

When Spring has Sprung

The issue of climate change has remained near the top of the scientific and political agenda over the last decade or more. Global temperature has increased rapidly since the late 1970s, a trend which most climatologists anticipate will continue into the future, as a result of rising greenhouse gas concentrations, with potentially far-reaching consequences for the global environment. In a new series for *BTO News*, James Pearce-Higgins will describe the impact such changes have had on UK birds, anticipate what the future may hold if climatologists' projections are realised, and consider what can be done by conservationists to manage such effects.

One of the most widespread and well reported effects of climate change in recent years has been changes in the timing (phenology) of biological events. I am sure we have all noticed changes in the countryside around us, whether it is the earlier flowering of plants, earlier appearance of butterflies and moths, or the earlier nesting of birds. Indeed, it was BTO research which first used data from the Nest Record Scheme (NRS) to report changes in the timing of nesting. Humphrey Crick and others

reported in *Nature* that about a third of the 65 UK species for which they analysed NRS data were nesting earlier in 1995 than they had done in the 1970s, with laying dates advancing by an average of almost nine days. A follow-up paper two years later confirmed that these changes could be directly related to spring warming. These patterns appear widespread, with more than half of bird species studied around the world showing statistically significant trends for earlier nesting associated with warming.

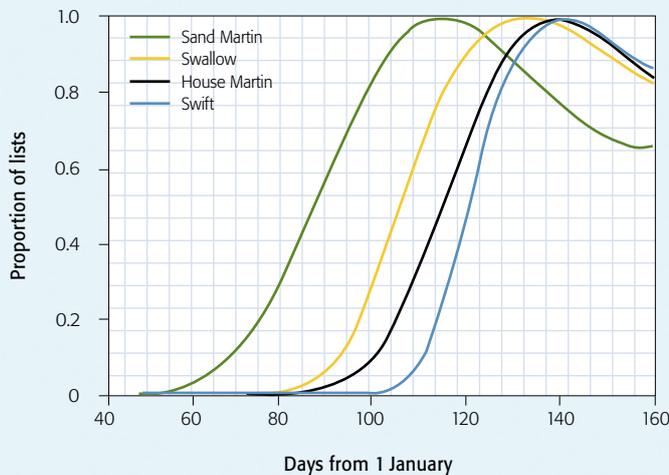
Spring warming: changes in the timing of migration

By using the proportion of complete lists from BirdTrack containing a given species, we can measure arrival patterns through the whole migration period. This information can be used to

show how the arrival times of different species vary, for example indicating the much earlier arrival of Sand Martin, compared to Swallow, House Martin and Swift.

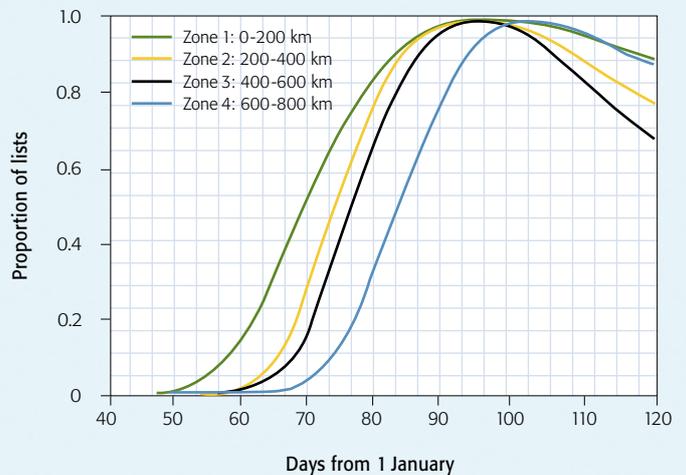
Lists can also be used to show how each species migrates through the country in a particular season.

BIRDTRACK HIRUNDINE REPORTING RATE



Simplified curves showing the pattern of arrival as assessed from the proportion of lists submitted by birdwatchers in which each species was recorded (standardised to a maximum of 1).

GEOGRAPHICAL VARIATION IN BIRDTRACK CHIFFCHAFF REPORTING RATE



Simplified curves showing how the pattern of Chiffchaff arrival varies with increasing distance northwards from southern coast.

CHANGES IN THE TIMING OF MIGRATION

It is not only the timing of nesting that is influenced by climate, but also the timing of bird migration. In response to increases in temperature, the arrival and departure dates of many migratory species show significant trends through time. For example, long-term data from bird observatories show that the first Swallows now arrive in the UK about 20 days earlier than they did during the 1970s, whilst the first Sand Martins arrive 25 days earlier, a trend repeated in many migratory populations across Europe. Whilst it is more difficult to identify the causes of these changes because migratory birds experience a range of weather conditions from their wintering to breeding grounds, these patterns have been linked to long-term changes in temperature. Through time, information from BirdTrack will help us gain a greater understanding of how climatic variation influences patterns of migration, by measuring patterns of arrivals and departures through the whole migration season.

