



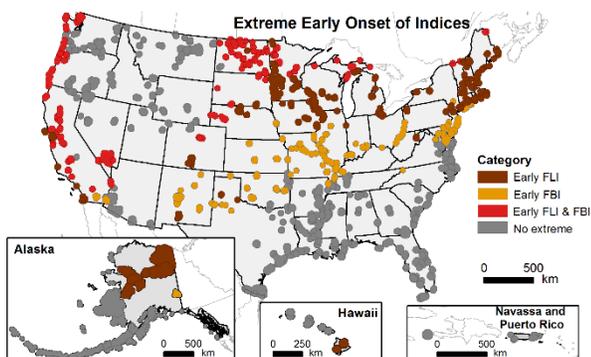
US Fish and Wildlife Service and the USA National Phenology Network

Helping the US FWS Achieve Its Mission

Understanding the seasonal cycles of plants and animals, how they are changing, and how these changes can inform management, operations, and interpretation is critical to the mission of the US Fish and Wildlife Service (FWS): to work with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. Phenology monitoring is particularly relevant to the management of national wildlife refuges.

Why Phenology?

Observations of phenology describe key aspects of ecological variability, and serve as indicators of climate change impacts on refuge ecosystems. Phenology is an essential biodiversity variable that aids in understanding species interactions, water availability, carbon cycling, and disturbances such as fire and pest outbreaks—the temporal component of nearly all ecosystem functions. Knowing whether flowering is becoming asynchronous with arrival of pollinators, or whether leaf production tracks with earlier snowmelt, helps managers understand the threats to ecosystem integrity.

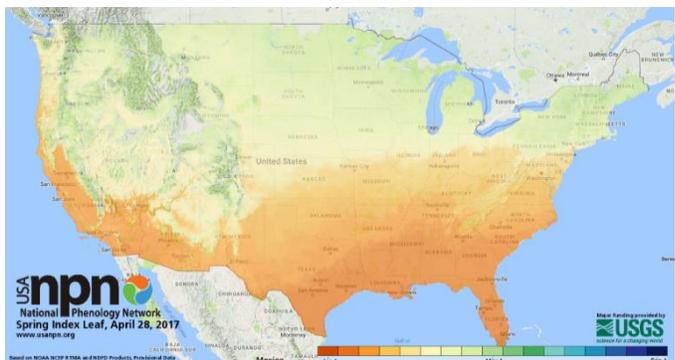


Spring is advancing in 3 out of 4 national wildlife refuges studied (points on map). First Leaf Index (FLI) and First Bloom Index (FBI) are now arriving extremely early (exceeding 95% of historical conditions) in 50% of refuges. The USA National Phenology Network provides essential monitoring and research to help refuge managers anticipate and respond to these early spring conditions.¹

Informing Refuge Planning and Operations

Phenology information provided by the USA National Phenology Network (USA-NPN) informs almost all typical refuge resource management practices—e.g., the management of fish and wildlife populations, invasive species, wildfire risk, and water resources—as well as planning activities, such as identifying vulnerable species, anticipating future conditions, and developing annual work plans.

Changes in phenology and lengthening growing seasons influence many basic aspects of managing wildlife refuges, including timing of peak visitation, the timing of staffing and facility needs, and strategies for managing water and landscaped areas. The USA-NPN provides phenology information that is essential for intelligent planning of future refuge staffing, budgeting, and operations.



The USA-NPN has developed short-term springcasts that use weather data to forecast the onset of spring across the country. USA-NPN data are also used in models of longer-term changes in phenology. These forecasts provide essential tools for planning resource management and other parts of refuge operations.²

Engaging the Public in Science

Phenology is one of the best ways to engage people of all ages in science. Day visitors, school groups, volunteers, and local community members can all contribute observations and learn about how refuge ecosystems are changing. By participating in phenology citizen science and associated programming, volunteers can see firsthand how science informs refuge

management and become better stewards. Volunteer efforts expand refuge capacity by collecting data at greater frequency and in more locations than refuge staff alone.

Robust Standards and Information Management

The USA-NPN relies on peer-reviewed, published protocols that maximize information quality and content and permit different kinds of analysis. The USA-NPN also provides robust information management tools and data products that are peer-reviewed and compliant with federal information policy, ensuring data quality, discovery, accessibility, reuse, and long-term curation. USA-NPN infrastructure complies with the Privacy Act and Paperwork Reduction Act (OMB Control #: 1028-0103).

Cost-Effective Information

The USA-NPN provides roughly \$200,000 worth of information directly for Refuges each year at a minimal cost. USA-NPN protocols are used by scientists and citizen science volunteers around the country, resulting in a broader value of over \$3 M worth of data per year that can be leveraged by FWS for landscape and national-scale inference. The rate of USA-NPN-informed publications and data products released increase each year.³

USA-NPN in National Wildlife Refuges

- Nearly 200,000 phenology records have been collected on national wildlife refuges.
- 175 species are monitored on national wildlife refuges, including migrant birds such as Sandhill Cranes and Swainson's Hawks, wildlife forage species such as quaking aspen and diamondleaf willow, and keystone forest species such as cottonwood and maple.
- 80% of refuges report they are meeting their science and outreach goals for phenology.

On-the-Ground Examples

Midway Atoll National Wildlife Refuge used phenology monitoring to determine the best time to treat invasive *Verbesina encelioides*. They are now using the data to time to limit spread of this damaging invasive plant.



Kupu Americorps intern Wieteke Holthuijzen monitors golden crownbeard (*Verbesina encelioides*), at Midway Atoll NWR
Photo credit: Ann Humphrey, USFWS

Data from a phenology trail established in Valle de Oro National Wildlife Refuge have informed the timing of restoration activities to promote the establishment of native plants and to inhibit the spread of invasive plants.⁴

The US Fish & Wildlife Service is seeking to better understand where and when nectar sources are available for endangered lesser long-nosed bats (*Leptonycteris curasoae yerbabuenae*) while they are in southern Arizona raising their young. Volunteer observers are tracking the timing of food availability over the course of the summer and fall seasons using *Nature's Notebook*.⁵

Plans for the Future

The USA-NPN will continue working with refuges to collect data tailored to specific goals of resource management, education, and operations while following standard protocols and data archiving practices. The USA-NPN will create tools to enable FWS to compare data between refuges and their surrounding landscapes. The network will also continue to cultivate and grow the community of researchers, managers, and educators exploring links between phenology, management, and learning that will help the FWS achieve its mission.

This info sheet has been peer reviewed and approved for publication consistent with USGS Fundamental Science Practices (<http://pubs.usgs.gov/circ/1367/>).



References:

1. Waller et al. 2018. PLoS ONE In Press
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Find out more at
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refuge collaborators and
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