Commission of Inquiry on Peatlands Update: Peatlands and forestry

'Forest to Bog' good-practice restoration

i. The challenge of restoring blanket bog from forestry requires different approaches to those generally used for open peatland restoration.
ii. Restoration projects must reverse the impact of the ridge-furrow cultivation process which continues to persist post-felling, as well as raising the bog water table within the underlying peat mass which have been damaged by the afforestation process.
iii. Methods comprising various surface smoothing techniques, and furrow/drain blocking or a combination of both have shown good potential in restoring active blanket bog habitat. Mitigation measures to manage surface runoff (particularly water quality) from restored sites may be required, in the short-term, depending on the method used, site conditions and sensitivity of receptors.
iv. The timescale for specialist bog plants to fully recolonise following treatment - and for bare peat to be re-colonised - is likely to be 3-10 years.
v. Conifer regeneration can be dealt with by surface smoothing methods, but otherwise must be removed by additional treatment depending on size and density.
vi. Treatment costs for surface smoothing, once sites have been felled, can be as low as £800/ha depending on the machine specification employed and ground conditions. Costs for other restoration methods are in the order of £800 – £1500/ha.

Climatic implications

i. The afforestation of peatland, and the subsequent options for either continued forestry or removal of forestry plantations and restoration of peatland vegetation, have significant implications for carbon cycling and hence for addressing climate change.

Material adapted from the technical report by Robson *et al.,* (2019) Commission of Inquiry on Peatlands Update: Peatlands and Forestry.

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ii. The main principles and processes involved have been studied in forestry and peatland ecology research. However, while there is agreement over the main processes operating, differences of opinion remain over the way these processes operate in afforested peatlands. More empirical evidence from UK forestry on peatlands is needed to understand how the carbon cycling of these systems responds to different types of restoration in different contexts.

iii. One of the reasons for the paucity of empirical data is that land use change from open peatland to forest and then back to open peatland is almost unique to the UK and Ireland. It is difficult to apply findings from other European countries, in particular those of Scandinavia, since the climate is different, peatlands are often naturally forested, land preparation and drainage are less severe, and nutrient status is often higher.

iv. The evidence available indicates that following afforestation of peat soils, there is a loss of peat carbon and a gain in tree carbon. Recent studies have suggested that for organo-mineral soils (less than 50 cm of peat) this balance may be positive – the gain in the trees outweighs any peat losses, even into a second rotation. The situation for a peat soil (more than 50 cm peat) is unclear and opinion is divided as whether forest growth is likely to compensate for losses of carbon from peat, and if so at what point tree carbon is likely to exceed peat carbon losses.

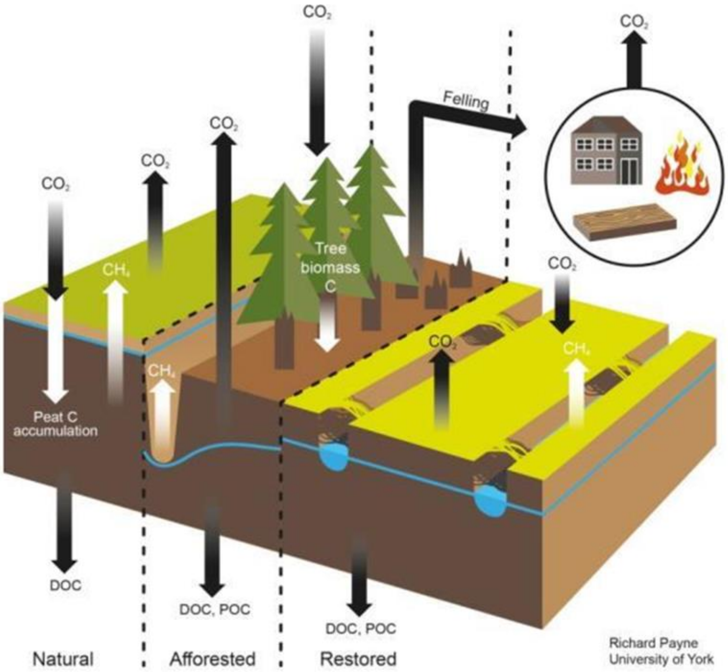
v. Part of the confusion stems from the role that methane emissions play in the carbon budget of forested versus restored sites. Methane is a potent GHG (with a Global Warming Potential 24.5 times greater than carbon dioxide) and typically increases as water tables are raised post-restoration. However, emissions are greater in the years after restoration, with emissions from this source typically less important when considered over timescales greater than a hundred years. While emissions may be halted or reversed after afforestation over the ground surface, new emissions can occur from drainage ditches. These are included in the IPCC reporting methodology and may be significant (in one Canadian study methane emissions from drainage ditches exceeded methane emissions from the natural undrained system). Recent evidence has demonstrated that for deep peat, forest-to-bog restoration can re-instate a net GHG sink function after the first 15 years, in the case of the simplest felling to waste, but further evidence is lacking for all other techniques.

vi. Another key consideration in determining the impact of forest to bog restoration on carbon cycling is the fate of carbon in harvested wood, depending on its use in short (e.g. biofuel) or long-lived products (e.g. building timber). Other aspects of the wider impact of forestry practices – tracks, fences, fertilisation, harvesting and transport, also need to be considered as part of a wider Life Cycle Analysis to determine the climatic implications of replanting versus restoring from forest to bog.

