

Massachusetts butterflies weigh in

Biological responses to climate change have most often been noted with respect to changing seasonal behavior (phenology): when do certain plants first flower, when do birds arrive, when do amphibians or insects emerge? Another class of information comes from range-shifts, for example southern species appearing more frequently north of their range. But when ranges change, population numbers are probably changing, too — becoming more numerous in some places, less in others.

This kind of information is hard to collect, as it requires fairly detailed population data from across a species' range. Under the right conditions, it's just the sort of field work that citizen scientists can conduct. In a [recent issue of Nature Climate Change](#), Greg Breed, Sharon Stichter, and Elizabeth Crone report on data collected by members of the Massachusetts Butterfly Club between 1992 and 2010, which tells a compelling story of climate change and its effect on butterfly distributions in central New England. Club members compiled over 19,000 observations on 100 species (86% of all species known from the state), providing evidence that species whose ranges were centered north of Boston were in significant decline, while species whose ranges were centered south of Boston were increasing in numbers. Thus, from the point of view of butterflies, the Massachusetts climate has "moved south." Some common summer butterflies are in decline, for example two species of fritillary (*Speyeria*), which have declined by 90% since 1992. The cause is not habitat destruction or some new disease, but climate transformation. At the same time, species associated with more southern climates have been thriving. The frosted elfin (*Callophrys irus*), which has been historically rare in Massachusetts, has shown a 1,000% population *increase*.

The researchers conclude that of the possible causes for these changes, climate change is the best candidate. It's not only that the average temperature has risen several degrees in recent decades: it's also the pattern of that warming. Climate models have long predicted that winter and nighttime would show the strongest warming trend in our latitudes, and that is what the temperature data have shown.

The butterflies agree, on the evidence of this study. There are some species that overwinter as eggs or larvae, and these species show the strongest declines in abundance. The researchers suggest that "Overwintering eggs and neonates are probably more susceptible to dehydration of summers, autumns, and winters become warmer, dryer, and with less snow cover."

These changes are happening very quickly, and at a scale that makes them hard to track and respond to (for example with conservation planning). There are data showing a similar response by a few other groups (taxa) of organisms, but much more work needs to be done. The paper shows how a large, skilled group of amateur naturalists can play an important part in Expedition Earth, helping us understand how our planet is changing before our eyes, and how rapidly.