

An overview of insect phenology

What is phenology?

"Phenology" is derived from the Greek word *phaino*, meaning to show or appear. Phenology refers to recurring, seasonal, 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 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, and so there is much country lore about annual cycles and co-occurrences. In some European countries, the national weather service collects citizen reports on phenological data about common species, and these data are used in advising farmers about when to plant and harvest. Records of these data have provided important evidence about changes in climate in New England and around the world, and have other scientific value, as well.

This Brief provides basic background about key seasonal changes that are studied ("phenophases") in insects; other Briefs detail specific methods for data collection.¹

Insect phenophases

Some phenophases commonly reported:

First appearance of active adults – may be first observation of moving adult, or observation of individuals emerging, e.g. mayflies or dragonflies emerging from water. For wasps or hornets, the beginning of nest-building may be noted.

Adults feeding, e.g. butterflies or bees visiting flowers.

Mating.

Adults laying eggs, or eggs visible on leaves etc.

First appearance of juveniles (caterpillars, grubs).

Chrysalids or other dormant phases visible.

Migrating adults (dragonflies or butterflies) – many adults of the same species moving in the same direction, either in groups or one after the other (perhaps a few per hour, or many per hour).

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

Phenological events are triggered by environmental cues taking place during the year. Thus, one year's observations are interesting, but don't tell us about trends. If, however, a phenophase takes place earlier and earlier

¹ And see USA-NPN National Coordinating Office. 2012. *USA-NPN Plant and animal phenophase definitions*. USA-NPN Technical Series 2012-004. www.usanpn.org.

(or later and later) than reported in the past, it suggests that the organisms are reflecting a real trend or shift. There have been numerous reports of insects such as butterflies shifting their ranges northwards with warming average temperatures – in Massachusetts as well as in other parts of the US and Europe.

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 insect emergence will start to fall out of synchrony with flowering and fruiting. In one case from the Netherlands, the winter moth, whose young caterpillars depend upon a supply of freshly-opened oak leaves in order to get the best start for the year, are now emerging much later than oak bud-burst. They can feed on the oak leaves, but the leaves are older, tougher, and richer in defensive compounds, so that the caterpillars do not grow as well. Research is continuing, but such changes in caterpillar health may well mean that birds have lower-quality food for their young than is ideal, so their broods are not as successful as in earlier years. Other mismatches of insects with the plants they pollinate are also of concern – but there are very many such partnerships and connections between insects and other organisms, and few have been studied. You can help!