IUCN UK Committee Peatland Programme
Briefing Note N°4

Ecological Impacts of Forestry on Peatlands

IUCN National Committee United Kingdom
Peatland Programme

Do trees occur naturally on UK peat bogs?

Peat bogs are wetlands, with water contents typically greater than 90% by dry weight. Most native UK tree species cannot tolerate permanently waterlogged conditions. The majority of UK peat bogs are therefore naturally tree-less, and are likely to have been so for millennia. Tree remains are nonetheless often found beneath blanket bogs, and there is continuing debate amongst palaeo-ecologists and archaeologists about whether human action in removing the forests then led to blanket bog formation (see ***Definitions Briefing Note 1***), or whether the increasingly wet climate eventually overwhelmed these basal forests by waterlogging. In other examples, horizons rich in tree remains can be found within the peat itself (photo), indicating that trees did expand across some peat bogs for periods in the past. The majority of these tree-remains consist of rather modest-sized trees or shrubs. Where these events have been dated the period of woodland or scrub cover has been brief. In other locations, evidence shows that such woodland or scrub has periodically extended only onto the margins of the bog. On the other hand, many peat profiles taken from lowland raised bogs and upland blanket bogs show no evidence of woodland cover since peat formation began.

It should be noted, however, that natural carr woodland once dominated the wet lagg fen of many raised bogs, while ribbons of poor-fen woodland probably once occurred along stream-courses and on steep slopes within blanket bog landscapes much as they do today in the undisturbed bogs of Tierra del Fuego and the blanket mire regions of coastal North America.

Afforestation of UK peat bogs since 1945

The need for deep drainage plus ploughing furrows

Improvements in post-war technology led to rapid expansion of forestry into areas of deep peat. Drainage was necessary on such peatland sites because they were generally too wet for the commercial conifer species used. Consequently it was necessary to drain the peat to remove excess surface water and plough the surface to provide a micro-habitat for the tree seedlings to establish. Such forestry practices were actively promoted by government

Rapid expansion and concern in the 1980s ***Development of multi-benefit sustainable forestry*** ***International commitments to biodiversity and to sustainable forestry objectives*** ***No new planting on peat*** ***Movement away from re-stocking, but planting targets are still a driver***	policy, through tax concessions and planting grants, government research, advice, regulation and activities on state forest land. By the early 1980s, environmental concerns were being expressed about such forest expansion[1]. Over the next decade forestry policy in the UK began to respond more sympathetically to biodiversity and environmental issues. Development of policy, grants and regulation for 'multi-benefit sustainable forestry' in the UK was facilitated by changes in 1985 to the Forestry Commission's statutory duties in Great Britain. International concern increasingly focused on the sustainability of forestry practices and biodiversity conservation in relation to both tropical rainforests and temperate plantations, and included discussions at the UN Conference on Environment and Development (Rio 'Earth Summit') in 1992. At the same time, the EU Habitats Directive identified raised bog and blanket bogs as habitats of EU 'concern', listing them under Annex 1 of the Directive for special conservation measures. The UK Biodiversity Action Plan (1994) which arose from Earth Summit discussions also included blanket and raised bogs as priority habitats with restoration targets. Subsequent country forestry and biodiversity strategies clearly highlighted the need for forestry practices to be consistent with these goals. Government commitments to adopting a more sustainable approach to forestry were detailed in *Sustainable Forestry – the UK Action Programme* in 1994. This was followed by the introduction of minimum mandatory sustainability requirements for all forestry planting and woodland management in the *UK Forestry Standard* (1998, 2004 & 2011). This was supported by peatland planting guidance for GB – *Forests & Peatland Habitats*[2] – and Northern Ireland's *Statement on Afforestation*[3], as well as the introduction of environmental impact assessment for afforestation. Extensive areas of peat bog, both lowland raised bog and upland blanket bog (see ***Definitions Briefing Note 1***) have nonetheless been planted during the past 60 years as a result of past polices and incentives. Many such plantations are now approaching the end of the first rotation. They would normally then be felled and re-planted but current practice is changing. The forestry regulators in the UK[4] no longer permit new planting on deep peat (over 50cm) and there is now no requirement for restocking of felled plantations on certain deep peat areas. Nonetheless while current policy and regulatory measures have helped to reduce the threat to peatland habitats from new afforestation, the restocking of plantation trees on areas of restorable peatland habitats continues to be actively promoted by certain policy drivers.
Impacts of afforestation ***Evapo-transpiration*** ***Interception*** ***Subsidence***	The establishment of trees is a significant impact on any bog ecosystem because of the immediate effects of ploughing (see ***Drainage Briefing Note 3***) and then the continued disturbance of the water balance due to the growing trees. Water is lost by evapo-transpiration from the trees and, as the tree canopies develop and close, water is further prevented from reaching the bog surface by interception. This can reduce the amount of water reaching the bog surface by as much as 40%. In addition, the weight of the trees and the loss of water from the peat cause the peat surface to subside (see ***Drainage Briefing Note 3***), with consequent hydrological effects on adjacent areas of peat bog as

