre of Linden viburnum (*Viburnum dilatatum*). In 2013 the park discovered Mile-a-Minute (*Persicaria perfoliata*) within its borders. The plant thrives in sunny places and spread into the park after Hurricane

Sandy created many canopy gaps in park forests and surrounding areas. The state of New Jersey released Chinese weevils to control the spread of mile-a-minute several miles from the park in both 2004 and 2007. The 2mm long weevils eat small holes in young leaves of the plant and lay eggs on leaves and stems. In field cage-tests, weevils

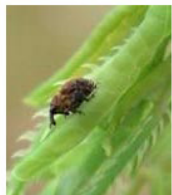


Fig. 1. Adult weevil

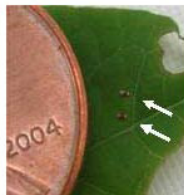


Fig. 2. Eggs (with penny)



Fig. 3. Adult feeding damage

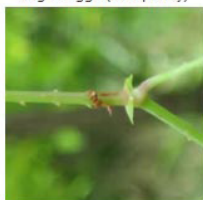


Fig. 4. Larval node damage

Lifestages and feeding sign of the Chinese weevil. Photos by Ellen Lake.

were shown to delay seed production, stunt plant growth, and cause mortality in the presence of competing vegetation. In three intensively monitored replicated release arrays in southeastern PA, the population of the weevil increased and mile-a-minute cover, seed production and/or spring seedling counts decreased significantly. It is hoped that eventually the weevils could find their way to the park and start feeding on mile-a-minute there. As of the fall of 2014 however, no evidence of weevil damage to mile-a-minute was seen in the park.

Saugus Iron Works NHS: There were no early detection reports of either terrestrial or aquatic species in the park during 2014. As with at Minute Man NHS, there is concern about the approach of EAB as it continues to expand its range eastward and northward.

Saint-Gaudens NHS: Garlic mustard was detected along the southeast shoulder of the access road in the park in June of 2014. Several plants were noted growing in and around a ditch and near a culvert that transports runoff under the road toward Blow-me-down Pond. The population is relatively small and can likely be managed without major efforts. Further investigations of the infestation, especially downstream and downhill, may turn up more individuals. No detections of target aquatic species were observed in park waters during 2014.

According to the NH Division of Forests & Lands, Hemlock Woolly Adelgid (*Adelges tsugae* - HWA) was detected just south of the park in Charlestown, NH in 2014. Elongate Hemlock Scale is often associated with HWA and has also been observed on Hemlock trees in New Hampshire. Red Pine Scale, which has the potential to decimate stands of Red pine in the region, has been found in Bear Brook State Park and several towns in central New Hampshire.

Saratoga NHP: One new observation of narrowleaf bittercress (*Cardamine impatiens*) was reported in a forest health monitoring plot in June of 2014. A few sporadic individuals were seen in and around the plot during an additional species search. It is not obvious how these individual plants made it into this area, however there are sections of disturbed soils near the plot and proximity to the road is relatively close. It is recommended that bittercress be kept on the ISED list since the population seems isolated for now, yet has the potential to spread widely along disturbed areas near the tour road and into the forest even further.

Weir Farm NHS: There were no early detection reports of either terrestrial or aquatic species in the park during 2014. As of late summer 2014, EAB had been identified in 38 towns and five counties in Connecticut, including the park's own Fairfield County. Quarantines have expanded to central and western Connecticut including Middlesex County this year. EAB had not yet been found in the park as of fall 2014. ^{TT}



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



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