ALL-SCOTLAND U3A CONFERENCE 2010
Incorporating the U3A in Scotland AGM
Saturday 12 June, Edinburgh
St Thomas of Aquin's High School, 3-20 Chalmers Street, Edinburgh EH3 9ES EH3

Gardening in the Global Greenhouse

Prof. Roy Thompson, FRSE
GeoSciences, UoE

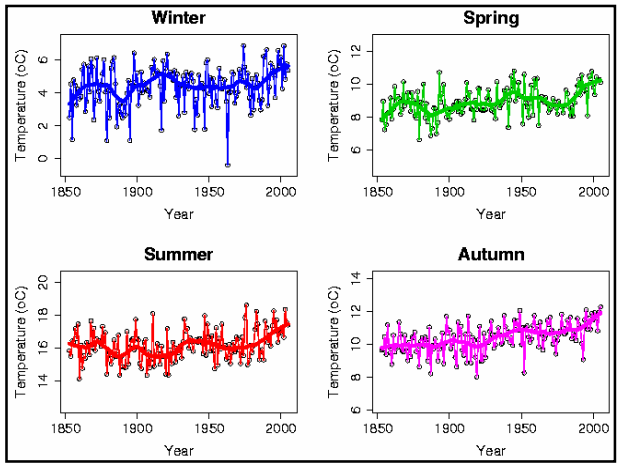
Topics

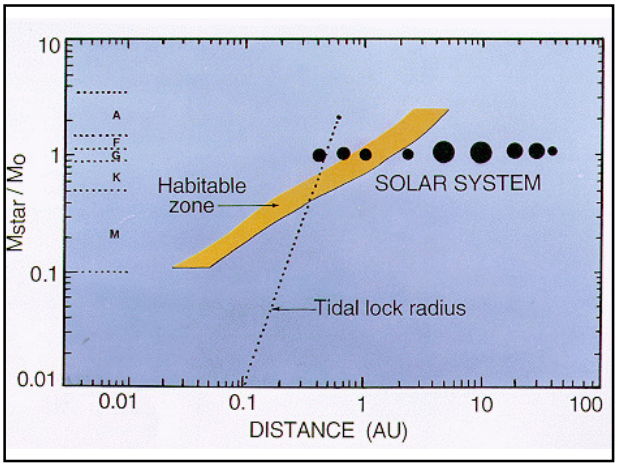
PART I

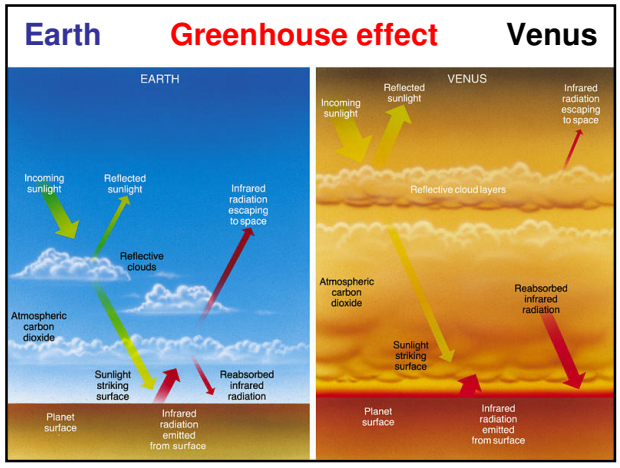
1. The Scottish climate.
2. The physical process of climate change.
3. Likely climate changes – the range and uncertainties of future greenhouse scenarios.
4. Risks to Scottish gardens and vegetation.