[1] For example see:

- Bainbridge, I.P., Housden, S.D., Minns, D.W. & Lance, A.N. (1987) Forestry in the Flows of Caithness & Sutherland. *RSPB Conservation Topic Paper 18*, June 1987. RSPB, Edinburgh & Sandy.
- Stroud, D.A., Reed, T.M., Pienowski, M.W. & Lindsay, R.A. (1987) *Birds, Bogs & Forestry.* Nature Conservancy Council, Edinburgh.
- Tompkins, S.C. (1986) *Theft of the Hills.* Rambler's Association, London.
- Watkins, C. (1991) *Nature Conservation & the New Lowland Forests.* Nature Conservancy Council, Peterborough.

[2] Patterson, G. & Anderson, R. (2000) Forests & Peatland Habitats. July 2000. *Forestry Commission Guideline Note 1*, Forestry Commission, Edinburgh. http://www.forestry.gov.uk/PDF/fcgn1.pdf/$FILE/fcgn1.pdf

[3] DANI (1993) *Statement on Afforestation.* Department of Agriculture Northern Ireland, Belfast. http://www.dardni.gov.uk/afforestation-the-dani-statement-on-environmental-policy.pdf

[4] Forestry Commission England, Forestry Commission Scotland, Forest Service Northern Ireland & Natural Resources Wales.

Indirect impacts ***Edge effect*** ***Loss of peatland birds*** ***Reduction in overall ecosystem services***	well as on the properties of the peat beneath the plantation itself. Shading from the trees and needle fall may have a negative impact on the peat-forming *Sphagnum* mosses, potentially further inhibiting peat formation. Tree plantations also have impacts on the biodiversity of peatlands not merely through direct habitat loss, but also through modification of adjacent habitat (the edge effect) and through the introduction of alien predators. Recent research has shown these edge effects to be particularly critical to populations of breeding birds that utilise peatlands. In wildlife conservation terms, the loss of specialised peatland ecosystem biodiversity characterised mainly by tundra species including breeding birds of international importance outweighs the gains in additional species from forest planting (*e.g.* a range of songbirds, and birds of prey which have alternative land-use available, unlike peatland-dependent species). In general, the composite range of services provided by an undisturbed peatland ecosystem will tend to be lost or substantially reduced if the ecosystem is, or remains, wholly or partially planted with conifers. Adjacent unplanted parts may appear superficially to remain unaffected by such actions, but the morphology, hydrology and biodiversity will undergo change over time (see ***Drainage Briefing Note 3***).
Carbon balance of planting on peat ***Planting on deep peat increases net GHG emissions***	When plantation forestry is established on a living bog surface (see ***Biodiversity Briefing Note 2***) the capacity for active carbon sequestration by the peatland can be greatly reduced or completely lost. Furthermore, the carbon stored over millennia in the catotelm peat will undergo drying and compression beneath the growing trees, and may be released in the form of GHG to the atmosphere or as particulate and dissolved carbon into water courses, then eventually into the atmosphere. By way of a balance, growing trees do sequester carbon from the atmosphere and accumulate carbon stores of their own in the forms of wood products, leaf litter and root tissues. There is therefore a critical trade-off between the GHG benefits obtained through the sequestration and storage of carbon by trees, and the GHG costs in terms of carbon lost from the peat through oxidative and particulate emissions combined with loss of sequestration capacity of the original bog ecosystem. It is generally recognised that tree plantations on deep peat result in increased net greenhouse gas emissions. Conversely, where plantation forests are removed from peat bogs and the bog ecosystem are restored through hydrological management, evidence suggests a long-term positive benefit with a net reduction in greenhouse gases together with wider ecosystem benefits in terms of water quality and biodiversity.
Restoration after afforestation ***Several successful major programmes*** ***Policy and regulatory support***	Substantial restoration of peatland habitat within formerly-planted areas is now occurring across the UK, with major peat-bog restoration programmes undertaken on both state and private forestry land (*e.g.* the Border Mires Restoration Project, and the RSPB restoration programme at Forsinard, Sutherland). These various restoration schemes have demonstrated considerable success in restoring active bog habitat from plantations. Such restoration activities have been assisted by important, if limited, policy and regulatory measures such as restoration grants in Scotland, changes to felling licensing rules or procedures to permit peatland restoration without compulsory replanting, and in some areas not requiring off-site 'compensatory' replacement tree planting for peatland restoration sites. 