vii. Given this uncertainty, it can be difficult to decide whether forest-to-bog restoration can bring similar climate benefits (through avoided emissions) to other types of peatland restoration. However, over longer time-horizons, afforestation and reforestation translocates carbon from a reservoir that is secure over millennia under natural conditions (peat) to a more reactive store (wood), which is more likely to be mineralised to carbon dioxide within years to decades. Moreover, when other drivers for restoration (e.g. biodiversity, water quality) are also considered, it is possible to build a case for restoring such sites.

viii. Modelling of forest to bog restoration processes is still at an early stage, with forest growth and soil carbon turnover models presenting partial and often contradictory findings. However, models are now being developed that will bring together an understanding of both forest growth and soil carbon turnover. If successful it may be possible to use such models to target locations where forest to bog restoration is most likely to lead to a net carbon benefit.

ix. The implications for the Peatland Code are that there is currently insufficient underlying data to support a forest-to-bog category.



Conceptual diagram of key carbon (C) cycle pathways and changes with peatland afforestation and restoration. Note that the arrow widths are indicative only as there is much uncertainty in their relative values. CO_2 = carbon dioxide; CH_4 = methane; DOC = dissolved organic carbon; POC = particulate organic carbon.

Recommendations and actions

There are a number of evidence gaps which remain. Addressing some of these data gaps may help to unlock private finance through inclusion of afforested sites under the Peatland Code (iv). It is recommended that these research needs are met through formal government research agendas as a priority to underpin data and modelling for future GHG emissions inventory reporting and unlock peatland natural capital finance:

i. Although consensus from projects around the UK revealed that ground-smoothing was effective in recovering some peatland structure and functions, there are some unknowns which warrant further study:
   a. the long-term succession, tertiary vegetation assemblages and implications for fauna
   b. longer-term studies of sediment, nutrient and DOC parameters are needed to provide confidence to the scale at which treatments can be implemented in the landscape and the effectiveness of mitigation measures
   c. Almost all of the work on forestry to bog restoration with companion monitoring data has been conducted on blanket bog, so the efficacy of the methods on lowland bogs is virtually unknown. Trials on lowland sites are recommended before conducting large scale ground-smoothing techniques on lowland bogs.

ii. A particularly important evidence gap is measurements of the whole system greenhouse gas budgets for afforested peatlands. There is currently no complete, published ecosystem-scale flux monitoring dataset for any UK afforested peatland, or for restored peatland sites, of any age. This data can only be obtained from aquatic flux monitoring paired with eddy-covariance or intensive field campaign assessments, which are both cost and labour-intensive. Additionally, such measurements need to be multiannual as no single year can be taken as being typical. It is imperative that monitoring needs to include CH_4 assessment to be of real value in understanding the ecosystem net GHG balance, with such data then being able to feed-in and constrain models of soil function, and ultimately inform land use change decisions.

iii. Whole-system values for the relative GHG balance of forestry plantations on peatland the same peat bog undergoing restoration management are still lacking. There is still conflicting evidence on the effect of afforestation on carbon accumulation or loss in peat soils. While there is agreement that C losses will have occurred during the early stages of planting there remains some disagreement as to whether carbon accumulation in the trees partially or completely offsets the C loss from the peat stores. Nevertheless, the evidence points to a net below ground soil carbon loss. Life Cycle Analysis is required to resolve this and the balance is likely to be site specific depending on the wetness and fertility of the site.

iv. At the present time there is a lack of data to allow broad average emissions values to be attributed to the various states of post-felling and post-restoration conditions for forest-to-bog projects to be included in the Peatland Code. Equivalent values for forest-to-bog restoration cannot reasonably be estimated from the available data and there is a lack of both evidence and consensus on how far towards achieving the carbon balance of a 'near-pristine bog' a previously afforested site can be restored to. Field emissions data from felled forestry sites needs to be established in order to create a baseline reference for the Peatland Code to calculate emissions reductions from. In time, research ongoing at a small number of forest-to-bog restoration sites will demonstrate the likely ecological and emissions reduction outcomes of restoration activity on forest-to-bog restoration sites.

There are remaining policy challenges which arise from competing land use agendas.

v. Whilst current forestry policy prevents new planting on peat, in practice there is pressure from tree planting targets which is creating a resistance to remove forestry from peatlands and is adding pressure to re-stock after first rotation. These conflicts are currently being explored in more detail through the Border Mires England Peat Strategy pilot project.

vi. Peatland Edge woodland is an emerging contention for peatland and forestry policy. The consensus view from the evidence and a risk based approach would recommend avoiding any form of forestry on peatlands. When balancing carbon, economics and biodiversity, what is considered most likely to be the *best* overall outcome for these services is to restore the previously afforested peatland back to open habitat whilst maintaining tree cover by new plantings on very thin peat/mineral soils: this is considered to be a win-win scenario whereby the trees are able to grow without much intervention and their accumulating carbon store is not counteracted by soil carbon losses. At the same time, the peatland can be restored to prevent further loss of carbon stock through erosion, oxidation and subsidence and to set it on the trajectory back towards being a carbon sequestering ecosystem at some point in the future. There are risks to other habitats with this approach and a shift from planting peat soils to planting other soils: some conservation bodies are concerned at the biodiversity impacts of shifting productive forestry onto wet heath/dry heath, which are also Annex 1 priority habitats.

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