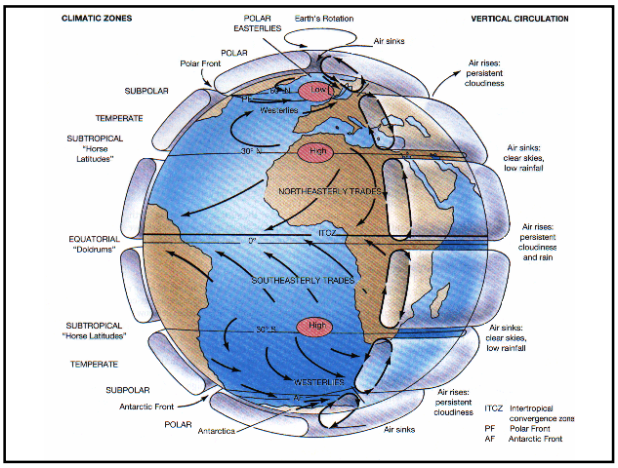
PART II

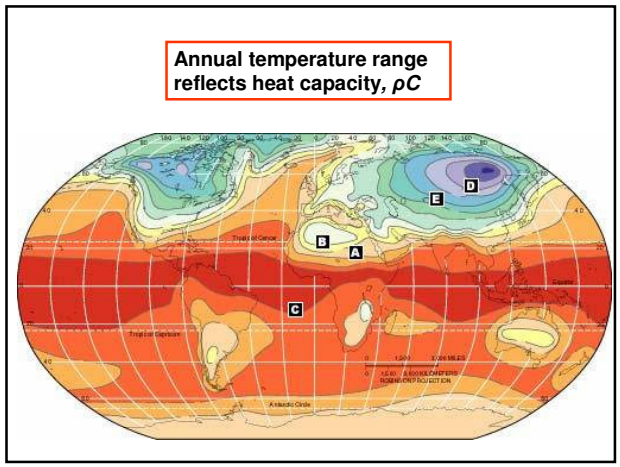
1. Phenology (monitoring flowering and fruiting).









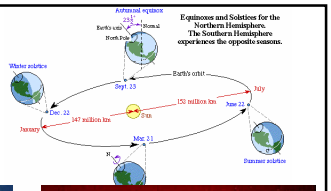


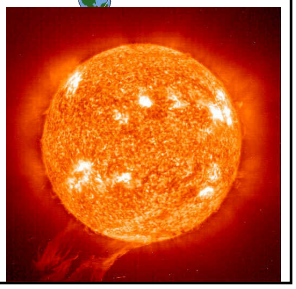
Summary

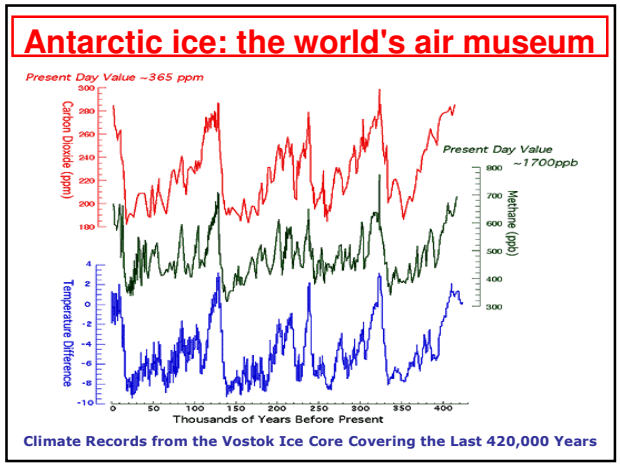
1. Scotland has a distinctive climatic regime. In particular it has a winter mildness due to its temperate, oceanic setting.
2. A low annual temperature range is accompanied by high day-to-day, and year-to-year, variability.
3. All four seasons have warmed in recent decades (at slightly below the global average rate of ~ 0.8°C / century).

