

THE USA-NATIONAL PHENOLOGY NETWORK

The USA National Phenology Network (USA-NPN) is an emerging and exciting partnership between federal agencies, the academic community, and the general public to monitor and understand the influence of seasonal cycles on the Nation’s resources. The goal of the USA-NPN is to establish a wall-to-wall science and monitoring initiative focused on phenology, the seasonal pulse of the biosphere and thus the gateway to climatic effects on ecosystems and ecosystem services.

Periodic plant and animal cycles driven by seasonal variations in climate are the most fundamental biotic oscillations connected to human activities. 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. Phenological data and models at local to national scales have many scientific and practical applications (Table 1) and are essential in ecological forecasting.

Table 1. Examples of six areas to which phenological research can contribute

<u>Scientific Research</u> Effects of climate variability & change, ecological forecast models, ecological synchrony, carbon sequestration, ground truthing for remote sensing, ecohydrology	<u>Human Health</u> Timing and prediction of allergy (hay fever) and pulmonary (asthma) problems. Study of vector-borne diseases (lyme disease, avian influenza, West Nile virus)
<u>Agriculture</u> Timing of management activities (pest and disease control, planting, harvesting, and provision of pollinators), drought monitoring, range management	<u>Natural Resources</u> 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
<u>Tourism and Recreation</u> Informing tourists when and where to go for seeing bird migrations, wildflower displays, and fall colors	<u>Education</u> School children and citizen scientist involvement in scientific observations; establish college curriculum in phenology that encourages local observations and educational use of the data products of the network

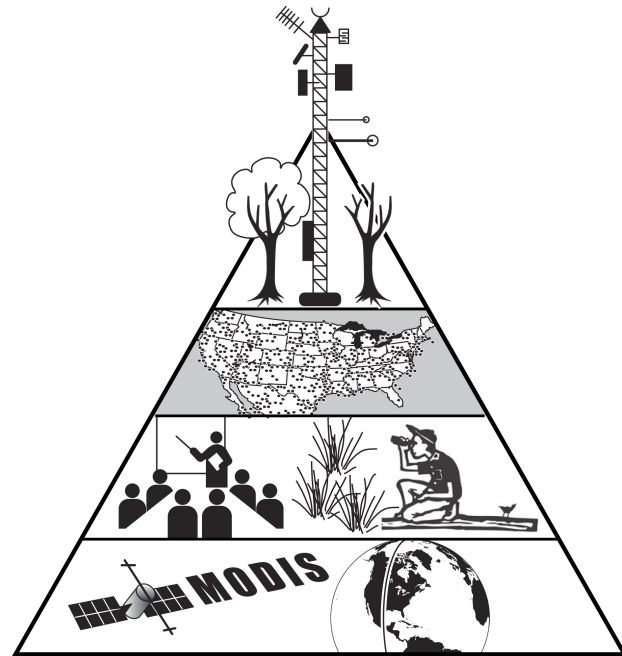
Phenology is as important as other processes and variables monitored at the national scale, such as weather, stream flow, fire outbreaks, and disease epidemics, for which it can serve as a predictor. Just as national networks of weather stations and stream gauges are critical for providing national weather,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

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*. A USA-National Phenology Network is essential to detect and to evaluate ongoing environmental changes, and can now capitalize on integration with

other monitoring efforts, remote sensing platforms and products, emerging technologies and data management capabilities, formal and informal educational opportunities, and a new readiness of the public to participate in investigations of natural systems on a national scale.

USA-NPN will provide phenological information that can be used to understand the role of the timing of life cycle events in the biosphere. It will establish a nationwide network of phenological observations with simple and effective means to input, report, and utilize these observations, including the resources to provide the right information at the right time for a wide range of decisions made routinely by individual citizens and by the Nation as a whole.

The USA-NPN consists of four components or tiers, following the "Framework for Environmental Monitoring and Related Research" recommended by the Committee on Environmental and Natural Resources of the National Science and Technology Council. Each tier represents different levels of spatial coverage and related environmental information: 1) Networks of locally intensive sites focused on process studies; 2) Spatially extensive environmental networks focused on standardized observations; 3) Volunteer and Education Networks; 4) remote sensing products that can be assimilated to extend surface observations.



