Are Spring Flowers Blooming Earlier in Montana?

by Sharon Eversman

from Kelseya, Spring 2005

We are regularly bombarded with news about global warming. It is clear that the world's glaciers are melting, including those in Glacier National Park (www.nrmsc.usgs.gov/research/glacier_retreat.htm) and on the Beartooth Plateau (Chatelain 1999). It is not as clear what the effects on Earth's plants and animals may be, either currently or in the future. If certain plant species bloom earlier, this could affect their pollinators and relationships with other species in their community (Beaubien & Hall 2003). This paper summarizes research that has been done on impacts of global warming on plant phenology (timing of flowering and other life history events) and suggests some activities that MNPS members may undertake to be part of a monitoring network.

Climate change is not unique to the current time period – known changes have occurred throughout Earth's history. Since the end of the Pleistocene Ice Ages about 10,000 years ago, for example, Earth apparently experienced an especially warm time, the altithermal period, about 3000-5000 years ago. A cold Little Ice Age was in the late 1300's and early 1400's. Global climate change involves alterations in temperature regimes, as well as precipitation distribution patterns. Future events are really unknown, but are being continually modeled, with various conclusions.

Plant phenology ("phen" = show, seem, appear) is the study of periodic events such as bud opening, flowering, pollination and seed set in the life history of the plant as influenced by its environment. Since temperature is important in phenology, observations by gardeners, botanical garden personnel and other botanists around the world have compiled spring flowering dates in various locations, and a pattern of earlier blooming in the spring is emerging in many places, especially in Europe. We know that spring flowering dates from one year

to the next may fluctuate wildly, so long-term monitoring, especially by many observers, becomes valuable. Day (night) length during any one season does not change from year to year, so earlier flowering dates are usually considered to be related to temperature.

In the Arnold Arboretum in Boston, Primack et al. (2004) compared current flowering dates of marked individuals in 10 native genera (*Amelanchier, Cornus, Corlopsis, Enkianthus, Halesia, Magnolia, Malus, Prunus, Rhododendron* and *Syringa)* with herbarium records of time of flowering between 1885 and 2002. The current flowering dates averaged about eight days earlier over the last 100 years, and it appears that the plants were most sensitive to warmer temperatures in February through May, before and during flowering. Timing, of course, varied with variations in temperatures each year, but the trend was toward earlier flowering. The temperature in Boston has risen 1.5°C in the last 100 years in the months of February through May.

In Washington, D.C., Abu-Aseb, et al. (2001), using a database, recorded earlier flowering in 89 of 100 non-cultivated native and non-native species in the last 30 years (1970-1999). In that time, the average minimum temperature for December-May has shown an increase of 1.2° C, and the average time of spring flowering was 2.4 days earlier. False strawberry (*Euchesnea indica*) showed the greatest advance, with an average of 4.6 days earlier, and Dutchman's-breeches (*Dicentra cucullata*) advanced by 3.2 days. Interestingly, 11 species showed later first-flowering dates (3.1 to 10.4 days later). The authors mentioned that the famous cherry blossoms (two species of *Prunus*) have been blooming 6-7 days earlier than they did in 1970.

At the farm of Aldo Leopold in southern Wisconsin, Bradley et al. (1999) compared their records of two phenological events, arrival dates of migratory birds and dates of first spring flowering, during 1976-1998 with those kept by Leopold in 1936-1947. Seventeen of 55 phenological events were statistically

earlier: nine bird species were earlier with first song and/or arrival, and ten plant species bloomed significantly earlier (*Hepatica acutiloba, Phlox divaricata, Aquilegia canadensis, Dodecatheon media, Anemone canadensis, Baptisia leucantha, Rudbeckia hirta, Asclepias tuberosa, A. syriaca* and *A. incarnata*). Since many species respond phenologically to photoperiod, not all species are expected to respond to temperature change alone.