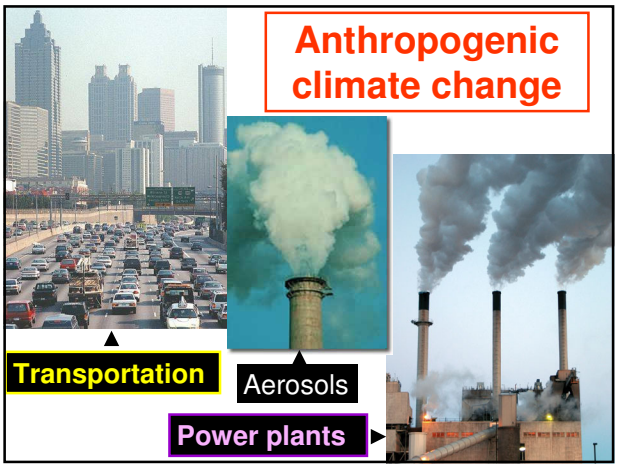
Natural climate change

1. Earth's orbit
2. Solar luminosity
3. Volcanic eruptions

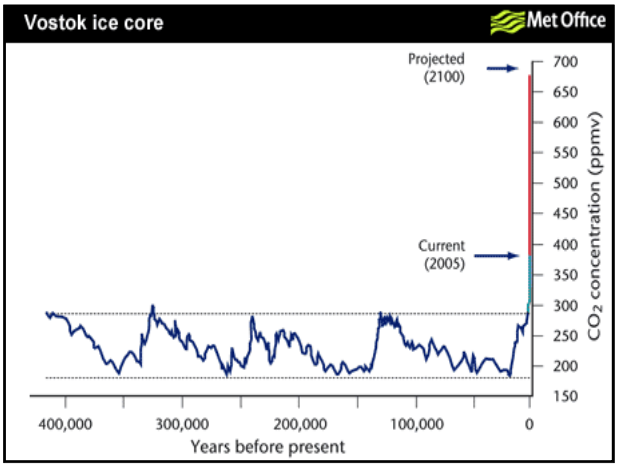


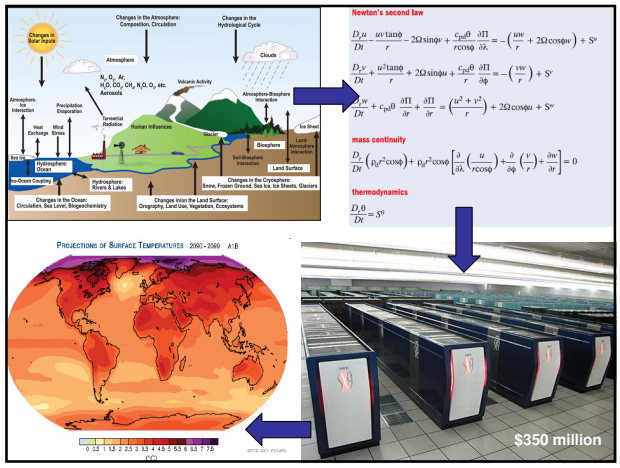


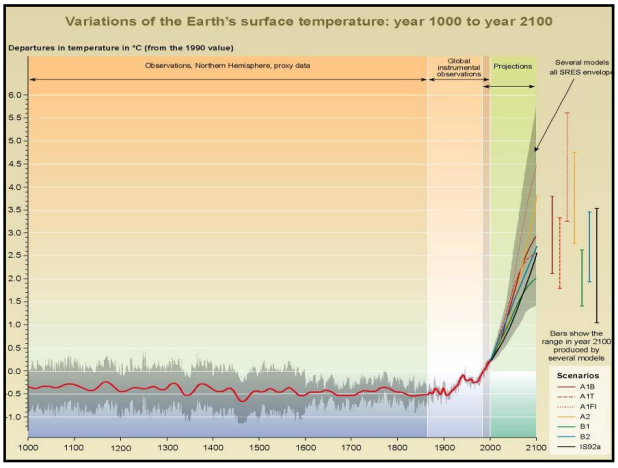


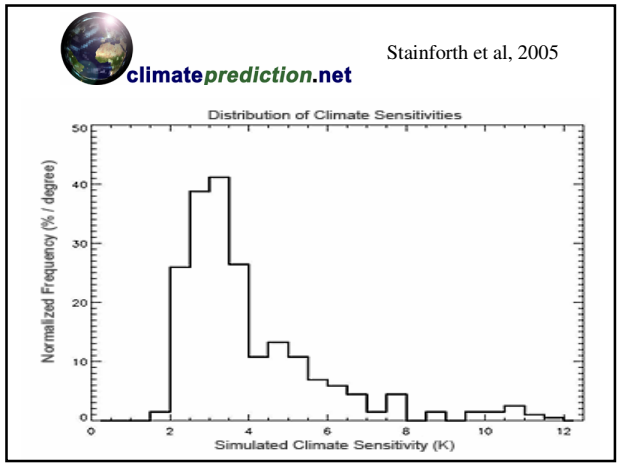


3. How large will climate warming be?



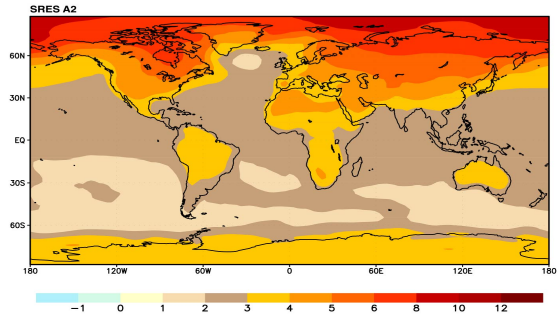






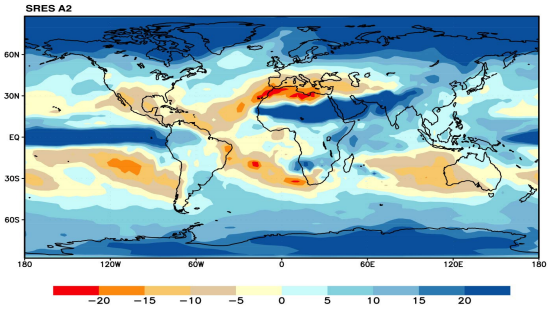
Regional climate change

Land areas are projected to warm more than the oceans with the greatest warming at high latitudes



Annual mean temperature change, 2071 to 2100 relative to 1990: global average in 2085 = 3.1°C

Some areas are projected to become wetter, others drier with an overall increase in precipitation



