The USA National Phenology Network serves science and society by promoting a broad understanding of plant and animal phenology and its relationship with environmental change.





Taking the Pulse of Our Planet



## **LETTER** FROM THE EXECUTIVE DIRECTOR



The foundation that's been established over the last 10 years is amazing. I would argue that the USA-NPN will become even more valuable in the next 10 or 25 years.

Jeffrey Morisette Member of inaugural USA-NPN Board of Directors

CLIMATE ADAPTATION LEADERSHIP AWARD for natural resources



Greetings! It is with great joy that we celebrated the USA National Phenology Network's 10<sup>th</sup> anniversary in 2018! In October, we had the privilege and pleasure of celebrating this milestone with several of our long-term partners and our co-founders Drs. Mark D. Schwartz and Julio Betancourt. We are still smiling at the memories!

I am amazed by what we've accomplished in 10 years. We've gone from a staff of two to an energetic team of 12. We've grown from an idea to an organization that increasingly supports scientific advancements and natural resource decision-making by offering indispensable data products and information. And we are leading the charge to greater awareness of phenology and its importance to the nation and world. Phenology is now part of the National Climate Assessment, is recognized as an indicator of climate change by the U.S. Global Change Research Program, and is even something that the *New York Times* covers in the spring.

This past year, we placed major emphasis on delivering products aimed at supporting natural resource decision-making. This starts with listening carefully to stakeholder needs, then iteratively developing and delivering data summaries and products—like calendars and maps—that have the greatest value and usability. For example, in spring 2018, we released our first set of *Pheno Forecast* maps (www.usanpn.org/data/forecasts), which indicate when management actions should be taken for key insect pest species. These maps were adopted nation-wide by tree care specialists and foresters. Based on feedback, we are improving and expanding our product line for 2019 to include additional insect pest as well as some invasive plant species.

Our contributions to natural resource management and conservation were acknowledged mid-year, when the USA-NPN National Coordinating Office staff were selected to receive the 2018 *Climate Adaptation Leadership Award* for Natural Resources by the Association of Fish & Wildlife Agencies and Partners. This award recognizes efforts that demonstrate outstanding leadership in developing broad partnerships for advancing the resilience of the nation's living natural resources.

Thank you again—for the 10<sup>th</sup> year!—for your continued support. The diversity, enthusiasm, and commitment of our partners are the reason for our continued success. We are excited to serve your phenological needs for the next ten years and beyond!

Sincerely,

take & West

Jake F. Weltzin, U.S. Geological Survey Executive Director, USA National Phenology Network



## NATURE'S NOTEBOOK'S ACHIEVEMENTS

Publications using contemporary data, models & data products		Data produ	Data products released		Local Phenology Leaders certified	
In 2018	In 10 years	In 2018	In 10 years	In 2018	In 10 years	
10	60	2	68	42	119	

Individual pla	nts observed	Individual animals observed		
In 2018	In 10 years	In 2018	In 10 years	
13,498	40,775	3,857	14,070	

# ADVANCE Science

Understanding what conditions drive phenological events is crucial to generating forecasts of these events. In a recent study, researchers from the University of California, Santa Barbara combined observations of flowering phenology from *Nature's Notebook* with herbarium records from across the nation to identify environmental cues that drive flowering in nearly 2,500 species of flowering plants.

The USA-NPN offers data, models, tools, and resources that lead to advances in understanding of the patterns and drivers of plant and animal phenology. A deeper understanding of phenology leads to improved phenological forecasts and more informed decision-making in natural resource and human health applications.

> A major finding of their study was that factors previously overlooked by most modelers, including the number of frost-free days, the quantity of snowfall, and the initial date of the frost-free period, were important predictors of flowering at the national scale.

> A better understanding of the climate variables that drive flowering phenology can help us anticipate how changes in climate might impact flowering. This research is an example of the discoveries that are taking place using phenology observations and data products offered by the USA-NPN.

