An overview of the science underpinning 'Forestry on peatland habitats: Supplementary guidance to support the FC Forests and Peatland Habitats Guideline Note (2000)'

This note provides a brief summary of the key scientific findings underpinning the supplementary guidance, and highlights the remaining scientific uncertainties. Two primary sources have been drawn upon to provide this summary:

[1] ***Forest Research (2010): Understanding the greenhouse gas implications of forestry on peat soils in Scotland.***

[2] ***Morison J.I.L. (2013): Afforested Peatland Restoration. ClimateXChange policy brief.***

Additional detail can be obtained by reference to these key texts and the papers cited therein. Additional policy-focussed scientific guidance on peatland restoration is available from ClimateXChange[3]

1. Recent research and sythesis of current state-of-the-art knowledge forms the underpinning scientific basis of the new FCS guidance, especially the conclusions it drew from process modelling of net carbon (not full GHG) balance of restocking deep peat soils.
2. Understanding the net C and GHG balance of a forest stand and its soil requires use of detailed process models, and these need to be sufficiently comprehensive to include CH_4 and N_2O fluxes, the effects of alterations to water tables and other disturbances, and be appropriate for deep peats in Scotland. Appropriate soil GHG process models are only now becoming available and their treatments of disturbance effects are limited. The overall GHG balance benefits of CO_2 uptake by the forest and production of timber and/or woodfuel should also be considered but this requires existing forest C accounting models to be linked to soil models.
3. A comprehensive evidence base is some years away, yet many forests on peatland habitats (i.e. those planted in the expansion phase of the 1970s and 1980s) have now reached maturity and so a decision-making framework is needed urgently. The FCS supplementary guidance is therefore based on available but limited evidence. Interested readers should refer to the highlighted reports which clearly state the underlying scientific basis and assumptions.
4. Commercial conifer species are only likely to achieve good growth on deep peats if there is substantial site modification, and such robust establishment practices are likely to result in increased CO_2 emissions and SOC[4] losses and probably a negative net GHG balance. Therefore the FCS policy position is to avoid new planting on peats greater than 50cm depth.
5. For restocking on deep peats a key consideration is the site-specific potential for tree growth. If the productivity of a second (or subsequent) rotation is likely to be good and little further disturbance necessary then SOC stocks may recover the losses during the first rotation and the CO_2 uptake by the forest and the provision of timber products would provide

[1] http://tinyurl.com/peatlandforestry

[2] http://tinyurl.com/afforested-peat-restoration

[3] http://www.climatexchange.org.uk/reducing-emissions/carbon-benefits-peatland-restoration/

[4] SOC: soil organic carbon

additional GHG benefits. Guidance for future management options on deep peat sites is therefore predicated on an assessment of site yield (growth) potential.

6. FR model outputs which underpin the FCS guidance are based on both a hybrid carbon model (3PGN) constrained by UK forest CO_2 flux data[5] and the FR CSORT model which is based on conventional forest timber yield models, coupled to models of biomass allocation, carbon content, decomposition, soil carbon exchange, product utilisation and empirical data on the GHG balance of forestry operations. CSORT also provides an estimate of the harvested wood products pool, as a guide to cumulative carbon sinks outside the forest. Both models predict soil carbon stock changes but do not attempt to predict other GHG fluxes.
7. An FCS expert group provided interpretation of the expert guidance to offer practical advice and a step-by-step decision making process to foresters. This led to a refinement of the conclusions about which site types (using FC soil codes) might be more suitable for a particular management option, taking into consideration local climatic and edaphic factors and the level of damage caused by the first rotation.
8. In addition, the use of site surveys and the Forest Research Ecological Site Classification (ESC) decision support tool are encouraged, to underpin effective decisions for restocking and appropriate tree species choices. A background note which explains how the elements mentioned in 7 and 8 can be used is currently in production and will be available on the FCS website.
9. Afforested peatland restoration should target sites with poor growth and with most potential for successful and early restoration of peatland to a net carbon sink. For successful restoration, a net reduction in GHG emissions is likely in the long term although the effect per unit area will not be large. There is uncertainty due to the lack of complete peatland restoration GHG studies in the UK.
10. There is high uncertainty over the magnitude of the methane (CH_4) flux, which varies across peatland types, and consequently it is not clear whether temperate peat bogs in disturbed or restored states are net GHG sinks or sources. The few remaining near-natural ombrotrophic bogs (raised and blanket bogs) are generally accepted as net GHG sinks.
11. There are still gaps in our scientific understanding of the relative benefits for the net GHG balance of different management options for afforested peatlands.
12. Artz et al. (2013) reported that "the evidence on emissions from afforested peatlands is still equivocal" and "the carbon benefits of restoration versus another forestry rotation, and indeed, whether restoration is realistically achievable, cannot be ascertained at present for the afforested area in Scotland". The scientific assessment of net benefit should ideally account for other ecosystem service provision by peatlands and forests[6].

[5] Minunno, F., Xenakis, G., Perks, M.P. & Mencuccini, M. (2010). Calibration and validation of a simplified process-based model for the prediction of the carbon balance of Scottish Sitka spruce (Picea sitchensis) plantations. Canadian Journal Forest Research 40: 2411-2426.

[6] http://www.climatexchange.org.uk/index.php/download_file/165/194/

Future work

13. There is now a considerable effort towards a Scottish Peatland Plan supported by government-funded initiatives e.g. Scotland's Soils website and the Green Stimulus Fund. Discussions are ongoing to develop the scope and direction of a national peatland research programme to address the key underlying uncertainties and ensure appropriate scientific assessments, monitoring and modelling to underpin effective policy[7].
14. To support these scientific assessments a series of studies on peatlands under restoration and different managements will require cross-disciplinary and inter-institute collaboration to ensure comparable methods, metrics and data sharing.
15. Future revisions of the FCS guidance will be informed by shared research and knowledge exchange to characterise all the key GHG gases and relevant pathways - including loss from dissolved organic carbon (DOC) and particulate organic carbon (POC) in waterways. Progress in delivery of such underpinning research is likely to be on a decadal timescale.

Forest Research, March 2014.

[7] http://www.climatexchange.org.uk/index.php/download_file/405/274/