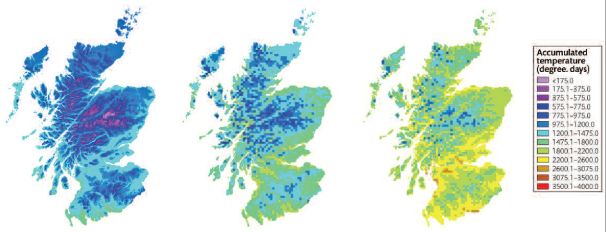
Annual mean precipitation change: 2090 relative to 1990

Summary

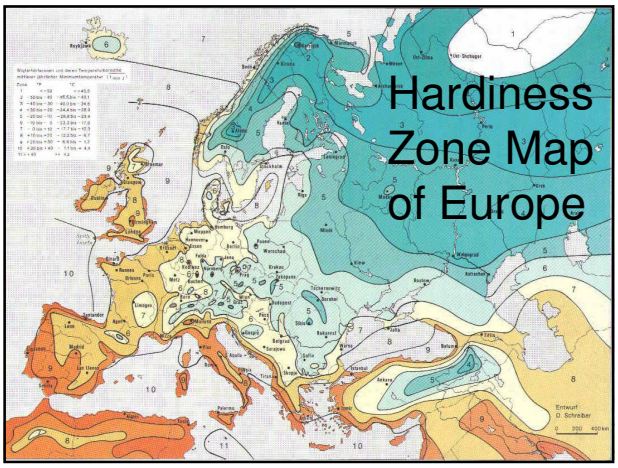
1. Climate change is being driven by humans burning fossil fuels, and is accelerating.
2. Temperature increases of 5°C, or more, are very likely this century.
3. The world will become warmer than at any time since the early Eocene Epoch (ca. 50 million years ago).
4. However, climate change in Scotland will be muted compared with that experienced by many other regions.

4. Risks to Scottish gardens and vegetation

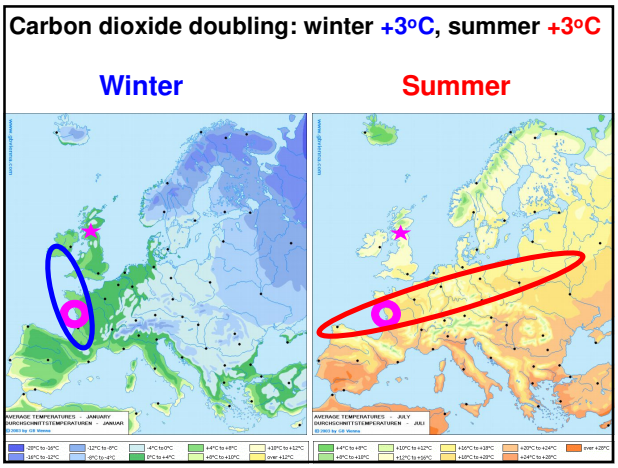
Projected changes in warmth of Scotland's climate



