Climate change and biodiversity

Can biodiversity help our woodlands in a changing climate?

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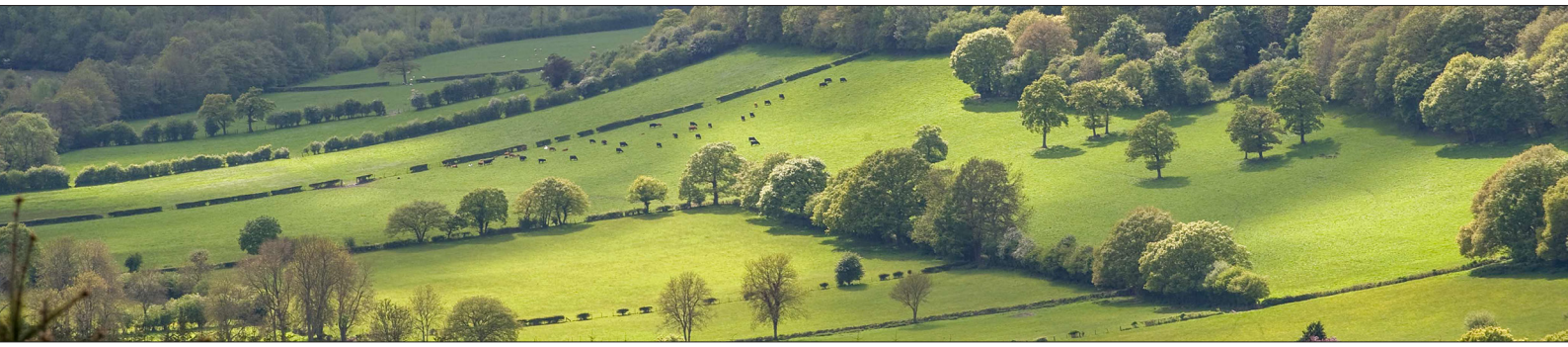


More biodiverse woodlands are better able to resist or adapt to threats, such as climate change. This enhanced resilience supports the continuity of woodlands and the ecosystem services they provide.

Biodiversity is the variation at different levels of biological organisation - the genes within a species; the species within a community; and the diversity between communities and ecosystems.

Genetic diversity

- Genetic diversity provides the building blocks for species to adapt via natural selection, as this promotes the survival of individuals that are best suited to their local conditions.
- Species with high levels of adaptive genetic diversity are more likely to contain some individuals with the appropriate genetic make-up to survive, reproduce and thrive in altered conditions such as those resulting from environmental change.
- Some of our native species in Britain contain high levels of adaptive diversity which has enabled them to respond and adapt to past, and potentially future, fluctuations in climate and their environment.

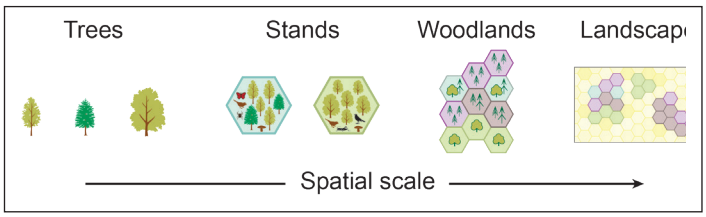
Species diversity

- Species diversity has the potential to enhance woodland resilience where species differ in their *response* and *effect* traits.
- *Response* traits relate to how species *respond* to external pressures, such as drought, increased temperatures or competition from invasive species, whereas *effect* traits are defined by the *effect* a species has on its environment, via processes or services that a species provides such as carbon storage or pollination.
- It is diversity in these *response* and *effect* traits across species (known as *functional diversity*), rather than simply the number of species, that tends to make woodland ecosystems more resilient to environmental change.

Community and ecosystem diversity

- Species interact in many ways (e.g. pollination, predation and parasitism) and often evolve into distinct and complex communities.
- *Functional diversity* also plays a role at the community level, so that diverse woodland communities, with a complex network of interactions, are likely to be more resilient to environmental change (even when individual species are not).
- The number and complexity of species interactions are expected to be highest in and among native woodlands as these relationships have evolved over long time periods.
- Some elements of biodiversity can be detrimental to woodlands, such as pests and diseases, including invasive non-native species. These can compound the negative effects of climate change.

Woodland biodiversity can be enhanced in existing and new woodlands through management at different spatial scales.



At the tree and stand scale

- Environmental heterogeneity[1] encourages biodiversity, and this can be managed and enhanced at the stand scale by promoting a mixed age and species composition, and retention of mature trees and dead wood.
- Well-established veteran trees tend to be rich in a diversity of microhabitats and support disproportionately high levels of biodiversity.
- Evidence for some taxonomic groups indicates that native tree species can support a higher diversity of associated species than non-native tree species.
- Stands with a mixed tree species composition support higher associated woodland biodiversity and can show greater resilience to environmental disturbances (e.g. pests and diseases), although this depends on the identity of the tree species in a mixture (and their *response* and *effect* traits) and not just the number of tree species present.
- Variations in soils, geology and topography can contribute to overall levels of heterogeneity within and between stands, thereby supporting higher biodiversity.
- Natural selection, leading to genetic adaptation, will only work for trees if there are regular cycles of natural regeneration which can be encouraged by gap creation and prevention of overgrazing.

At the woodland scale

- The size of an individual woodland has a major influence on the biodiversity it contains. Recent modelling work predicts significant biodiversity benefits (for a range of species) of enlarging small (<3 ha) woodland fragments with new woodland creation.
- Larger woodlands are likely to capture greater environmental heterogeneity, provide more ecological niches, and support larger and more robust populations of woodland species.
- Ancient semi-natural woodlands tend to support high species richness and provide habitats for many rare and specialist species.
- Increasing the diversity and species composition between woodlands may further enhance resilience as each woodland may respond differently to environmental change. It is essential nevertheless to match the suitability of planted trees to the location.

At the landscape scale

- The landscape context of an existing or new woodland can impact on the resilience of the woodland ecosystem.
- In principle, well-connected woodlands support higher levels of biodiversity and are more resilient and better able to adapt to or recover from environmental changes than small isolated woodland fragments.
- The movement of species and genes between woodlands is important to maintain and enhance genetic, species and community diversity, and to allow species to shift their range to more suitable conditions in response to climate change or other drivers.
- Species movement is primarily driven by the proximity to other woodlands and how easily species can move through the surrounding landscape matrix.
- Hedgerows and trees outside of woodlands can also make an important contribution to landscape connectivity by providing corridors and stepping stones between woodlands that would otherwise be isolated.

[1] *Heterogeneity relates to the variation and arrangement of environmental attributes.*

More information:

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