BACKGROUND and IMPLEMENTATION: Current USA-NPN planning, development, and implementation was initiated by Dr. Julio Betancourt and Prof. Mark D. Schwartz in 2004, and draws heavily from earlier national network visions created by Prof. Schwartz, as well as building on the legacy of regional lilac phenology networks developed and maintained across parts of the country by Dr. Joseph Caprio (Montana State University) and many others.

The U.S. Geological Survey (USGS) and the University of Arizona (U of A) recently reached a cooperative agreement to establish the USA-NPN National Coordinating Office in Tucson, AZ. The USGS will provide base-stable support for the National Coordinating Office, and has hired Dr. Jake Weltzin, most recently an Associate Professor at the University of Tennessee and a Program Director at the National Science Foundation (NSF), as the first Executive Director of USA-NPN. The U of A has hired Mark Losleben as Assistant Director of USA-NPN, and will provide offices and other services at the University's Office of Arid Lands Studies.

USA-NPN research development efforts are being spearheaded by Prof. Mark D. Schwartz, University of Wisconsin-Milwaukee (UWM), as Chair of the recently

established USA-NPN Board of Directors, and as Principal Investigator (PI) for a five-year Research Coordination Network (RCN) grant recently awarded by NSF to move phenological science forward.

Project BudBurst (www.budburst.org) is an annual USA-NPN field campaign for citizen scientists, including individuals, school or other groups. Participants enter their observations of plant leafing and flowering using an online database, and view maps of the results at the end of the campaign. PBB is a collaborative effort between the Chicago Botanic Garden, Plant Conservation Alliance, ESRI, National Science Foundation, National Phenology Network, UCAR Office of Education and Outreach, University of Arizona, University of Montana, University of California – Santa Barbara, University of Wisconsin – Madison, and Windows to the Universe with monetary support from the U.S. Bureau of Land Management. The PBB management team includes Drs. Kayri Havens, Jennifer Schwarz, Sandra Henderson, Carol Brewer and Sara Mulder.

PARTNERS: USA-NPN can benefit from and contribute to many existing local, state, and federal organizations that are concerned about nature and climate. Close collaboration with these organizations represents not only the best use of available resources but also the best scientific practice. There has been wide participation in planning and implementation of USA-NPN from individuals at over twenty universities and participation and support from other federal agencies, including NSF, National Park Service (NPS), U.S. Fish & Wildlife Service (USFWS), Bureau of Land Management (BLM), U.S. Dept. of Agriculture-Forest Service and Agricultural Research Service, National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), and the Environmental Protection Agency (EPA).

The USA-NPN Collaboration Plan seeks to (1) coordinate research activities with existing networks to advance phenological science and develop mechanistic phenological models to support improvement of climate and ecosystem models; (2) maximize the representation of phenological monitoring sites at the national and regional scale to enable biological baseline characterization and trend detection; (3) Provide data and information to policy makers to support land management decisions related to agriculture, forestry, and wildlife conservation in regard to the mitigation of climate change impacts. Collaboration principles include mutually beneficial activities; shared vision on science/education /outreach; minimizing the demand on the capacities of partners; feedback to improve collaboration; and transparent data and information sharing policies.

The most recent USA-NPN workshop, held in Milwaukee, WI on Aug. 27-29, 2007, began drafting Memorandums Of Understanding (MOUs) among agencies and participating networks, including NPS Inventory & Monitoring, USFWS Refuge System, National Weather Service Cooperative Observer Network, Long-Term Ecological Research, Ameriflux, and Organization of Biological Field Stations.

PROJECT PERIOD: This is a long-term observation network, which we hope to maintain indefinitely.

SUPPORT: NSF and 7 agencies have funded the planning effort thus far at a cost of ~\$100K. NSF has also funded a 5-year \$100K/yr RCN grant in support of building USA-

NPN research infrastructure that is administered by Prof. Mark D. Schwartz at UWM. USGS is providing \$270K/yr and the U o fA \$100K/yr to maintain a National Coordinating Office on the University's campus in Tucson. The USFWS has pledged ~ \$100K support for organizing Citizen Science, and BLM supports Project BudBurst - a campaign to recruit volunteers. The organizers of USA-NPN fully recognize that funding levels will have to be ramped up for the network to succeed over both the short and long term. The USA-NPN will need a stable funding level of about \$3-5 million/yr to be fully successful.

WEB SITES:

National Coordinating Office www.usanpn.org

Plant Phenology Programs www.npn.uwm.edu

Citizen Science Field Campaign: Project Budburst www.budburst.org