Summary for policy makers

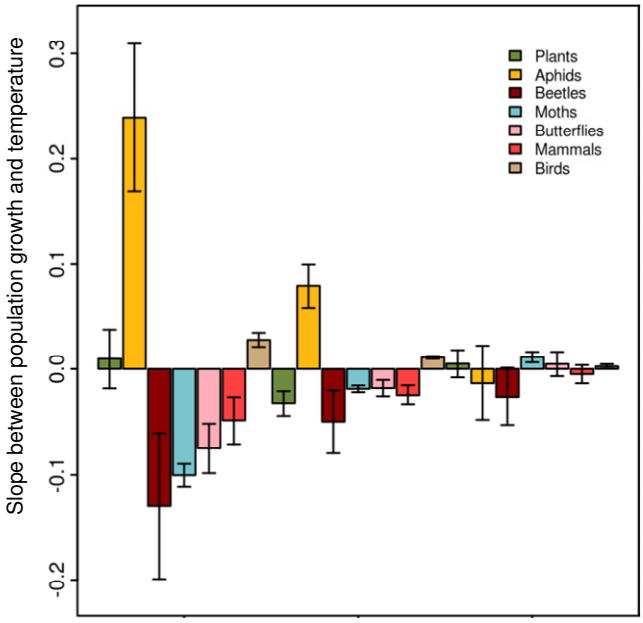
Introduction

- BICCO-Net assessed the impact of climate change on UK biodiversity by analysing long-term monitoring data on eight terrestrial taxa and reviewing the latest literature.
- Analysis linked national population change to weather (temperature and precipitation) and assumed that this provided information about species responses to climate change.
- The reliance on extensive long-term monitoring means that most of the species covered were relatively common and widespread.

Policy context

- Species monitoring across habitats and taxa should be coordinated (English Biodiversity Strategy, UK Biodiversity Partnership).
- Thorough analyses of causes of change are required to identify climate change impacts (Hopkins *et al.* 2007).
- Climate change adaptation requires knowledge in order to plan strategically (Smithers *et al.* 2008).
- The UK Government needs to develop a system to monitor the effects of climate change on the abundance of vulnerable taxa (ccra.defra.gov.uk).

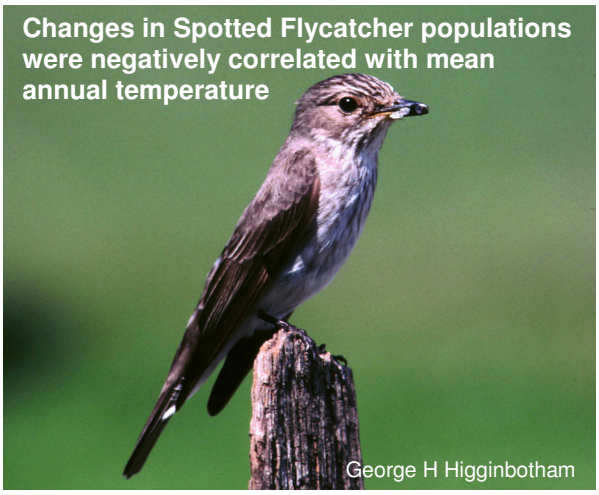
Results



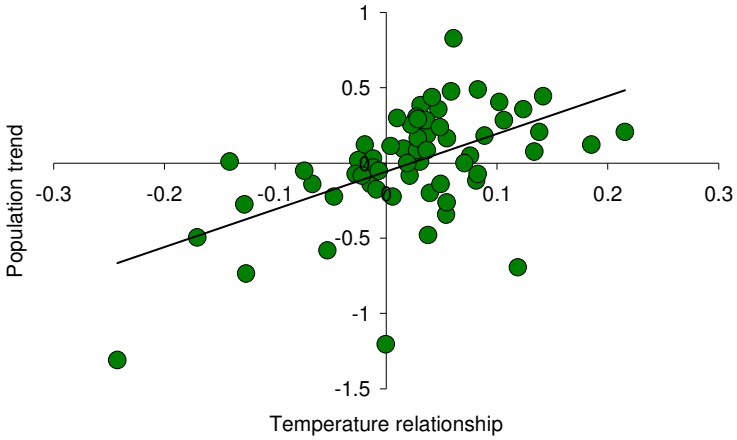
Effects of temperature on population growth differ between taxa. Positive values indicate that high temperatures promote growth. MEANT - mean annual temperature (℃), MTCO - mean temperature of the coldest month (℃), MTWA - mean temperature of the warmest month (℃).