Vigorous Sphagnum carpet can hold as much carbon as plantations ***Improved ecosystem services***	Where peat bog restoration is the alternative to maintaining the forest crop, the carbon bound up in a restored acrotelm (see ***Biodiversity Briefing Note 2***) can be measured against the carbon store and sequestration-rate of the plantation standing crop. A vigorously-growing carpet of *Sphagnum* mosses around 20 cm thick contains the same amount of carbon per hectare as a 60-year old plantation of Lodgepole Pine grown on deep peat. A *Sphagnum* moss layer of around 25 cm provides the equivalent to that found in the more commercially-attractive plantations of Sitka Spruce planted on deep peat. The important difference between forested examples and restored *Sphagnum*-rich examples is that the former generally diminish the scale and range of other services obtained from the peatland ecosystem while the latter provide an increasingly wide range of peatland ecosystem services as habitat recovery progresses.
Areas of particular concern	Areas of particular concern include: • Any areas of bog with existing plantation forestry and any surrounding hydrologically-connected peatland (*i.e.* potentially all parts of the "tope" system – see ***Definitions Briefing Note 1***, ***Biodiversity Briefing Note 2*** and ***Drainage Note 3***). • Areas approaching second rotation are also of particular significance.
Gaps in Knowledge	Identified gaps are: • Whole-system values for the relative GHG balance of forestry plantations on peat and the same peat bog undergoing restoration management. • Comparative effects on other peatland ecosystem services in relation to plantations on peat and the same systems undergoing restoration management. • Long term studies into peat bog restoration following felling to determine impacts on GHG, water and biodiversity.
Practical Actions	Practical actions: • The removal of appropriate plantations as set out by current guidance. • Implementation of peatland restoration plans based on current best practice. • Research to establish the ecosystem benefits arising from plantations on peat compared with peat bog ecosystems undergoing restoration management.
More Information	Underpinning scientific report: http://www.rspb.org.uk/Images/Peatbogs_and_carbon_tcm9-255200.pdf (low resolution) http://www.uel.ac.uk/erg/PeatandCarbonReport.htm (high resolution : downloadable in sections) IUCN UK Peatland Programme: http://www.iucn-uk-peatlandprogramme.org/ Forest Research: http://www.forestry.gov.uk/website/forestresearch.nsf/ByUnique/INFD-7J5E7F Natural England Uplands Evidence Review: http://www.naturalengland.org.uk/ourwork/uplands/uplandsevidencereviewfeature.aspx Scottish Natural Heritage Report on peat definitions: http://www.snh.org.uk/pdfs/publications/commissioned_reports/701.pdf Peatland Action: http://www.snh.gov.uk/climate-change/what-snh-is-doing/peatland-action/

This briefing note is part of a series aimed at policy makers, practitioners and academics to help explain the ecological processes that underpin peatland function. Understanding the ecology of peatlands is essential when investigating the impacts of human activity on peatlands, interpreting research findings and planning the recovery of damaged peatlands.

These briefs have been produced following a major process of review and comment building on an original document: Lindsay, R. 2010 'Peatbogs and Carbon: a Critical Synthesis' University of East London. published by RSPB, Sandy. http://www.rspb.org.uk/Images/Peatbogs_and_carbon_tcm9-255200.pdf, this report also being available at high resolution and in sections from: http://www.uel.ac.uk/erg/PeatandCarbonReport.htm

The full set of briefs can be downloaded from:www.iucn-uk-peatlandprogramme.org.uk

The International Union for the Conservation of Nature (IUCN) is a global organisation, providing an influential and authoritative voice for nature conservation. The IUCN UK Peatland Programme promotes peatland restoration in the UK and advocates the multiple benefits of peatlands through partnerships, strong science, sound policy and effective practice.

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