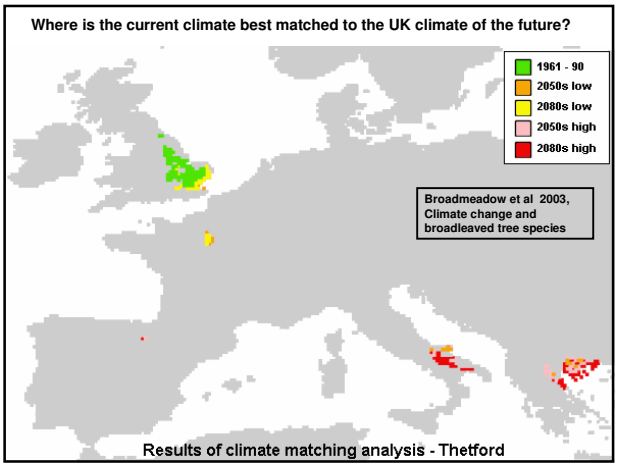
Accumulated temperature distribution of Scotland's climate: a) baseline climate, 1961–1990; b) projection for 2050; c) projection for 2080.



Carbon dioxide doubling: winter +3ºC, summer +3ºC



Where is the current climate best matched to the UK climate of the future?



Results of climate matching analysis - Thetford

The UKCIP02 Briefing Report – Key findings

Hulme, Turnpenny & Jenkins (2002)

In Scotland by the 2080's

Temperature
- Annual average temperatures are set to rise 3.5ºC.

Precipitation
- Precipitation in winter will increase 25%.

Snow
- Less snow will fall - a decline of up to 90% in parts of Scotland.

Extremes
- The probability of a typical Scottish Highland summer day experiencing a maximum of 23ºC will increase from 1% to over 25%.

Ocean currents
- Although the strength of the Gulf Stream may weaken, it is unlikely that this would lead to a cooling of UK climate

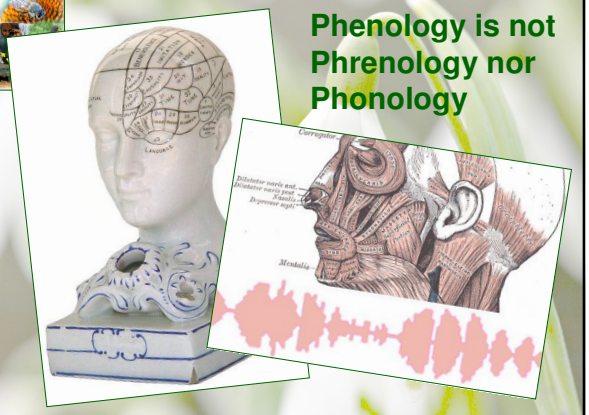
UKCIP - Gardens scoping study - Key findings

- **Higher carbon dioxide levels** will tend to increase the rate of plant growth.
- **Higher temperatures** are expected to advance flowering dates.
- **The range of species** that can be grown will increase. Temperature increase is likely to extend the northern limit for growing some vegetables and fruit. For example grape cultivation could extend as far north as Scotland during the second half of the 21st century. However historical collections of plants will become increasingly difficult to maintain.
- **Pest populations** could increase with warmer temperatures as their life cycles will shorten and a longer growing seasons will allow additional reproductive cycles to take place.
- **Soils** face water-logging in increasingly wet winters, and drought in summer, calling for careful water management.
- **Warmer, wetter winters** could favour the spread of diseases such as Phytopthera and the red-thread that affects lawns.
- **Lawns** will need year-round maintenance.
- **Fewer frosts** will mean more reliable fruit crops, but plants that need a period of cold weather to initiate flowering, like some bulbs and certain fruit trees, might struggle.

What is phenology?

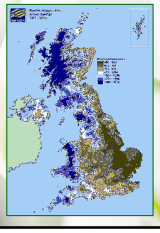
- recording nature's signs of the seasons
- the study of the times of recurring natural phenomena especially in relation to climate
- recording when you heard the first cuckoo
- or saw the blackthorn blossom
- your record can then be compared with other records

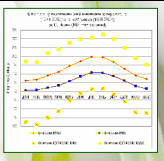
Phenology is not Phrenology nor Phonology



Phenological triggers

- Day length
  - Latitude and time of year
  - Not in tropics
- Temperature
  - Year before
  - Month before
  - Day before
- Rainfall

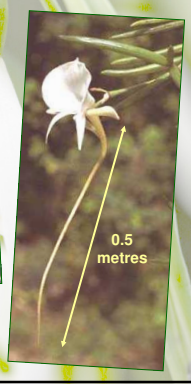




Why is phenology important?