- Taxa showed contrasting sensitivities to changes in temperature and precipitation. Populations of birds and aphids largely increased in response to higher temperatures, whilst beetles, butterflies and moths showed more complex responses, increasing during warm summers but declining after warmer winters.
- Climate change may disrupt the functioning of the wider ecosystem by exerting differential effects on species at different trophic levels.
- Although many birds increased with warmer temperatures, negative effects of summer warming on ground feeding species and long-distance migrants suggest these could be vulnerable to climate change.

- Long-term climate change is not occurring in isolation, but in combination with many other environmental changes. However, specific studies of farmland birds and carabid beetles showed the effects of temperature were distinguishable from other potential drivers of change.



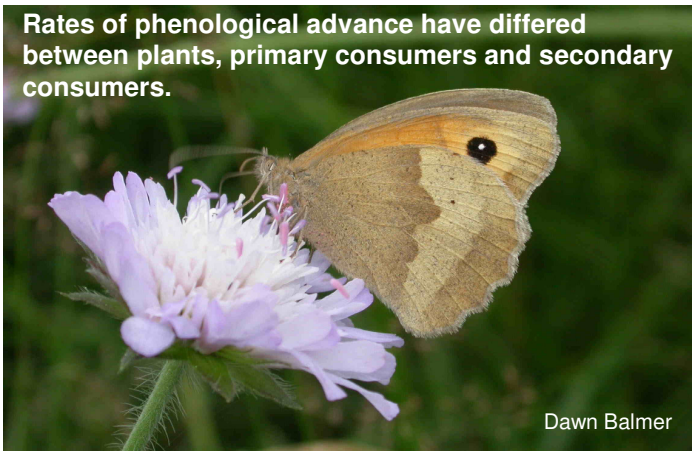
- Recent changes in bird populations were correlated with species' sensitivities to mean temperature, suggesting that at least some of these changes may be driven by climate change.



Species sensitivity to mean temperature is positively correlated with recent bird population trend (1995-2008).

Literature review

- Much of the recent literature on climate change impacts on UK biodiversity has focussed on the timing of biological events (e.g. breeding, hatching etc.). These appear to be changing at different rates for different taxa, potentially leading to the desynchronisation of life cycles of populations at different trophic levels. There are examples where this mismatch has affected higher order predators, particularly insectivorous woodland birds, although other studies have found no evidence for this being the cause of recent population declines.
- Direct effects of warming are apparent for a number of invertebrate groups, with many butterfly species apparently benefitting from increases in temperature. As a result, climate change is generally regarded as unlikely to be a major threat to all but a small number of northern butterflies adapted to cooler conditions.
- Birds are the most widely studied taxa with respect to effects of climate change. Increases in temperature are associated with significant changes in the composition of bird communities. Detailed studies of individual species suggest that, aside from direct physiological effects resulting from amelioration in winter weather, changes in climate also impact on these populations by altering the availability of prey either through changes in prey abundance or phenological mismatch. The systematic monitoring of key prey groups in relation to climate should therefore be a high priority for biodiversity surveillance.



Conclusions

There is growing evidence that climate change is influencing UK biodiversity. BICCO-Net has used long-term monitoring data to quantify this impact for a range of terrestrial taxa, and identified those species most likely to benefit or suffer from anticipated future warming. Continued maintenance and development of long-term ecological monitoring programmes, coupled with a rolling programme of rigorous statistical assessment, especially in relation to climate change as exemplified by the BICCO-Net approach, is essential for the reliable recording and attribution of changes in biodiversity. The ecological understanding this provides is key for the development of appropriate priorities within adaptation strategies.

This work was undertaken as part of the joint research initiative, Biodiversity Impacts of Climate Change Observation Network (BICCO-Net), funded by Defra with the support of the Joint Nature Conservation Committee, Countryside Council for Wales and Scottish Natural Heritage. Our analysis is dependent upon the availability of long-term monitoring data, and we are indebted to the dedication of the thousands of voluntary and professional observers who have contributed to the collection of such data over many years.