Peatlands, forestry and climate change

What role can forest-to-bog restoration play?

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The UK's peatlands play an important role in global climate regulation. Like all ecosystems, their plants take up CO_2 from the atmosphere but, unlike most other ecosystems, a substantial part of the carbon gets stored underground as peat. The rate of carbon accumulation is slow but it has continued for up to 11,000 years. In upland blanket bogs, the predominant UK peatland type, the peat layer is typically 1–5 m thick and every square metre contains 40–200 kg of carbon. This factsheet explains how forestry affects the carbon stored in peat and the role forest-to-bog restoration can play in reducing carbon emissions.

Carbon sequestration in peat bogs

Carbon sequestration is the long-term removal of carbon dioxide (CO_2) from the atmosphere which will help reduce climate change. Net rates of carbon sequestration by Britain's blanket bogs have averaged

Peatland plants like Sphagnum moss take in carbon dioxide as they grow and form carbon-rich peat when they die.

10–30 g C m^{-2} yr^{-1} (= removal from the atmosphere of 0.4–1.1 t CO_2 ha^{-1} yr^{-1}) over the thousands of years they have been accumulating. Those bogs that are still in a near-natural condition appear to sequester carbon much more quickly than this (e.g. 99 g C m^{-2} yr^{-1} reported recently in the north of Scotland) (= 3.6 t CO_2 ha^{-1} yr^{-1}) but much of this carbon will not be stored long-term because of continuing slow decomposition and also infrequent disturbance events, particularly droughts and fires, which release carbon.

It is uncertain how climate change will impact on peatlands but restoration of degraded non-forested (e.g. drained or eroding) peatlands is expected to increase their resilience to drought, wildfire and other effects of climate change.

Carbon sequestration by forests

New forests also remove CO_2 from the atmosphere. The carbon accumulates in the living parts of trees, both above ground and in the roots, and some is shed as dead leaves, needles and twigs, helping to build up carbon-rich organic matter in the soil. When trees are harvested, the time that their carbon remains stored depends on their use. For example, typical carbon storage times for wood fuel, fencing posts and roofing timbers are 1, 20 and 100 years respectively. The roots, containing a quarter or more of the trees' carbon, are usually left in the ground, adding to the soil organic matter and carbon store. Use of wood fuel and timber can reduce use of fossil fuels too.

To grow productive forests on most types of peatland, drainage and fertilisers are needed. Both interventions cause increased decomposition of peat, which releases some of its stored carbon as CO_2. The rate of carbon loss due to peat decomposition has been estimated at approximately 270 g C m^{-2} yr^{-1} (= 9.9 t CO_2 ha^{-1} yr^{-1}) during the first generation of trees. This release offsets some of the carbon accumulation in the trees so that the net rate of carbon accumulation in first-generation woodland on peat is less than that of woodland growing at the same rate on mineral soils.

Harvesting Sitka spruce timber grown on peat 4 m thick at Tywi Forest in the uplands of Wales.

New tree planting on deep peat is not allowed under the UK Forestry Standard. However, replanting after harvesting of existing forests is allowed, provided the balance of benefits for carbon and other ecosystem services is considered. The best available evidence suggests that replanted Sitka spruce forest on deep peat will help reduce overall CO_2 emissions if it grows at Yield Class 8 or above (i.e. moderate or better productivity). If the forest grows more slowly, there will be a net loss of carbon, potentially exacerbating climate change.

Forest Research is working to improve the evidence base on which to formulate guidance. We are examining growth rates of replanted forests compared to first-generation forests to see whether the modern low-input silviculture required to protect peat soils reduces the growth and timber yield and thus the climate-change-mitigation benefit. We are also investigating the feasibility of semi-wooded bogs and whether there are carbon and biodiversity benefits from their creation.

The role of forest-to-bog restoration

Since about 1990, when the first attempts were made to restore ecologically valuable peatland habitats, it has become clear that such habitat restoration is feasible. The table shows the expected recovery times for some key peatland functions following successful rewetting, with ranges reflecting dependence on the degree of degradation.

Function	Recovery time (years)
Protection of peat carbon store	1–2
Net carbon accumulation	10–20
Habitat for specialist plants and animals	20+

Forest-to-bog restoration has a role to play in restoring special habitats impacted by forestry in the past. Notable examples include lowland raised bogs which had been planted up in the post-WW2 drive to increase productive use of peatlands and afforested blanket bogs in the Flow Country in northern Scotland, where important bird populations had been reduced by forestry in the 1980s.

Forest-to-bog restoration can help to reduce CO_2 emissions but only when relatively poorly productive forests are removed. Restoration of peatland currently growing more productive forests may help regain valued habitats but will increase net greenhouse-gas emissions, adding to climate change.

Photo: Forestry and Land Scotland.

Rewetting afforested blanket bog at Dalchork Forest in the north of Scotland. An excavator turns the stumps over into the plough furrows, then runs across the ploughing, pressing them down. Vegetation regrows quickly on the flat, wet surface.

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