PHENOLOGICAL MISMATCH

What is the biological significance of these changes? A recent collaboration of organisations, including the BTO, showed that although there have been consistent advances in the timing of a wide range of biological events in the UK, different

organisms have responded at different rates.

Although birds are now nesting earlier than they used to, the timing of insect emergence has changed more rapidly, whilst plant phenology has advanced even faster still. This could be a problem for birds that rely on seasonal peaks in food abundance. Indeed, there is good evidence from continental Europe that a number of insectivorous woodland passerines, such as Great Tits and Pied Flycatchers, are suffering reduced breeding success because, as a result of spring warming, they are now nesting later than the peak availability of their main caterpillar prey.

Importantly, this change is thought to have caused recent Pied Flycatcher population declines in various Dutch woodlands. It has been suggested that such mismatch is a particular problem for migratory birds, as they are less able to advance their timing of breeding in response to warming on the breeding grounds than resident species, because of constraints on their arrival time.

Whilst some have suggested that this may account for many of the recently observed declines in long-distance migrants across Europe, more recent analysis suggests that it is only likely to be a problem for migratory birds occupying habitats with a narrow peak of food availability, such as deciduous woodlands.

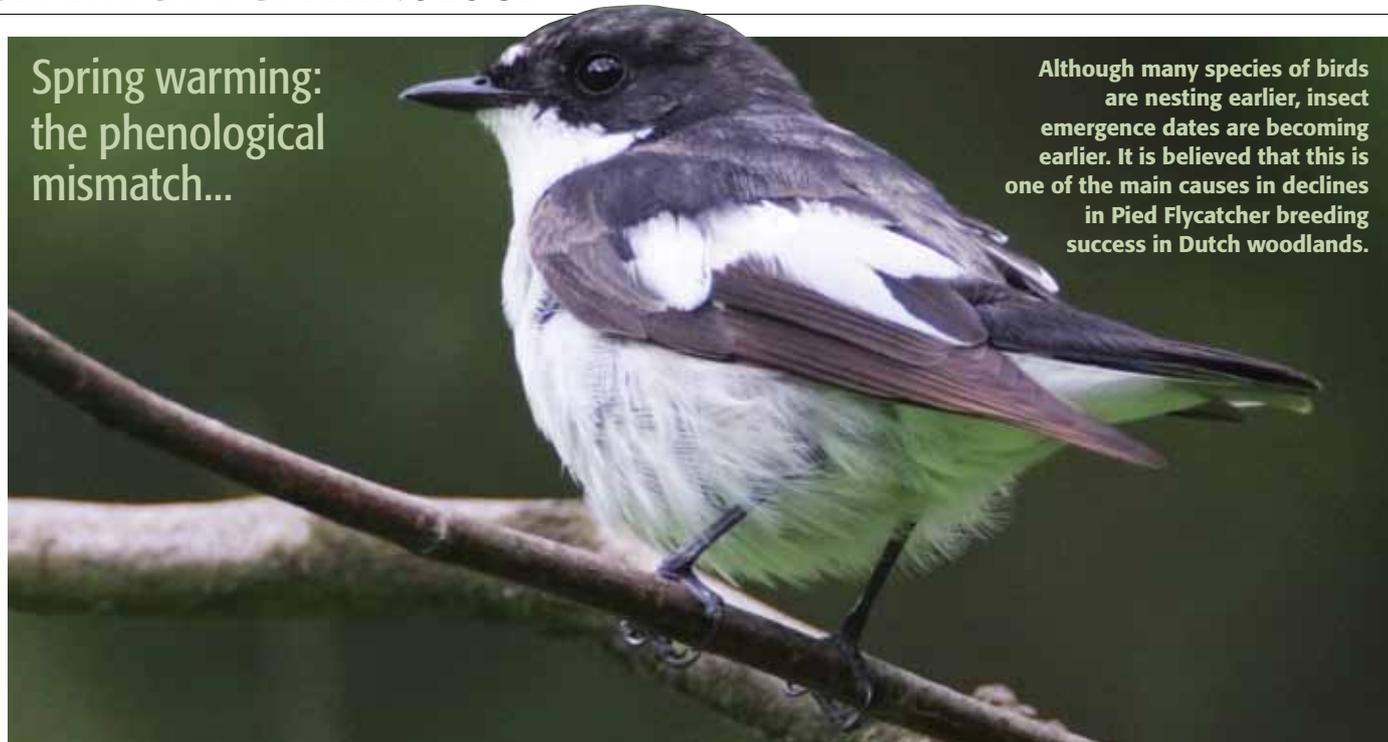
'Through time, information from BirdTrack will help us gain a greater understanding of how climatic variation influences patterns of migration, by measuring patterns of arrivals and departures through the whole migration season.'



