B4. Pressure from climate change

Spring Index

Type: Context indicator

Summary

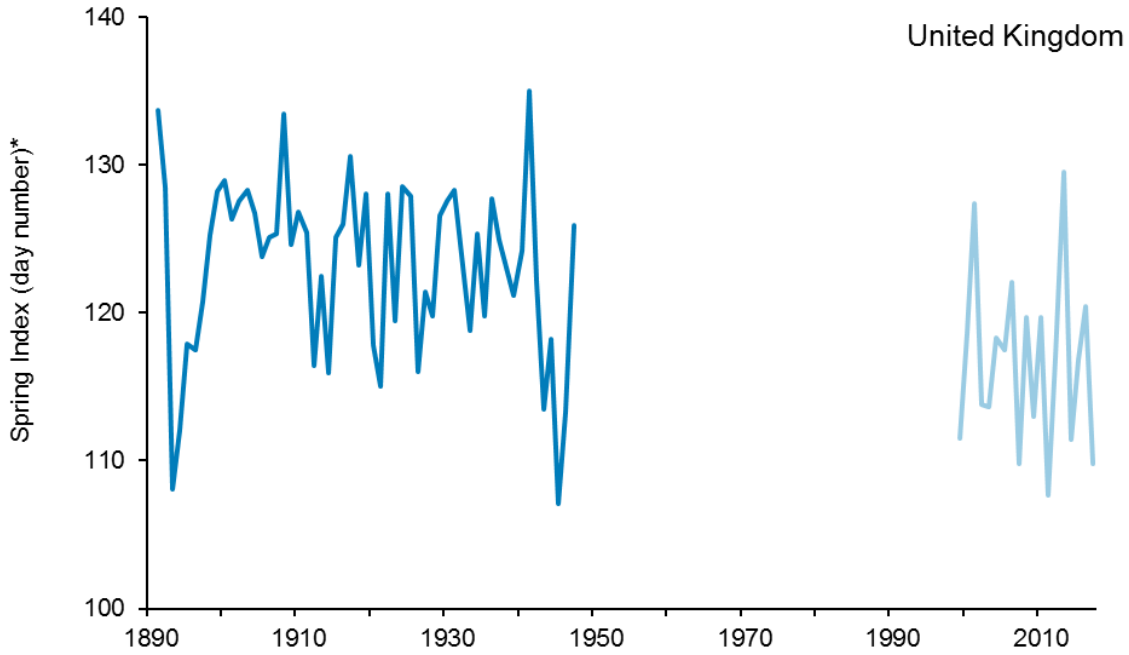
Since 1999, the annual mean observation dates have been around 6 days in advance of the average dates in the first part of the 20th century.

The Index shows a strong relationship with mean temperature in March and April, and it advances more rapidly when the mean temperature equals or exceeds 7 degrees Celsius.

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 UK Spring Index is calculated from the annual mean observation date of the following four 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*).

Figure B4i. Index of the timing of biological spring events (number of days after 31 December) in the UK, 1891 to 1947, and 1999 to 2017.



Notes: * Number of days after 31 December (e.g. day 121 = 1 May).

Source: 1891 to 1947 – Royal Meteorological Society; 1999 to 2017 – UK Phenology Network.

This is a contextual indicator showing how changes in climate, particularly temperature, are associated with changes in the timing of biological events.

The Spring Index for the UK has high year-to-year variability, but since 1999 biological events in the spring have occurred around 6 days in advance of the average dates in the period 1891 to 1947 (Figure B4i). The figures published since 2015 are slightly different to those published previously as a result of data correction in the underpinning database.

The advancement of spring events is strongly linked to warmer temperatures in March and April. The mean observation dates in 2011 were the second earliest for which there are records. The warmest April in the Central England Temperature series (1659 onwards) occurred in 2011 and was almost certainly influential.

Relevance

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. This indicator illustrates the stress that one aspect of climate change (spring warming) can place on biological systems. Differential responses among species may cause problems for life cycles (e.g. pollinating insects emerging out of synchrony with flowers opening in spring), increasing vulnerability to extreme events such as late frosts, disruption of food webs, and changing the balance of competition between species.