Park, I.W. and S.J. Mazer. 2018. Overlooked climate parameters best predict flowering onset: Assessing phenological models using the elastic net. *Global Change Biology*. https://doi.org/10.1111/gcb.14447



Nature's Notebook data is essential to our research because it not only provides us with high-quality phenological information, but also provides highly trustworthy data that can be used to vet the accuracy of other phenological data where accuracy was previously unknown.

**Dr. Isaac Park** University of California, Santa Barbara

Photographs by Brian Forbes Powell

## INFORM DECISIONS



Photograph of endangered whooping crane by Tony Campbell

THE SPREAD OF SPRING LEAF OUT AND BLOOM



Waller, E.K., T.M. Crimmins, J.J. Walker, E.E. Posthumus, and J.F. Weltzin. 2018. Differential changes in the onset of spring across US National Wildlife Refuges and North American migratory bird flyways. *PLoS ONE* 13(9): e0202495.

Spring is arriving much earlier than in previous decades in 76% of U.S. National Wildlife Refuges, though not at a uniform rate across the migration routes of many birds. In three of four major migration flyways, the start of spring is advancing more rapidly at higher latitudes than at lower latitudes. These different rates of advancement may have consequences for food availability for arriving migrants, and ultimately, for birds' long-term survival.

The USA-NPN provides relevant, timely phenological information to support decision-making in a wide range of applications based on needs expressed by user groups.

The changes in the arrival of spring at U.S. National Wildlife Refuges were documented in a study using the Spring Index models curated by the USA-NPN that represent the biological start to the spring season. The research team, a partnership between the USA-NPN and USGS, analyzed patterns in the timing of spring at nearly 500 refuges and four major North American bird migratory routes using Spring Index maps created and maintained by the USA-NPN. The findings of this study offer valuable information to support conservation strategies and protect vulnerable migratory birds under rapidly changing environmental conditions.

This collaboration demonstrates how analytical capacity and information offered by the USA-NPN can support and enhance natural resource management and decision-making.

#### Learn more:

www.usgs.gov/news/will-early-bird-still-get-worm

Refuge biologists are seeing a lot of changes. Through our partnership with USA-NPN we're able to formally document the changes that we're seeing. **Sue Wilder**, US Fish & Wildlife Service



# COMMUNICATE AND CONNECT

### PHENOCHAMPION AWARD



In 2018, we debuted the USA-NPN Local Phenology Program PhenoChampion Award. This award recognizes outstanding achievements by Local Phenology Programs (LPPs). The award program is open to any LPP that actively and consistently collected observational data using Nature's Notebook over the previous two years. Winners are selected based on a clear program plan, sustained support, and demonstrated impact toward short-, medium-, and long-term goals.

In 2018, this honor was awarded to the McDowell Sonoran Conservancy Phenology Program in Scottsdale, Arizona for exemplary performance in establishing and maintaining volunteer observer activity.

Learn more: www.usanpn.org/nn/ PhenoChamp-Award



Cemeteries may seem like a surprising place to observe phenology, but in truth can be ideal spaces for carefully documenting plant and animal status. Set aside as eternal resting places, these green spaces are protected from development and disturbance, ensuring that plants under observation will be preserved.

The Green-Wood Cemetery in Brooklyn, New York, was founded in 1838 and opened to the public in 1842 to offer visitors a sanctuary for solace, reflection, and escape from the surrounding cityscape. Designated a National Historic Landmark for its art, architecture, history, and landscape and an accredited arboretum, this space is an outstanding greenspace for peacefully observing life cycles in plants and animals.

Visitors to the space are invited to join the Green-Wood Phenology Project and record leaf, flower, and fruit status on common trees like red maple and sweetgum and also pollinators like monarchs and bumblebees. The observation sites have been strategically selected to explore the impact of light pollution on plant phenology.

