

# Tracking seasonal changes to support science, natural resource management, and society

*The USA National Phenology Network is a national-scale monitoring and research initiative focused on collecting, organizing and delivering phenological data, information, and forecasts to advance the science of phenology, to support natural resource management and decision-making, and to promote understanding and appreciation for phenology by a wide range of audiences.*

## WHY IS PHENOLOGY IMPORTANT?

Phenology – the timing of recurring plant and animal life cycle stages, such as leafing and flowering, insect emergence, and bird migration – is highly responsive to local environmental conditions. Changes in temperature and precipitation may cause timing of events like leaf-out and insect emergence to vary noticeably from year to year and place to place. Further, phenology is a clear indicator of the impact of climate change on plants and animals – many seasonal events have shifted days to weeks earlier in recent decades, in response to warming temperatures.

The USA National Phenology Network (USA-NPN) supports a diversity of applications, including:

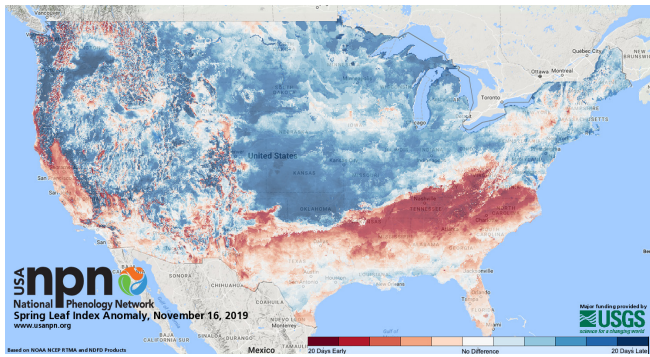
- **Understanding climate change impacts** – Shifts in seasonality (e.g. earlier springs) are resulting in the advancement of leaf-out, migration, egg hatch, and other spring-season biological events.
- **Managing invasive species** – Planning treatment actions to coincide with the life cycle stages when problematic species are most vulnerable to management improves effectiveness of treatment.
- **Restoring ecosystems** – Seed mixes selected for reseeding ideally incorporate a mix of plants that flower throughout the growing season.
- **Predicting allergy season and disease vector activity** – With changing climate conditions, allergy seasons are beginning earlier and increasing in intensity. Vectors of disease are extending into new areas and seasons, impacting both humans and native species.
- **Understanding species interactions and ecosystem functioning** – Differential rates of change in phenology among interacting species affect species abundance, community structure, and nutrient cycling.
- **Understanding and mitigating risk** – Phenological forecasts can help prevent and mitigate the spread and impact of forest pests and invasive plants.

## What is Phenology?

Phenology is the timing of seasonal activity of plants and animals over the course of the year.



The USA National Phenology Network engages hundreds of partners across the country including natural resource management agencies, universities, botanical gardens, nature centers, and other organizations.

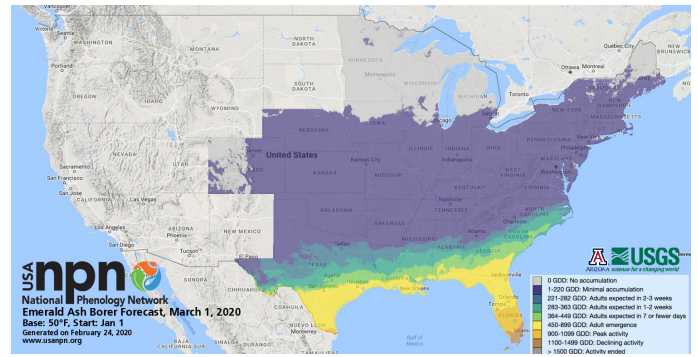


The difference, in days, between spring leaf out in 2019 and the 30-year average (1981-2010). Red colors indicate areas where 2019 was earlier than average; blue areas are later.

### USA-NPN ACTIVITIES AND INFORMATION PRODUCTS

The USA National Phenology Network supports science, natural resource management, and communication by providing data, tools, resources, and connections among partners. The growing suite of resources offered by USA-NPN include—

- **Stakeholder engagement**—Embracing the knowledge co-production model, the USA-NPN develops resources, tools, and information products in close collaboration with end users to increase the application of science in decision-making.
- **Rich, taxonomically diverse phenology dataset**—Through the plant and animal phenology observing program, *Nature's Notebook*, the USA-NPN maintains a rapidly growing data resource that is interoperable with other major national and European datasets. These data have been used in over 80 peer-reviewed publications, resulting in a better understanding of patterns and consequences of changes in phenology.
- **Status of Spring maps**—These maps and short-term forecasts indicate when early-season plants leaf out and bloom across the country and how the current year compares to a long-term average. The maps have been widely referenced and circulated within the news media.
- **Pheno Forecast maps**—Pheno Forecasts indicate the optimal time to take action to control insect pest and invasive plant species. These maps, available in real-time and 6 days into the future, are currently available for 13 species.
- **Growing Degree Day accumulation and anomaly maps**—The accumulation of springtime warmth is a primary driver of plant and animal activity in much of the U.S. These maps indicate the daily, real-time accumulation of warmth across the country relative to typical conditions.
- **Data access and visualization tools**—The USA-NPN accommodates data users of all skill levels in accessing and exploring the data, maps, and products through several online tools, application programming interfaces (APIs), and an R programming language library.



Emerald ash borer 6-day Pheno Forecast, February 24, 2020. Colors indicate the status of adult emergence; yellow indicates adult emergence.

- **Extensive resources and activities to engage and retain *Nature's Notebook* participants**—To ensure high quality, accurate, long-term, and taxonomically deep observations are entering *Nature's Notebook*, our team undertakes extensive activities to recruit, train, and support participants in using our standardized protocols for nearly 1,400 species. These include a diversity of education, training, and outreach materials and frequent, information-rich communications with participants.



*Nature's Notebook* is a plant and animal phenology observing program suitable for nearly all age and skill levels. *Nature's Notebook* has been adopted by hundreds of partner organizations to support management and engagement goals.

The *Nature's Notebook* program offers:

- Standardized, peer-reviewed observation protocols
- Flexible online data collection system including mobile apps
- Customizable platform with administrator rights for local program implementation and management
- Secure, long-term data management
- Ready access to data
- User-friendly data visualization tools
- Comprehensive training materials to support individuals and groups
- Compliance with federal policy governing information management (OMB Control #: 1028-0103)

### PHENOLOGY: A RAPIDLY GROWING FIELD

An appreciation of the need for phenological information is rapidly growing among natural resource managers, researchers, and community members across the country. The USA-NPN is responding to these needs by listening carefully to the problems articulated and working collaboratively to identify, shape, and deliver information products. Partner with us!



#### FOR MORE INFORMATION:

[www.usanpn.org](http://www.usanpn.org)

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