

# 18. Climate change impacts

**Type:** Pressure indicator

## Indicator Description

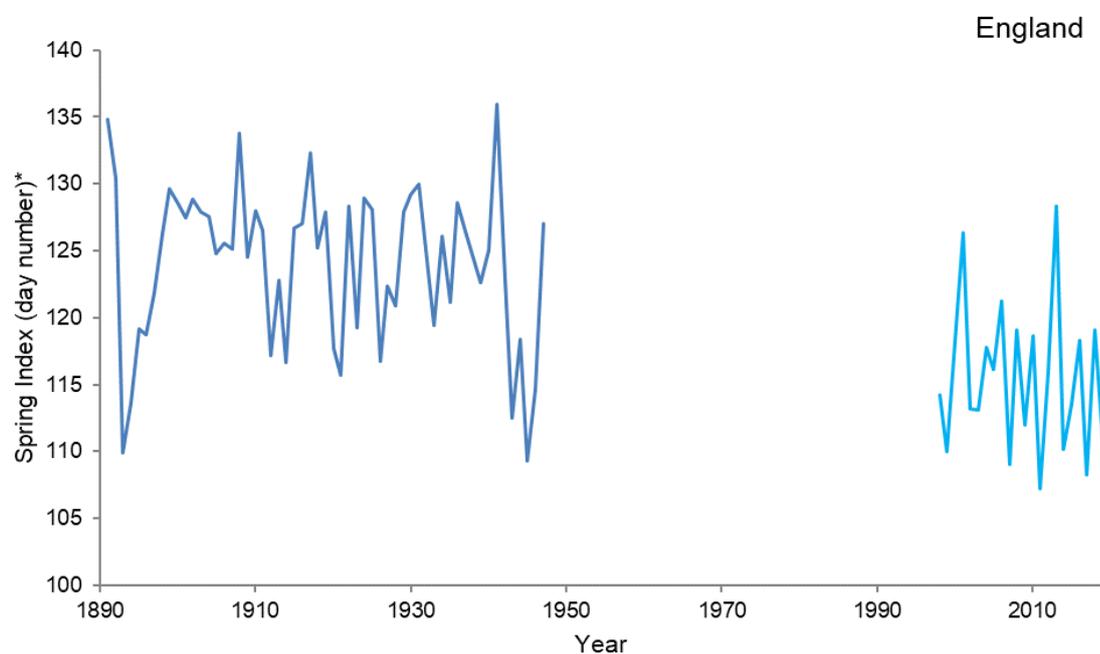
This is a context indicator and is not assessed; it is shown to highlight a biological response to climate change and a potential pressure on biological systems. It shows the impact of temperature change on the timing of biological events such as flowering or migration in the spring. The Spring Index is calculated from the annual mean observation date of the following 4 biological events: first flowering of hawthorn (*Crataegus monogyna*), first flowering of horse chestnut (*Aesculus hippocastanum*), first recorded flight of an orange-tip butterfly (*Anthocharis cardamines*), and first sighting of a swallow (*Hirundo rustica*).

## Spring index

Since 1998, the annual mean observation dates have been around 8 days in advance of the average dates in the first part of the 20th Century.

The advancement of spring events is strongly linked to warmer temperatures in March and April. The warmest April in the Central England Temperature series (1659 onwards) occurred in 2011 and resulted in an especially early spring that year (Fig. 18.1).

**Figure 18.1: Index of the timing of biological events in England, 1891 to 1947 and 1998 to 2019**



### Notes:

- \* Number of days after 31 December (e.g. day 121 = 1 May).
- Not directly comparable to previous versions of the indicator following a change in methodology in 2019.

**Source:** 1891 to 1947 – Royal Meteorological Society, 1998 to 2019 – UK Phenology Network (Nature's Calendar).

## Indicator assessment

### Assessment of change in the timing of spring events: No assessment – indicator provided for context only

#### Relevance

According to the UK Climate Impacts Programme, evidence for the warming of the global climate is unequivocal, with global average temperatures having risen by nearly 0.8 °C since the late 19th century, and rising at about 0.2 °C each decade over the past 25 years. These changes will impact on the distribution, condition and behaviour of our wildlife.

The indicator shows progress with commitments in [Biodiversity 2020: A strategy for England's wildlife and ecosystem services](#) to reduce pressures on biodiversity and to integrate biodiversity considerations into other sectors of decision making such as climate change adaptation (see Annex A of the aforementioned report). The indicator is also relevant to the following global target in the Strategic Plan for Biodiversity 2011–2020:

- **Target 10:** By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.

#### Background

Phenology is the study of the timing of recurring natural events in relation to climate and such observations provide year-on-year information on how nature is responding to a changing climate.

The global climate is changing. According to the UK Meteorological Office, the average temperature over the first decade of the 21st century was significantly warmer than any preceding decade in the series of records stretching back over 160 years. In 2007, the Intergovernmental Panel on Climate Change (IPCC), concluded that most of the observed increase in global average temperatures since the mid-20th century is very likely to be due to the observed increase in anthropogenic (man-made) greenhouse gas concentrations.

According to the UK Climate Impacts Programme, evidence for the warming of the global climate is unequivocal, with global average temperatures having risen by nearly 0.8°C since the late 19th century, and rising at about 0.2°C each decade over the past 25 years. These changes will impact on the distribution, condition and behaviour of wildlife.

