

What's up with British moths? Like much of our wildlife, they're being hit hard by habitat loss and responding to warmer weather. Richard Fox and Tom Oliver explain.

# Much ado about MOTHS



**W**e hear a lot about the global declines of animals from honey bees to elephants. These are important species, but does their plight tell us anything about the wider state of the millions of other species that make up the Earth's biodiversity or about the benefits that this biodiversity generates, including food, clean water, fertile soil, pollination and so on?

Scientists usually assess biodiversity based on a few groups of animals, such as mammals and birds, that are relatively large and popular and, consequently, well studied by humans. Yet these groups are almost irrelevant compared to the enormous diversity and sheer abundance of other types of wildlife – particularly insects.

It may be that the trends of birds mirror patterns of change among beetles, butterflies and bugs – but, equally, they may not. If we really want to know about the state of our wildlife, whether in our gardens, our nations or our planet, we need to understand what is happening to insects.

But it's no coincidence that past assessments have been based on furred and feathered animals; detailed datasets

of insect populations and distributions are rare. In Great Britain, though, we're fortunate enough to possess just such information on the larger moths, thanks to a long tradition of natural history study by dedicated amateur enthusiasts. Moths are a major branch of the insect tree, so there are many different species, and they also form important links in food chains and act as plant pollinators.

We used 11 million recorded moth sightings, made by knowledgeable amateur observers for Butterfly Conservation's National Moth Recording Scheme, to calculate long-term population trends for Britain's larger moths. Although previous studies based on different data have done this for widespread, nocturnal moths, this is the first time it's been done for all Britain's resident larger moths – day-flying and nocturnal, rare and common.

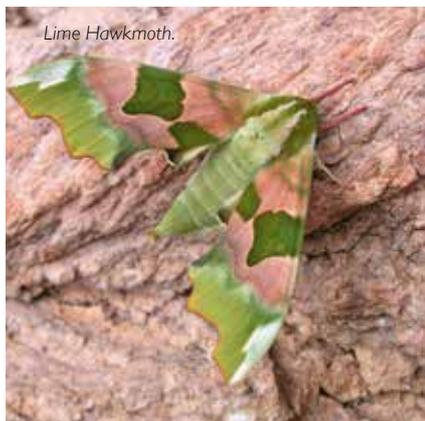
The study, which was conducted by a team from Butterfly Conservation, NERC's Centre for Ecology & Hydrology (CEH) and the University of York, determined changes in the occurrence of 673 larger moth species in Britain over the four decades from 1970 to 2010. There were some

considerable technical challenges involved because the moth records are not gathered through systematic survey – they are simply sightings of moths whenever and wherever encountered by the recorders, and so vary greatly both geographically and from year to year.

If we're not careful, such biases can lead to false conclusions that species have colonised new areas over time, or that certain colonies have become extinct, when the reality is just that recorders happened to visit a particular area one year and not the next. We used an innovative approach, recently developed at CEH, to adjust for this kind of uneven recording in our analysis.

The overall picture for British moths is gloomy. Larger moths, as a group, had declined significantly over the period. Examining each species in turn showed that 260 had decreased significantly. Only 160 had increased significantly, with the rest showing no clear trends. So two-thirds more of our larger moth species declined than increased.

Beyond this gloomy, if not altogether surprising, result, the analysis revealed interesting patterns of change that



Lime Hawkmoth.

Shane Farrell



Moth trapping.

Dore Green



Archer's dart.

Chris Manley

provide clues as to what might be behind these trends. It is likely that many factors come together to influence each moth's population and distribution, but our results suggest substantial influences of both climate change and shifts in land use such as more intensive farming.

### North versus south

Many moths are limited to just northern or just southern parts of Britain. Among those that only live in more northerly, colder areas, almost all had decreased since 1970, which matches what you might expect to happen as the climate gets warmer.

Species associated with the warmer southern half of Britain, on the other hand, might be expected to have benefited from climate warming. Yet these species also have to contend with high levels of habitat degradation in the more intensively-managed south, which probably harms moth populations. In agreement with these expectations, we found that southern moths showed a variety of trends, with a mixture of increasing and declining species and no overall pattern.

Widespread moths – those found throughout most of Britain – decreased on average, but when we looked at the trends of these species separately in the north and south, we found most had declined only in the south. In northern Britain, there was no overall trend – some species declined and others increased. It is interesting, and perhaps informative, that these widespread moths, which by nature of their extensive

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distributions are probably not too sensitive to the climate, only decreased in southern Britain where more habitat has been lost and degraded as farming has become more intensive. This includes the removal of hedgerows and field margins and increased use of pesticides and chemical fertilisers. In northern Britain, where much more wildlife habitat survives, there was no overall pattern of decline.

There was even more support elsewhere in our findings for the idea that land-use change has a major impact on moth trends. Moths, such as the cistus forester, associated with open grassland habitats and low levels of soil fertility (nitrogen) – usually because the plants they need as caterpillars (common rock-rose in the cistus forester's case) grow only in these habitats – tended to decline. In comparison, moths associated with taller vegetation and more fertile conditions, such as the snout whose caterpillars feed on nettles, tended to increase. This finding suggests that nitrogen pollution of the environment, known as eutrophication, may be influencing moth trends. Eutrophication is a consequence of intensive farming and vehicle emissions.

We are still a long way off understanding

the causes of the British moth trends that our study revealed, let alone addressing them. But the overall picture of decline is as clear in this diverse insect group as it is among the few high-profile creatures that garner media, celebrity and political interest. Restoring the habitats that have been damaged by human activity – for example, replanting hedgerows, allowing mature trees to develop in hedges and encouraging the ecologically-sensitive management of farm field margins, road verges, urban parks and other green space – would be a first step to counteracting the declines of moths and other pollinating insects.



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You can read the full study at <http://onlinelibrary.wiley.com/doi/10.1111/1365-2664.12256/full>

Hawkmoth and Magpie moth caterpillars/Alex Hyde/Nature Picture Library