



Recent changes in plant life cycles caused by a changing climate

Changes in the timing of biological events in plants, such as flowering, observed in recent decades are in response to ongoing climate change, according to recent research from Spain. These results can be used to improve modelling of the effects of future climate change on plants and crops in the region.

'Phenology' refers to changes in the timing of seasonal events, such as the onset of flowering in spring or leaf fall in autumn. Since climate strongly influences seasonal plant events, changes in plant phenology are useful bioindicators of climate change. Changes in the timing of biological events can be observed easily and historical phenological records allow scientists to examine the impact of past climate trends.

Using more than 200,000 records on 29 perennial tree and bush species monitored between 1943 and 2003 throughout Spain, the researchers assessed the response to climate fluctuations of six plant phenological changes: leaf unfolding, flowering, fruit ripening, fruit harvesting, leaf falling and growing season.

The effect of three climate variables, temperature, precipitation (rainfall) and the North Atlantic Oscillation (NAO) on variations in phenological events were considered simultaneously and over a full annual cycle before the occurrence of the event, in order to determine if patterns of change were sensitive to the climate in the previous seasons. The results of the study suggest modeling these climate variables individually can overestimate their true impact.

Overall, the study suggests climate change has appeared to shift plant cycles over the past six decades. The greatest impact on year-to-year changes in plant phenology was caused by temperature, with rainfall and NAO only accounting for about 10 per cent of variability. In the case of rainfall, this was a surprise because water availability plays a key role for plants in Mediterranean ecosystems.

NAO affects large-scale atmospheric circulation patterns. The lack of relevance of NAO on plant phenology revealed by this study suggests that local weather is more important. Records from weather stations close to areas of study should be used in modelling, rather than applying macro-scale climate variables.

Spring events are changing more than autumn events. Previous studies suggest Mediterranean plants are more sensitive to temperature than plants of the same species in other parts of Europe. In addition, phenological events at the start of the annual cycle (i.e. those in spring) are affected more by the weather than those at the end of the season (in autumn). Given that spring is becoming warmer (whilst autumn is not) under climate change, spring events are advancing whereas autumn events show little change.

Leaf unfolding, flowering and the growing season are strongly affected by climate, fruiting to a moderate degree and leaf fall is the least affected. For example, leaf unfolding and flowering have advanced on average by 0.48 and 0.59 days per year, but only since the mid-1970s. Flowering and leaf unfolding are advancing because of warmer and drier springs, as well as after cool, wet autumns.

The greatest impact is from current weather conditions (i.e. the previous few weeks), although climate from several months beforehand also can affect phenological events. Warmer temperatures in spring advance spring events, whereas warmer autumns delay spring phenological events.

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Contact: ogordo@mncn.csic.es

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