The UK Spring Index is calculated from the annual mean observation date of the following 4 biological events: first flowering of hawthorn (*Crataegus monogyna*), first flowering of horse chestnut (*Aesculus hippocastanum*), first recorded flight of an orange-tip butterfly (*Anthocharis cardamines*) and first sighting of a swallow (*Hirundo rustica*).

These 4 events were chosen for the following reasons:

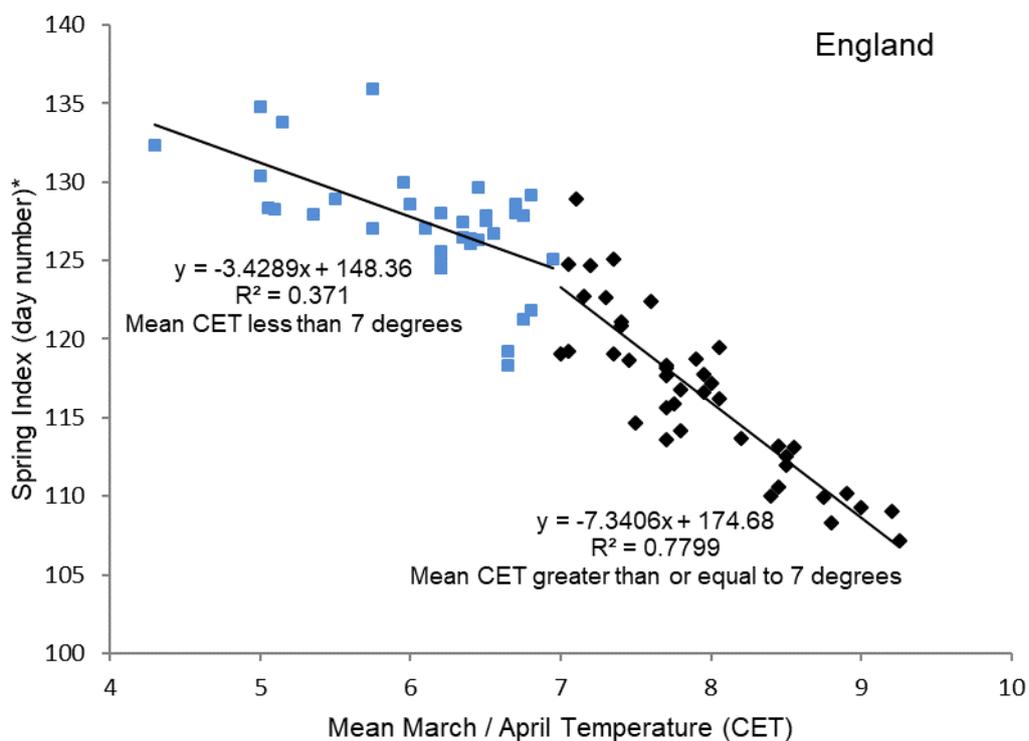
- Good UK coverage;
- Well recognised and easily recorded species;
- Good historical data;
- Both early and later spring events are included;
- The observations cover plants, a vertebrate, and an invertebrate;
- A strong phenological response is observed.

Until 2018 the overall index was compiled by calculating an annual mean across all sites where all 4 biological events were recorded. The figures published since 2015 are slightly different to those published previously as a result of data correction in the underpinning database. In order to include more data in the calculation the method was changed in 2019 and the overall index was compiled by calculating an annual mean for each species using all available data and averaging these four means (see 18. Climate change Impacts Technical Background Document for further information). This new method of calculation has been applied to all previous years retrospectively.

The pre-1948 data were mostly collected by the Royal Meteorological Society (RMS). In 1998, the UK Centre for Ecology & Hydrology revived the UK Phenology Network (UKPN) in the UK, which was launched by the Woodland Trust as a web-based project in 2000. The UKPN has grown since its inception, and now records a series of events in both spring and autumn through the [Nature's Calendar](#) project.

The average value of the Spring Index between 1998 and 2019 is 8.4 days earlier than the average value for 1891 to 1947. The index shows a strong relationship with mean temperature in March and April (Figure 18.2), and it advances more rapidly when the mean temperature equals or exceeds 7°C. The average advance in dates for the Spring Index is 3.2 days for every one degree Celsius below a mean March to April temperature of 7°C, and 7.3 days for every one degree Celsius above 7° Celsius.

**Figure 18.2: Relationship between Spring Index and Central England Temperature (CET), 1891 to 1947 and 1998 to 2019**



**Notes:**

1. Day number = number of days after 31 December (e.g. day 121 = 1 May).
2. CET = Central England Temperature series, in degrees Celsius.

**Source:** 1891 to 1947 – Royal Meteorological Society, 1998 to 2019 – UK Phenology Network (Nature's Calendar).

The Living with Environmental Change (LWEC) project has produced a series of [report cards](#) which detail the evidence for climate change and its impact on the environment. The terrestrial biodiversity climate change card evaluates the amount of, and strength of evidence of climate change impact on terrestrial biodiversity. It complements the climate change impact report card produced by the Marine Climate Change Impacts Partnership.

## Web links for further information

Defra: [Technical Background Document](#)

Environmental Change Network (ECN): [UK Environmental Change Network Index](#)

Royal Meteorological Society: [Weather and climate](#)

UK Climate Impacts Program: [Recent climate trends](#)

UK Phenology Network: [Nature's Calendar](#)

**Last updated:** October 2020

**Latest data available:** Spring Index – spring 2019