Impacts on woodland ecology

Keith Kirby
English Nature, Northminster house, Peterborough, PE1 1UA

The composition and structure of our woodland reflect the interactions of soils, history, management, but also climate. When big woodland plant data-sets are analysed, such as the recent BSBI atlas or the records used to produce the National Vegetation Classification clear geographic trends show up which appear to reflect the north-south temperature gradient across the country and the east-west rainfall gradient.

While this is most easily seen for plants it is shown in patterns in woodland animal distributions, for example in the range of some butterfly species and trends in abundance of woodland birds across the country.

We need however to remember that woods are not just one climate regime, but many: the temperature at ground level within a recently-cut coppice coupe may be several degrees warmer than under older stands: this has been shown to be a critical factor in the association of some fritillary butterflies and coppice regimes; many bryophytes are restricted, even within woods in Wales or Scotland, to ravines or other areas with a particularly humid microclimate.

Some species may experience different microclimates at different stages in their life-cycles: deadwood beetle larvae tend to prefer logs in relatively humid conditions, but the adults often feed on nectar produced by flowers at the woodland edge. Which microclimate will first prove limiting? During regeneration at least shade-tolerant species may be sheltered from some climatic extremes, but if/when they reach the canopy they are then exposed to the raw elements.

Not just climate, but weather events shape our woods: extreme frosts, droughts, wind events can influence the distribution/growth of species for years after the event: for example the impact of the 1987 storms in southern England, or the differential effects of the 1976 drought on beech and birch in Lady Park Wood.

How then will changing climate affect woodland ecosystems? My concern is with ecological changes, which may or may correspond with changes in the productive capacity of woodland. We also need to remember that the limiting factors for many species, both at present and in future may not be the weather or climate within the British Isles – it may competition/disease (red/grey squirrels), habitat declines elsewhere (migratory birds), persecution (some predators),

The way woodland responds to climatic and weather fluctuations
Woods and woodland do not respond to changes in climate or weather events *en bloc*. What we will see is the net effect of responses by many individual species and individual organisms, in the context of the sites in which they occur and the species with which they are associated.

Individuals may respond to fluctuations by phenotypic adaptation; over time populations may respond by genetic modification. Short-term fluctuations are perhaps more likely to lead to phenotypic response; longer term trends to genetic adaptation; but in woodland what counts as short term varies according to whether we are considering an oak tree (300-600yr lifespan), primrose (10-60 yrs) or a fritillary butterfly (1 yr).

A three-hundred year old oak started growth in the Little Ice Age (1450-1890), survived hot summers in August ever (c 1826, 1908), severe winters of 1947,1962, droughts of 1975,76, the 1981 severe winter, the mid-nineties heat-waves etc. Phenotypic plasticity is therefore more likely to be important as a coping strategy in trees than in shorter-living components of the ecosystem. By contrast very short-lived species such as invertebrates, often with annual life-cycles, have a greater capacity to respond through genetic adaptation over short time-scales.

Species on the edge of their range are likely to show may show more sensitivity to small changes in conditions, but these are again individualistic. Rackham points out that primrose an Atlantic species, as appears to do less well under summer droughts in Eastern England, so potential under threat from climate change. However so does its continental equivalent the oxlip which might have been expected to increase. Reproduction of two continental trees beech and small-leaved lime that both reach the edges of their range in Britain seems to be increased by warm summers, so potentially increasing their potential to spread. Lime seedlings in Collyweston were particularly good this year. However in the case of beech any benefits may be offset by reduced adult survival if summer droughts increase.

So what might we see?
We may see shifts in species distribution – both increases and decreases are possible, but the increases also require that there is habitat space for the species to move to and a capacity for long-distance dispersal. Local movement of populations may be irrelevant if the whole of a region becomes unsuitable.
Potentially some new species may invade – but again this assumes that they can disperse into the new climate space. There are issues about how we view such new colonists in conservation terms: do we accept them as part of the natural response to changing conditions; or do we strive to maintain existing patterns.

There may be shifts in species dominance. If some species start to grow earlier in the season, and there is good evidence that the growing season has advanced, how will this affect the competitive balance between, for example a traditional spring plant such as bluebell and a summer growing species such as bramble. How will these both be affected by changes in the time at which the tree canopy overhead comes into leaf? Rackham notes that the patterns of species distribution in Hayley Wood are in part associated with spring waterlogging: as this has become less common so the balance between dog's mercury bluebell, anemone and meadowsweet may change.
We are building up information on changes in timing of growth for different species, models can be made of the climate space that they occupy, but the detail of the outcome of competition in any one wood remains very difficult to predict.

There will be shifts in species behaviour and habitat association: a butterfly that currently needs locally hot open micro-climates might move into dappled shade (as they do in southern Europe). Beech might become a species of north-facing coombs in south-east England, or be found largely in the understorey.

The third type of change that we need to be aware of is in functional links. Much work has been done on the link between the timing of emergence of oak leaves, the caterpillars that feed on them and the breeding of blue-tits that feed on the caterpillars. If climate change affects these links differentially, so the whole pattern may be disrupted. To date this has not happened, but it could do in future. At the same time new functional links could become important: most obviously if climate change is seen to favour a new disease; for example the oak dieback that was noticed a few years back (*not* Sudden oak death) seemed to be a combination of a fungus attack on trees weakened by drought, followed by infestation by a bark beetle. However we could see over time links that we regard in conservation terms as positive developing as well.

Implications for conservation and management
A later speaker will be covering the practical aspects of how we might respond to climate change, but I would like to consider issues to do with how we approach change in the conservation movement.

We have been very poor at predicting detailed changes in woodland composition even under a constant environment. Models for ground flora response to management or how species spread to new sites for example are still in their infancy (similarly for bird and invertebrate modelling). The additional level of uncertainty brought in by climate change means that we have to proceed with caution.

We should not underestimate the robustness of woodland and woodland wildlife. What we have has survived a few thousand years of habitat destruction on a greater scale than most other countries; over the last two centuries there have been massive changes in the internal and external environment of our woods (abandonment of coppicing, wood-pasture, development of modern forestry practices; site destruction, countryside change, changing pollution regimes). I expect our woods to surprise us when it comes to responses to climate change. The critical changes may be come as unforeseen thresholds or crossed, or in the emergence of new disturbance regimes (more fire for example?).

We seek to conserve 'sites of special scientific interest' based on statements of their value that assume that value will remain in the future, in more-or-less the same places. What is currently an SSSI for beechwood might not contain much beech in the future. We assume ancient woodland floras will remain distinct in the future. While it is likely that SSSIs will remain the most species rich woods, that ancient woods will remain distinct they may still change radically from their present state. In the future we probably need to take a more dynamic and more landscape scale focussed approach.

Conserving past-natural or traditional communities where they currently occur will often not be possible. It will also not be possible to recreate or re-assemble them inexactly the same way in a different part of the country.

So often we need to be looking at accepting and encouraging new, diverse, but different communities in our woods in future.

Woodland ecologists are in for 'interesting times'!