

The USA National Phenology Network



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National Coordinating Office in Tucson

By Susan McGinley

Seasonal changes are all around us: flowers bloom, leaves turn color, butterflies emerge, birds and mammals migrate. By studying the timing of these periodic plant and animal cycles—a science known as “phenology”—scientists learn more about environmental trends across regions. Phenological data and models are important to agricultural planning, drought monitoring and wildfire risk assessment, as well as management of invasive and pest species and infectious diseases.

In January 2007, the US Geological Survey and the University of Arizona jointly established the National Coordinating Office for the USA National Phenology Network (USA-NPN) in Tucson. The facility is housed in the Office of Arid Lands Studies, part of the UA College of Agriculture and Life Sciences and maintained with funding from the UA and USGS.

The USA-NPN is a new partnership between federal agencies, non-profits, the academic community and the general public. The goal is to monitor and understand the influence of seasonal cycles on the nation’s resources, according to Jake Weltzin, the first executive director of the USA-NPN



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“Phenology is as important as other processes and variables monitored at the national scale—such as weather, streamflow, fire outbreaks and disease epidemics—for which it can serve as a predictor,” Weltzin says. “Just as national networks of weather stations and stream gauges are critical for providing national weather, climate and water services, a national phenological network will be critical for providing national biological services.”

These may include understanding and forecasting outbreaks of pollen or the spread of disease, potential for wildfire, behavior and timing of migrating animals such as monarch butterflies or neotropical songbirds, and spring wildflower and fall foliage change. Biological services also involve understanding how earth systems are driven by environmental change to facilitate human adaptation to that change.

Weltzin, most recently an associate professor at the University of Tennessee, is particularly interested in how the structure and function of plant communities and ecosystems might respond to global



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environmental change, including atmospheric chemistry, climate change and biological invasions. His research has spanned temperate and tropical grasslands and savannas, temperate woodlands, deciduous forests and high-latitude peatlands.

“Periodic plant and animal cycles driven by seasonal variations in climate are the most fundamental biological oscillations known to humans,” Weltzin says. “They set the stages for the dynamics of ecosystem processes, determine land surface properties, control biosphere-atmosphere interactions and affect food production, health, conservation and recreation.”

His recent experience as a program director at the National Science Foundation underscored the need to foster large-scale science initiatives such as USA-NPN. As its first executive director, Weltzin’s vision for USA-NPN is “to develop a continental-scale instrument for integrative assessment of global change for researchers that simultaneously serves as an outreach and educational platform for citizens and educators.”

The UA hired Mark Losleben as assistant director for USA-NPN in January 2007, when the National Coordinating Office opened. He had spent the previous 26

years as director of the Mountain Climate Program at the University of Colorado's Mountain Research Station, attaining senior professional status. Losleben has studied climate processes in complex terrain throughout the world, including Mt. Kilimanjaro, Greenland, Switzerland, Barbados, Argentina, Antarctica and the Colorado Rockies, and has a particular interest in the development of climate and ecological measurement networks.

"Phenology is a window through which we can see the effects of climate change in our world," Losleben says. "Its integrative power makes phenology a natural model, accurately tracking the nonlinear effects of climate change that are so difficult for computational models to capture." In the past, computational models have taken quantitative data and reconstructed changes in ecosystems that have already been integrated in plants and animals. By recording the changes in the natural world, scientists can directly track individual species and the climate change effects associated with them. They can use the information to develop models of the environment that will help human societies adapt to changes in ecosystems.

According to Weltzin, the predictive potential of phenology requires a new data resource—a national network of integrated phenological observations and the tools to access and analyze them at multiple scales.

"The key strength of the network is that it is science-based, but its success is predicated on the involvement of the public," Weltzin says. "Scientists collect detailed, intensive observations at a relatively small number of sites, whereas citizens collect less-detailed

observations from an extensive number of sites. When we put it all together, we have a fantastic tool that can help us understand and adapt to climate change."

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One example of public involvement in phenology is a USA-NPN affiliate program called Project BudBurst (www.budburst.org), where people of all ages can report when plants leaf out and bloom across the nation. More extensive plant monitoring programs will be rolled out in 2008, and a national animal phenology program is under development.

"This is an excellent way to engage citizens in climate change research," Losleben says.

"During the past year or two, the general public has become quite aware of climate change—not if there is climate change, but rather *when* it is occurring. Instead of wondering or worrying about it, the average citizen can do something about it by contributing to the national database the NPN is building. Thus, the creation of the USA-NPN is very timely, and its potential to advance climate change research is great."

Agencies responsible for planning and supporting the USA-NPN include National Science Foundation, US Geological Survey, National Park Service, US Fish & Wildlife Service, Bureau of Land Management, USDA-Forest Service and Agricultural Research Services, NASA, National Oceanic and Atmospheric Administration and EPA. ★

USA-NPN National Coordinating Office
www.usanpn.org

Plant Phenology Programs
www.npn.uwm.edu

Project Budburst Citizen Scientist Field Campaign
www.budburst.org

Examples of six areas to which phenological research can contribute

- **Scientific Research**
Effects of climate variability and change, ecological forecast models, ecological synchrony, carbon sequestration, ground truthing for remote sensing, ecohydrology
- **Agriculture**
Timing of management activities (pest and disease control, planting, harvesting, and provision of pollinators), drought monitoring, range management
- **Tourism and Recreation**
Informing tourists when and where to go for seeing bird migrations, wildflower displays, and fall colors
- **Human Health**
Timing and prediction of allergy (hay fever) and pulmonary (asthma) problems. Study of vector-borne diseases (lyme disease, avian influenza, West Nile virus)
- **Natural Resources**
Prediction of forest pest and disease outbreaks, fire management, invasive species management, watershed management, selection of species and varieties to be used in "assisted migration" to conserve ecosystem services as climate changes
- **Education**
School children and citizen scientist involvement in scientific observations; establishing college curriculum in phenology that encourages local observations and educational use of the data products of the network