Learn more: www.green-wood.com/phenology

During the set-up of Green-Wood's phenology project I was surprised by how intimately familiar I became with the trees being observed and how much it deepened my understanding of biological processes and botany. For me, capturing the photographs of all the phenophases for each tree species (to curate identification material for volunteers) felt similar to bird watching. There is real excitement from actually sighting what you've spent time learning about from textbooks or online.

Sara Evans, Green-Wood Cemetery

Learn more about how hundreds of other organizations are using *Nature's Notebook* to accomplish their natural resource monitoring and outreach goals at www.usanpn.org/partner/ current. Nearly 400 Local Phenology Programs have adopted *Nature's Notebook* over the past ten years.

## GW GREEN-WOOD

The USA-NPN supports a greater understanding and appreciation for phenology among the general public, scientists, and natural resource managers.

Photographs on pages 6–7 by **Sara Evans**, **Green-Wood Cemetery** 

# **RESOURCES** DURING FY 2018

Base funding for operations was provided primarily by the US Geological Survey. The USA National Phenology Network gratefully acknowledges these additional sponsoring organizations: University of Arizona, US Fish and Wildlife Service, National Science Foundation, and National Aeronautics and Space Administration.



#### SOURCES

USGS Ecosystems Mission Area	\$734,848
USGS Core Science Systems Mission Area	\$34,324
USGS Land Resources Mission Area	\$25,000
US Fish and Wildlife Service	\$160,323
National Science Foundation	\$19,307
National Aeronautics and Space Administration	\$111,098
TOTAL SOURCES	\$1,084,900

# THANK YOU

Our success stems from the many partner organizations and individuals who have helped to build our Network by creating and maintaining long-term phenology monitoring programs, consistently collecting highquality data, and conducting innovative research using USA-NPN data and data products.

## Thank you for being part of our Network.

### **Our Sponsors**









THE UNIVERSITY OF ARIZONA



## **USA-NPN National Coordinating Office Staff**

Jake F. Weltzin, Executive Director; Ecologist, United States **Geological Survey** Theresa Crimmins, Assistant Director; University of Arizona LoriAnne Barnett, Education Coordinator; University of Arizona Ellen Denny, Monitoring Design & Data Coordinator; University of Arizona Kathy Gerst, Data Product Coordinator; University of Arizona Lee Marsh, IT Coordinator; University of Arizona Stuart Marsh, Planning and Administration; University of Arizona Sharon Oliver, Administrative Associate; University of Arizona Erin Posthumus, Outreach Coordinator and US Fish & Wildlife Service Liaison; University of Arizona Alyssa Rosemartin, Partner and Application Specialist; University of Arizona Sara Schaffer, Web Designer & Developer; University of Arizona Jeff Switzer, System Analyst; University of Arizona

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All cover photographs except top, center, by **Brian Forbes Powell**. Top center photograph by **Karin Hildebrand Lau**.

## USA-NPN VISION STATEMENT

The USA-NPN is broadly recognized as the national leader for collection, organization, synthesis and application of high-quality phenological data and information for the benefit of science and society. Our products, tools and information are widely and regularly used for research and to facilitate decisionmaking relative to ecosystem services and climate change adaptation for natural resource management, agricultural systems, and human well-being.

### USA-NPN NCO MISSION STATEMENT

The USA-NPN NCO coordinates efforts among natural resource managers, scientists, and citizen science volunteers to collect phenology observations, offer relevant data and interpretive products to support decision making, and offer high-quality phenology data to support scientific discovery.

### JOIN A CAMPAIGN

You can make exciting new discoveries in your own backyard by participating in a *Nature's Notebook* campaign! By tracking the phenology of species of special interest, you can help researchers and natural resource managers get the data they need to discover how phenology is changing over time and respond accordingly. Sign up for campaigns at www.naturesnotebook.org!



USA National Phenology Network | National Coordinating Office 1311 E 4th Street, Suite 325 | Tucson, Arizona 85721 | usanpn.org