To chart the advent of spring, thousands of volunteer naturalists are logging when cherry trees and lilacs first blossom, when Monarch butterflies and hummingbirds fly north, when insects stir and robins nest.

Taken together, their backyard observations record how plants and animals across North America are responding to long-term temperature changes that, according to the U.S. National Climatic Data Center, have meant earlier springs than in past decades. Indeed, the annual growing season in much of the U.S. is two weeks longer now than a century ago, federal records show.

"The last frost comes earlier and earlier," said ecologist Jake F. Weltzin, executive director of the USA National Phenology Network in Tucson, Ariz. Phenology is the study of the timing of natural events. "The first frost in fall comes later and later."

While satellites can capture the global sweep of seasons across an entire hemisphere, there is no substitute for field work when it comes to gauging the local effects of pollution, urban development and greenhouse gases that most scientists say contribute to climate change. The aim is to create a reliable technical daybook of seasonal change that researchers can use to better calculate the response of crops, forecast the onset of allergy seasons and manage wildlife.

Among nature's most sensitive climate sensors are flowering plants. Long-term botanical records could show trends that yearly swings in seasonal weather don't, as when unusually warm springs alternate with cooler ones, which has been the U.S. pattern for the past five years.
So far, laboratory experiments meant to measure how plants will respond to warmer temperatures in the future haven't worked well, and computer models to forecast regional climate effects have fared no better, NASA and university researchers recently concluded.

Researchers must instead rely on gardeners, farmers, bird watchers and other amateur naturalists to document how plants and animals respond to shifts in annual cycles of frost and thaw—one plant, one bird, one animal at a time.

To enlist an army of observers, the U.S. Geological Survey and the National Science Foundation set up the National Phenology Network in 2007. This year, the network has more than 2,000 people tracking variations among 600 species of plants and animals in the U.S., Canada and Mexico. So far, the group has logged almost two million data points through a public online program called Nature's Notebook and hopes to add an additional million observations this year.

The federal project joins efforts by groups such as Project Budburst, which has collected seasonal data from more than 15,000 volunteers across the country, and an educational project called Journey North, funded by the Annenberg Foundation, which every year mobilizes students in some 6,000 schools to report sightings of migrating birds, butterflies and flowering plants.

"We want to capture the changes day-by-day throughout the seasons," said geographer Mark Schwartz at the University of Wisconsin-Milwaukee, who monitors lilacs at a thousand U.S. locations.

The scientists are finding signs of change. Researchers at Clemson University in South Carolina and Taylor University in Indiana earlier this year analyzed records of bird sightings dating to 1880 and discovered that ruby-throated hummingbirds are migrating to North America as many as 18 days earlier than decades ago.
"We are starting to see dramatic effects across the country and the National Phenology Network is helping to document that," said botanist Richard Primack at Boston University, who studies seasonal changes in New England. Reliable long-term national records are needed, he said, because "there is so much variation from year to year."

In fact, flowers in Massachusetts bloomed earlier last spring—in April—than at any time in 161 years of local record-keeping, Dr. Primack reported in the science journal PLoS One. The normal time for first flowers in 1852 was May 15, records show.

By the same token, the first flowers of spring were blooming in Chicago last year by Jan. 25, while this year they had yet to bud by March. "We are still waiting for spring in Chicago," said botanist Kayri Havens at the Chicago Botanic Garden, who is co-director of Project Budburst.

To be sure, the national effort is just beginning. "We can't ask questions about whether there is any kind of climate trend in these [phenology records] until we have 20 or 30 or 40 years of data," said terrestrial ecologist Steven W. Running at the University of Montana.

In New Mexico, volunteer naturalist Sharman Peter is taking climate measurements one day at a time. She is monitoring mesquite, yucca plants and prickly pear by her high desert home as well as the cottonwood and willow along the nearby Gila River for the national network.

"The cottonwood right now is a beautiful soft pussy-willow gray," she said. "As spring gets going, the leaf buds unfurl and they get that wonderful luminous, limey green."

Write to Robert Lee Hotz at sciencejournal@wsj.com

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