

Standards and tools for using phenology in science, management, and education

By Carolyn Enquist and Abraham Miller-Rushing

THE USA NATIONAL PHENOLOGY NETWORK (USA-NPN), established in 2007, is a national science and monitoring initiative focused on using phenology to understand how plants, animals, and landscapes respond to environmental variability and climate change. The network is collaborative, involving the contributions of government agencies, tribes, nongovernmental organizations, academic institutions, and individuals across the country.

The national coordinating office (NCO) of USA-NPN maintains an information management system for phenology-related data and information, develops and implements standardized phenology monitoring protocols, facilitates research and the development of decision support tools for resource managers, and promotes education and public engagement activities related to phenology and climate change. In addition the coordinating office facilitates partnerships across organizations, disciplines, and regions.

The tools and services provided by the national coordinating office are rapidly expanding, as is the field of phenology as a whole. Here we list a few of the new tools and services the network provides:

- *Nature's Notebook*, an online Web interface that allows participants to submit phenological observations following peer-reviewed, standardized methods.
- Tools for visualizing or downloading data from Nature's Notebook that can be customized to facilitate local phenology monitoring projects, such as those organized by parks and Inventory and Monitoring Networks, eliminating the need for local projects to create their own databases and other cyberinfrastructure.

- A list of phenology-related citizen science projects.
- Tools for running phenology trainings and workshops.
- A clearinghouse of educational resources and a guide to phenology monitoring for students, teachers, and families.
- An online registry of historical data sets. You can submit records of data sets or search the registry to find data sets to use for research or educational applications.
- *Coming soon:* Peer-reviewed documentation of standard phenology monitoring methods designed to enable collection of sampling intensity and absence data for both plants and animals (i.e., standard operating procedures and protocols) is anticipated in 2012.
- *Next steps:* Development of phenology-based forecast and early warning systems for anticipating the ecological effects of changes in streamflow, drought, temperature and precipitation extremes, and wildfire frequency.

For more information about the USA-NPN, go to www.usanpn.org. For National Park Service-specific activities, go to www.usanpn.org/nps.

About the authors

Carolyn Enquist is the science coordinator with the USA National Phenology Network and The Wildlife Society and can be reached at (520) 622-0363, carolyn@usanpn.org. **Abraham Miller-Rushing** is science coordinator with Acadia National Park and Schoodic Education and Research Center; (207) 288-8733, abe_miller-rushing@nps.gov.