Background

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 four 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 four events were chosen for the following reasons:

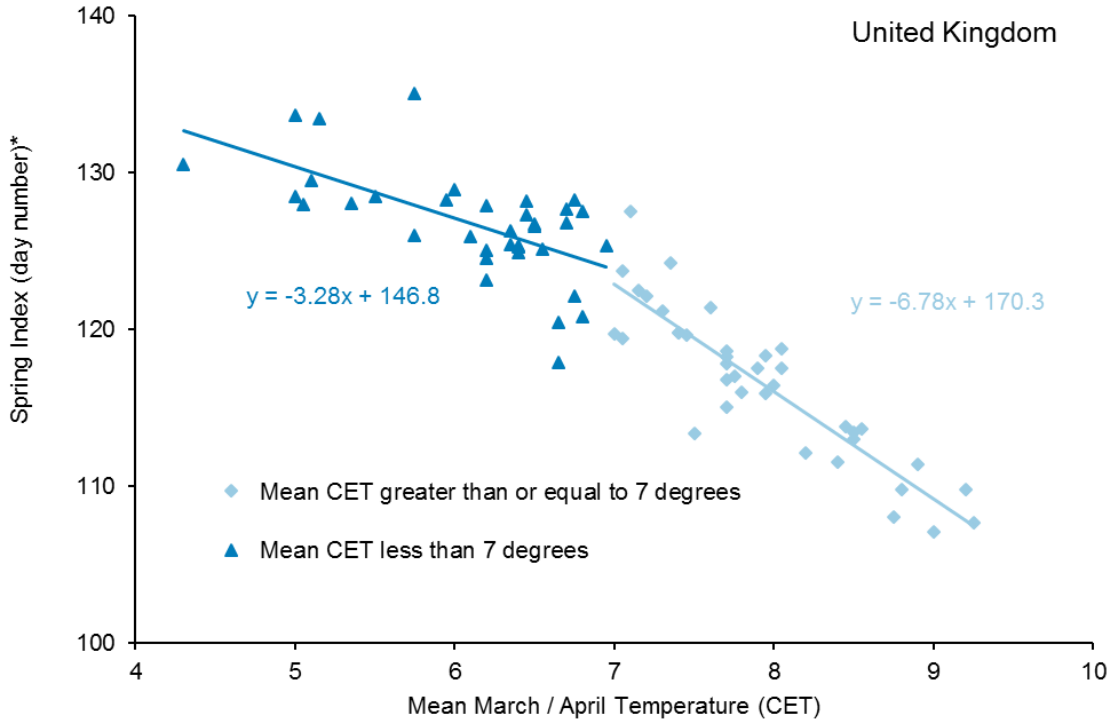
- Good UK coverage;
- Well recognised and easily recorded species;
- Good historical data;
- Both early and later spring events are included;
- The observations cover plants, a vertebrate, and an invertebrate;
- A strong phenological response is observed.

The overall index is compiled by calculating an annual mean across all sites where all four biological events were recorded. The pre-1948 data were mostly collected by the Royal Meteorological Society (RMS). In 1998, the 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 survey.

The average value of the Spring Index between 1999 and 2017 is 6.47 days earlier than the average value for 1891 to 1947. The index shows a strong relationship with mean temperature in March and April (Figure B4ii), and it advances more rapidly when the mean temperature equals or exceeds 7°C. The average advance in dates for the Spring Index is 3.3 days for every one degree Celsius below a mean March to April temperature of 7°C, and 6.8 days for every one degree Celsius above 7°.

Figure B4ii. Relationship between Spring Index and Central England Temperature, 1891 to 1947, and 1999 to 2017.



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; 1999 to 2017 – UK Phenology Network.

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.

Goals and targets

Aichi Targets for which this is a primary indicator

Strategic Goal B. Reduce the direct pressures on biodiversity and promote sustainable use.

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

Aichi Target for which this is a relevant indicator

Strategic Goal D. Enhance the benefits to all from biodiversity and ecosystem services.

Target 15: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

Web links for further information

Reference	Title	Website
Woodland Trust	Nature's Calendar: the UK Phenology Network	http://www.naturescalendar.org.uk/
UK Climate Impacts Programme	Frequently asked questions	http://www.ukcip.org.uk/
Living With Environmental Change (LWEC)	Biodiversity Report card	http://www.nerc.ac.uk/research/partnerships/lwec/products/report-cards/biodiversity/report-card/
Marine Climate Change Impacts Partnership	Report card	http://www.mccip.org.uk/annual-report-card.aspx

Full details of this indicator, including a datasheet are available at:
http://jncc.defra.gov.uk/page-4247**.**

Last updated: July 2018

Latest data available: Spring 2017