- Timing is everything for survival
- Plant and plant interactions
- Plant and animal species interact
- Complex interactions

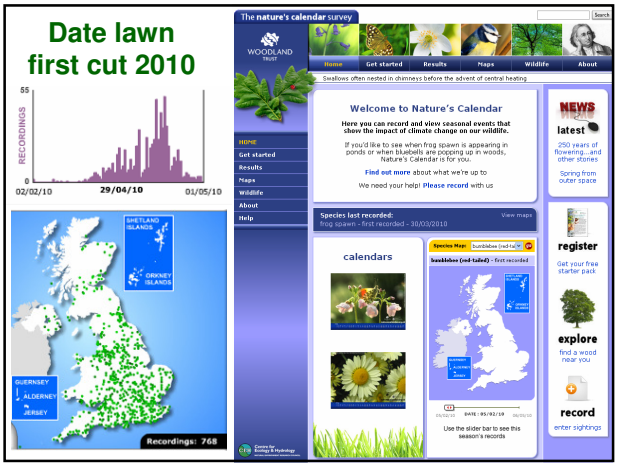
Plant animal interactions



You can join in

- Woodland Trust - Nature's calendar survey
  - 17 trees & shrubs
  - 8 flowers
  - 5 grasses
  - 21 birds
  - 13 insects
  - 3 amphibians
- Springwatch
- Autumnwatch
- http://www.naturescalendar.org.uk/survey

Date lawn first cut 2010



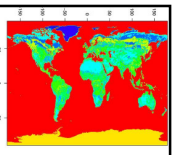
Modelling the response to climate change of the timing of flushing in thirteen temperate trees

Thompson, R. & Clark, R.M.

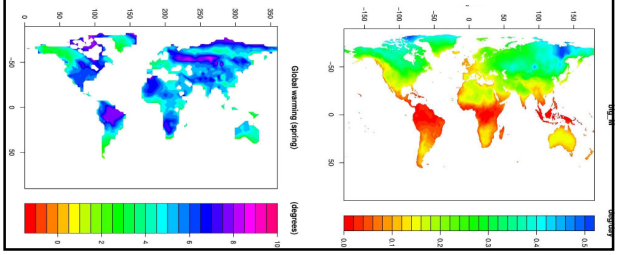
$$\mu_i = \sqrt{\frac{2\exp(\phi_i)}{m_i}} + \gamma_i + \frac{\kappa}{m_i}\gamma_i$$

where $\phi_i = \ln(\beta + \lambda\gamma_i)$, and **λ** is the rate of change in thermal requirement, **β**, associated with changes in the duration of winter chilling; **γ** is the day on which the spring temperature rise reaches the thermal threshold, **α**; **κ** is **α's** rate of change; and ***m*** is the rate of increase in spring temperature.

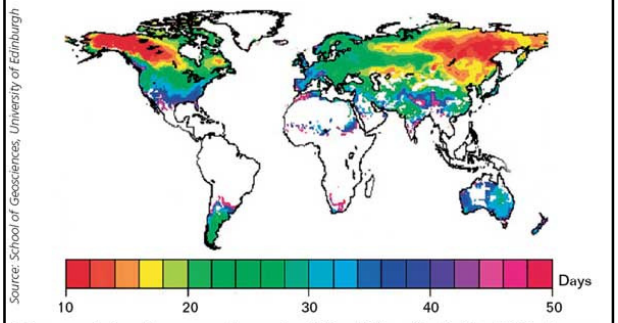
Combining maps of global warming with the local climate (spring temperature increase) allows desynchronisation to be estimated worldwide.



Phenological change = Global warming * 1 / oceanicity



Desynchronisation



Colour-coded regions are where plant life will be affected by 2080. Figures reveal the number of days by which plants will flower earlier than expected

A full page spread in the Guardian twisted our global warming message from:

"Massive global desynchronisation of plants and animals leading to disruption of ecosystems"

into

"Women will be happy as more flowers will be available on Saint Valentine's Day"

Summary

1. Phenology is important. Recordings of seasonal occurrences offers real evidence that climate change is happening now and that it is already having a significant effect on our wildlife.
2. Phenological observations are straight forward to make.
3. Contributing observations to the Woodland Trust - Nature's calendar survey - is extremely worthwhile, particularly in the more remote parts of Scotland.