

Plant behavior through the seasons: An overview of plant phenology

What is phenology?

"Phenology" is derived from the Greek word *phaino*, meaning to show or appear. Phenology refers to recurring plant and animal life cycle stages, such as leafing and flowering, maturation of agricultural plants, emergence of insects, and migration of birds. It is also the study of these recurring plant and animal life cycle stages, especially their timing and relationships with weather and climate.

Naturalists, farmers and gardeners, herbalists and hunters have always been attuned to these seasonal changes. They have formed part of country lore about annual cycles. In some European countries, the national weather service has citizens reporting phenological data about common species, and these data are used in advising farmers about when to plant and harvest. Records of these data have also provided important evidence about changes in climate in New England and around the world. This Brief provides basic background about key seasonal changes that are studied ("phenophases") in plants; other Briefs detail specific methods for data collection, and describe the phenology of birds, insects, and herptiles.

Phenology in New England

-Reproduction (flowers and fruit)

Reproduction takes a large commitment of resources for any species, and is generally dependent on seasonal availability of those resources. Flowering and seed-setting both occur in relation to the season.



-Green-up

In any temperate climate, springtime is marked by the emergence of leaves and plants that moves north as the season progresses, a phenomenon sometimes called "green-up."

-Green-down

Green-down is the opposite of green-up, and follows the pattern you'd expect – in the autumn, the green goes away, starting in the north, and moving south as leaves turn and plants die back or go dormant.

What triggers these phases?

There are a number of different triggers to phenological events, some of which rely on climate, and some of which do not.

-Temperature

Many plants respond to sustained changes in temperature. If the ground is warm for a certain period of time, dormant plants will send up new shoots, seeds will sprout, and fruit trees will bloom. When the temperature drops for a period of time, plants die back or go dormant.

-Light

For many plants, a short day provides less energy through photosynthesis than it costs to maintain the leaves needed to collect that light, so they remain dormant during the dark days of the year, and only put out leaves when the day gets beyond a certain length in the spring.

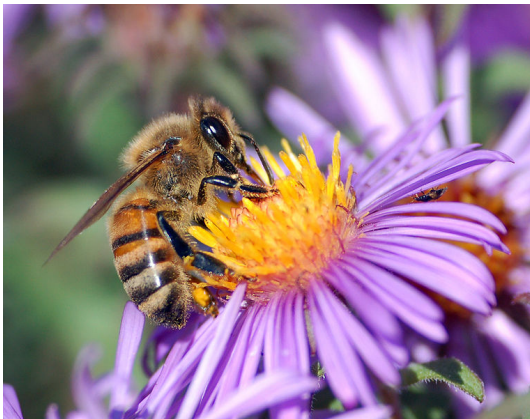
-Water

A number of plants have evolved to stay dormant, or stay as seeds, until there is enough water to sustain their growth. This is especially common in areas without much water, but in general, seasonal rains are a direct trigger for certain phenological events.

How we study it

-Recording events

Studying plant phenology means carefully observing the seasonal changes in plants, and recording events such as budding, flowering, fruiting, putting out leaves, dropping leaves, and so on. In order to be able to tell to what degree things are changing, it's important to have as much data as possible for reference.



The involvement of "citizen scientists" is rising in popularity -

interested volunteers are trained to collect a particular kind of data, and submit it to a common database. This allows for a much larger pool of information and thus more accurate results, and engages members of the public in science.

At the same time, the change of the seasons can be seen from space, and satellite imaging can

track when the seasons turn on a regional scale.

All of this gathered information can then be compared to historical data from universities, botanical gardens and societies, farming records, naturalist diaries. The timing of “phenology festivals” like flower festivals, harvest festivals – cultural events that celebrate signs of seasonal change, some of which form traditions dating back hundreds of years has also provided historical data.

What does it mean? How does phenology tell us about climate?

Changes in phenology have a number of implications, ranging from the loss of maple syrup production, to an upheaval of the seasonal patterns that form the backbone of our agricultural system. Beyond that, there are some species that are able to adjust their behavior to match the change in climate, and some that cannot. This means that seasonal events like bird migration and insect emergence will start to fall out of synchrony with flowering and fruiting. This causes problems for the animals that don’t have food when they expect it, but also for plants that may not get pollinated, or may not have their seeds dispersed. Changes in seasonal temperatures can also lead to draining effort put into reproduction at the wrong time, reducing the ability of the plant to reproduce later in the year when success is more likely.