



Fall foliage coats the hills of Vermont while a rainbow forms in the distance. Ed Sharron photo.

Phenology Monitoring

Northeast Temperate Network Program Brief



Monarch
Butterfly

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.

Why monitor phenology?

Scientists are finding that many ecological relationships and processes have already been affected by climate change, and more change is inevitable.

Studying phenology provides information for national park managers and local examples of the effects of climate change that are relevant to visitors and the communities surrounding parks. The Northeast Temperate Network (NETN) is one of several national park programs and partners that are utilizing techniques such as citizen-science data collection and remote sensing for monitoring phenology, and then using the results to inform science, management, and education. These activities will make significant contributions to the NPS's understanding of the effects of climate change and how best to communicate climate change science to the public. Tracking phenology will also enhance information gathered from other monitoring efforts such as water quality, animal population sizes, and forest health.

How is the monitoring done?

Citizen scientists, remote cameras, and automated recording devices all help track nature's sounds and sights.

Monitoring methods were developed together with the USA National Phenology Network (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 of agencies, schools, volunteers, and others to monitor and understand phenology.

Depending on the monitoring goals and capacity of their volunteer community and park staff, parks rely on combinations of trained volunteers, staff, and automated cameras and audio recorders to observe the phenological status of a particular target species. "Status monitoring", as defined by USA-NPN, is the evaluation of the phenological status of a species over the course of a year using carefully defined "phenophases". 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

Right: The aptly named Red-winged Blackbird is a harbinger of spring across much of its range. Kelly Colgan-Azar photo.



Below: Red maple trees produce some of the first flowers to appear in early spring. Red maple are also a USA-NPN calibration species because they are ubiquitous across much of North America. Annakatrin Rose photo.





Above: Volunteers being trained to monitor birds, trees, and plants at Marsh-Billings-Rockefeller NHP in Vermont. NPS photo.

Trees and Shrubs *Deciduous (with pollen)*

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.



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

	Date: 5/5/15	Date:	Date:	Date:	Date:	Date:	Date:	Date:
Do you see...	Time: 1:45 PM	Time:	Time:	Time:	Time:	Time:	Time:	Time:
Breaking leaf buds	y n ? 20% to 1,000	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Leaves	y n ? 25-45%	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Increasing leaf size	y n ? <25%	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Colored leaves	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Falling leaves	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Flowers or flower buds	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Open flowers	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Pollen release	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Fruits	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Ripe fruits	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Recent fruit or seed drop	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Check when data entered online:	☐	☐	☐	☐	☐	☐	☐	☐

Above: A sample of a datasheet for monitoring red maples.

flowers, or the period during which male Ovenbirds can be heard singing their territorial song.

Automated monitoring using relatively inexpensive time-lapse cameras helps to provide a more complete observational record of individual plants and allows for automated detection of certain phenophases at the individual and stand scales. Automated audio monitoring is very effective at capturing the breeding vocalizations of frogs, toads, songbirds, and some insects, as well as trends in the general soundscape.

Phenology monitoring is one of NETN's newest programs, and it will take place in network parks where resource management staff are able to coordinate monitoring activities for their park. 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 NRA and Saugus Iron Works NHS - the two network parks that do not contain those habitats. Park staff can also

choose to monitor optional habitats that occur in their park.

How is the information delivered to parks?

Reports and access to the USA-NPN website will provide the 411.

Annual reporting will include descriptive statistics for select phenophases of monitored species, and once 10 years of data have been collected, network staff can begin to analyze and report on trends in phenology and explore correlations

between phenological data and climate variables. This will allow for the development of hypotheses about impacts of climate change on phenology.

More information:

For protocols, annual reports, dataforms, and briefs:

NETN website

<http://go.nps.gov/phenology>

USA-NPN website

<https://www.usanpn.org/>

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