From 1956-1992, Joe Caprio, retired biometeorologist at Montana State University, organized a lilac bloom observation network in Montana, in connection with a nation-wide system. From his collected data (Caprio 1992), I estimate that lilacs bloomed a maximum of 10 days earlier in 1992 than in 1957, with the largest differences being in the northern part of the state. The lilac network evidently became defunct in Montana in 1992, but a new national effort is being organized by a geographer (Dr. Mark D. Schwartz) from the University of Wisconsin-Milwaukee, who is enlisting volunteers to observe lilacs from a single genetic strain to establish a "National Phenology Network" for the entire country (www.uwm.edu/~mds/).

Dr. Schwartz also wants observers of native plants for the National Phenology Network. The plants that have been suggested as widespread plants, and that grow in Montana, are the trees boxelder (*Acer negundo*) and quaking aspen (*Populus tremuloides*), and the herbs pasqueflower (*Anemone patens*), white mountain avens (*Dryas octopetala*), wild strawberry (*Fragaria virginiana*), and alpine pennycress (*Thlaspi montanum*). Pollination times for lodgepole pine (*Pinus contorta*) and ponderosa pine (*P. ponderosa*) have also been suggested. The list has many other genera that grow in the state, but species different from ours. Research has shown that early spring flowering plants are more sensitive to temperature change than are the later spring and summer flowers. Observers in Montana may want to include other spring flowers such as arrowleaf balsamroot (*Balsamorhiza sagittata*) and yellowbell (*Fritillaria pudica*), among others.

European flower-watchers include many interested amateur plant enthusiasts, and substantial networks of phenology information have accumulated. In addition to scientific publications (references provided upon request), attractive phenology web pages make information readily available. The European Phenology Network (www.dow/wau.nl/msa/epn/index.asp) is a clearing house for the vast database that is accumulating on bud break, leaf unfolding, pollination and flowering times in Europe. In the United Kingdom, two sites are valuable in learning about phenology projects: www.phenology.org.uk and www.plant-talk.org/resource/climate.html. Closer to home, Elisabeth Beaubien, Devonian Botanic Garden, University of Alberta in Edmonton, has been collecting data on weather/climate and plant phenology in western Canada; that information and references to publications is available on an excellent website www.plantwatch.ca.

One of the questions that is frequently asked is how valuable old records from gardens, personal notebooks and herbaria are. These records are vital in establishing a historical base on which current data can build. It takes many years and many observations by many people (*i.e.,* a large database) to establish reliable trends in phenology. The site www.plantwatch.ca has an example of the form that is used to collect standardized information that can go into their accumulating database. It could be easily adapted for Montana observers.

If members of the Montana Native Plant Society are interested in becoming involved in observations for a phenological network, please contact me at eversman@montana.edu. If a substantial number of volunteers are interested in such a project, we could get started on some records this very year!

Sharon Eversman, Department of Ecology, Montana State University, Bozeman, MT 59717

Literature Cited

Abu-Asab, M.S., P. M. Peterson, S. G. Shetler & S. S. Orli. 2001. Earlier plant flowering in spring as a response to global warming in the Washington, D. C. area. *Biodiversity and Conservation* 10: 597-612.

Beaubien, E. G. & B. M. Hall. 2003. Plant phenology in western Canada; trends and links to the view from space. *Environmental Monitoring and Assessment* 88: 419-429.

Bradley, N. L., A. Carl Leopold, J. Ross & W. Huffaker. 1999. Phenological changes reflect climate change in Wisconsin. *Proceedings of the National Academy of Sciences* 96: 9701-9704.

Caprio, J.M. 1993. A collection of the annual reports to cooperators of the phonological survey in the western region of the U.S. and related phenological information for the period 1956-1992. *State Climate Center Circular No. 2* , Montana Agricultural Experiment Station, MSU, Bozeman

Chatelain, E.E. 1999. Ice-mass loss in glaciers of the Beartooth Plateau in south-central Montana during the last two decades; combined effects of global warming and El Nino? Geological Society of America, *1999 Annual Meeting Abstracts* 31: 7

Primack, D., C. Imbres, R. B. Primack, A. J. Miller-Rushing & P. Del Tridici. 2004. Herbarium specimens demonstrate earlier flowering times in response to warming in Boston. *American Journal of Botany* 91: 1260-1264.