Phenology is the timing of biological events. We all anticipate the arrival of the first Swallow of spring, and data from bird observatories show that we don't have to wait as long as we did. Swallows are now arriving about 20 days earlier than they did in the 1970s, with Sand Martins arriving even earlier still.

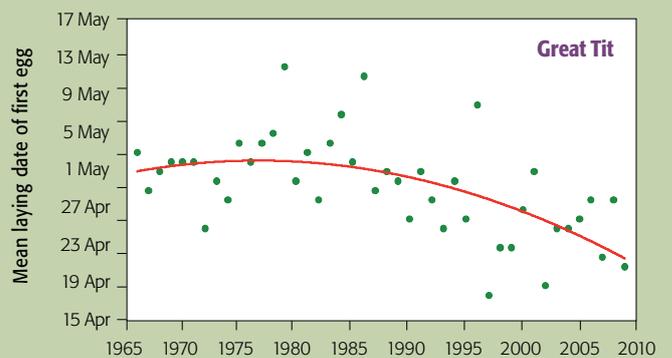
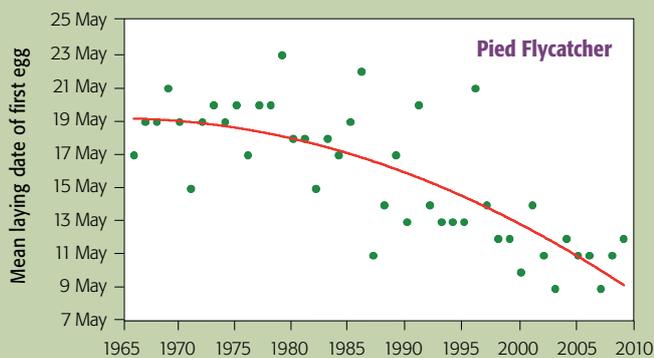
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Spring warming:
the phenological
mismatch...



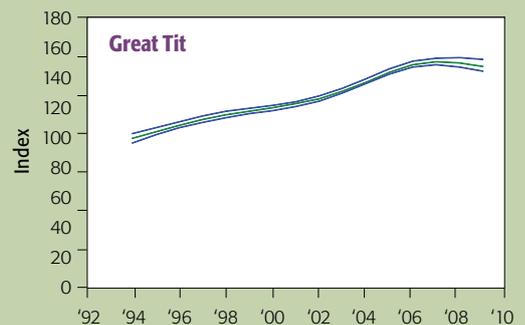
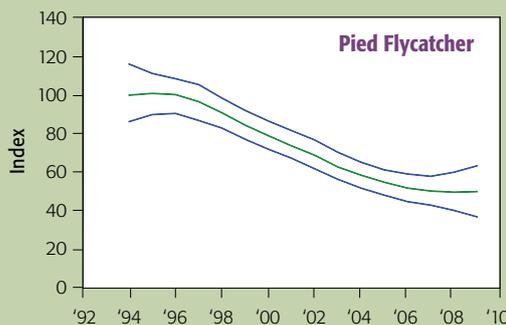
Although many species of birds are nesting earlier, insect emergence dates are becoming earlier. It is believed that this is one of the main causes in declines in Pied Flycatcher breeding success in Dutch woodlands.

Both Pied Flycatchers and Great Tits are now nesting earlier in response to recent spring warming.



Trends in Pied Flycatcher and Great Tit laying dates identified by the Nest Record Scheme. The dots represent mean dates for each year with a fitted line to show the pattern of change.

During the same period, Pied Flycatcher populations have declined, which is consistent with a possible phenological mismatch effect, but Great Tit populations have increased, suggesting that for this species any reduction in productivity as a result of mismatch is swamped by other factors, such as improved overwinter survival.



Recent trends in Pied Flycatcher and Great Tit populations identified by the BBS scheme, bounded by 95% confidence intervals.

Oxford University studies on Great Tits at Wytham Wood, England, show that in contrast to the Dutch situation, individuals in that population have continued to remain in synchrony with changes in caterpillar availability, and have not suffered reduced breeding success in recent years. Ongoing BTO research using NRS data is examining what is happening to Great Tits, Pied Flycatchers and other species more widely across the UK. Thus far, a number of published studies have failed to find strong evidence for phenological mismatch

being the cause of recent declines in three UK migrants; the Ring Ouzel, Common Sandpiper, and Cuckoo, but much more work is required. We are therefore currently using NRS, ringing and Breeding Bird Survey (BBS) data to assess the extent to which phenological mismatch may be responsible for declines of many of our much-loved long-distance migrants. There will be much to report in due course, so watch this space!

ACKNOWLEDGMENTS

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