The '95 drought

extreme climate events have contrasting effects on species

Extreme events such as intense summer droughts - predicted to increase due to climate change - can benefit some species more than others

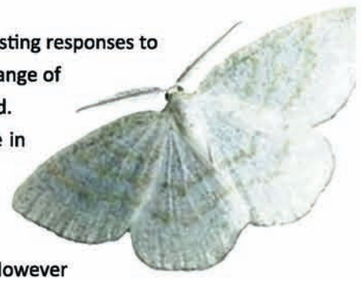
The summer of 1995 was one of the warmest and driest in the United Kingdom since records began (see box below). The ecological effects of such an extreme event are of interest in their own right, but in the context of climate change they acquire extra significance. Current climate change scenarios predict that the incidence and intensity of summer droughts in the United Kingdom will increase. It is likely that these will be major drivers of ecological changes. A series of dry, hot summers, for instance, could lead to rapid changes in the populations of some species, which in turn may lead to complex changes to ecosystems.

Long-term records are required to test whether ecological changes are underway, and to ascertain the mechanisms involved. ECN data for vegetation, butterflies, moths and ground beetles have been used to examine the effects of the 1995-6 drought[1]. These contrasting organisms enable us to build a very good picture of drought impacts.

- June–August rainfall was the lowest in the 229-year combined series for England and Wales
- Temperature in August 1995 was the second highest for any month in the 336-year Central England Temperature Record
- Rainfall was below average throughout most of 1996
- Dry soil conditions and low river flows, persisted until 1997, despite some wet periods in autumn 1995 and winter 1995–96

Features of the 1995-96 drought

Winners and losers



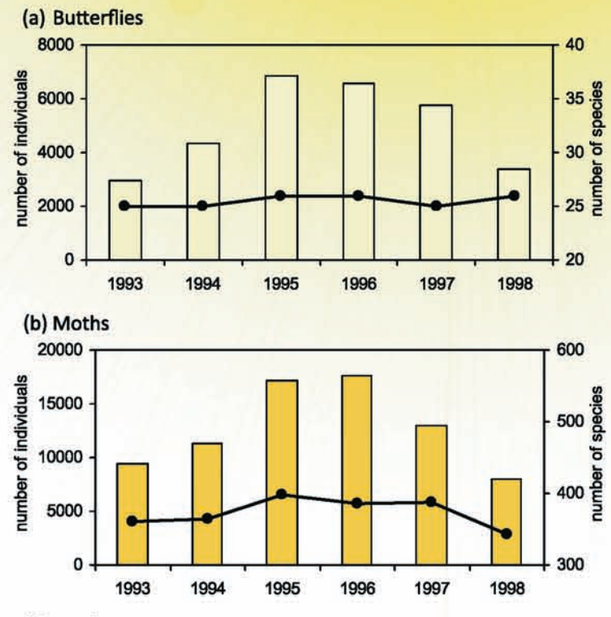
The ECN study showed contrasting responses to drought conditions over the range of plants and animals monitored. Overall there was an increase in most butterfly and moth species, and in plant species, particularly 'weedy' annual species in some grasslands. However in all the groups studied, some species showed no response or declined. The main findings are shown in the box (right).

Implications

Plants, beetles, butterflies and moths represent different levels in food chains. They also contrast in other ways. For example, mobility of individuals typically increases from plants through beetles to butterflies and moths. The animal groups encounter very different microclimates; moths are mainly night-flying, butterflies day-flying, and ground beetles are typically found in the shady, damp litter layer. Within each of the groups there are many different species, with different distributions, life histories and ecological requirements.

The ECN results suggest that many species are acutely sensitive to climatic fluctuations but individually they have limitations as indicators. The longevity and slow dispersal rates of plants restrict their short-term responses, while invertebrate populations appear to respond very quickly. Shifts in climate therefore could lead to important impacts on patterns of herbivory and pollination as new species assemblages form. Climate induced changes in species interactions may be extremely difficult to predict and may only be revealed through continued long-term monitoring. For example, recent work utilising other long-term datasets suggests a link between changes in plant species abundance and declining populations of bumblebees[2].

Trends in butterfly, moth and beetle populations from 1993 to 1998, surrounding the drought years of 1995-96. *Total numbers of individuals (bars), and total numbers of species (points). Data were only included where a complete time series was available. Butterfly data for 7 ECN sites, macro-moth data for 8 sites, carabid beetle data for 9 sites.*



- Between 1994 and 1996, the total number of plant species recorded increased by 10% from 147 to 162
- Significantly more plant species increased in number than decreased. The increase was principally among vascular plants. Seedling numbers for most tree species increased in 1996 compared to 1994
- Among the herb species that increased, proportionally more were annuals or biennials rather than perennials, particularly short-lived species in grasslands
- Ground beetles showed no clear pattern of change in either overall numbers of individuals or of species in 1995 and 1996. In fact, for the studied years, the highest number of ground beetle individuals at most of the sites were recorded during 1997, a wet summer at all sites
- The beetle species showing a sustained decrease tended to occur at cooler sites and on soils with a higher soil water content
- Most species of butterfly and moth increased in numbers during 1995 and 1996
- Typically it was the butterfly species with a more southerly European distribution, or the more mobile species, which increased in abundance: the conditions did not tend to favour the more northerly species or those which were less mobile

Biological effects of the drought