Forest Research

Protection of forest soils in the UK in a changing management and policy challenges

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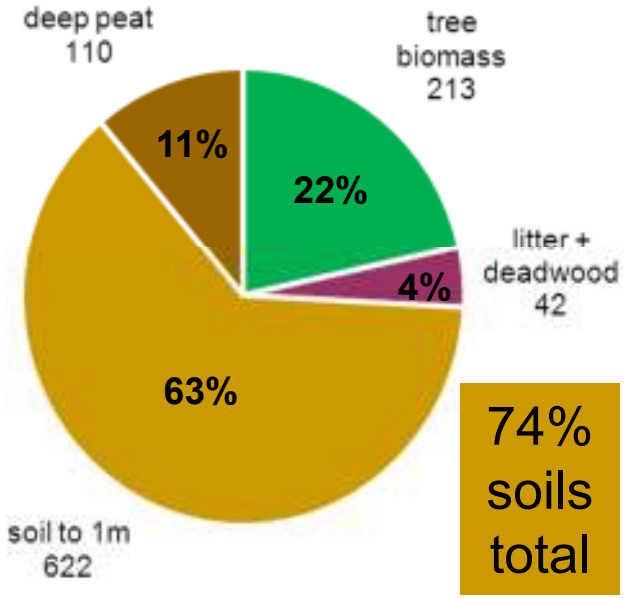
GB forests & woodlands

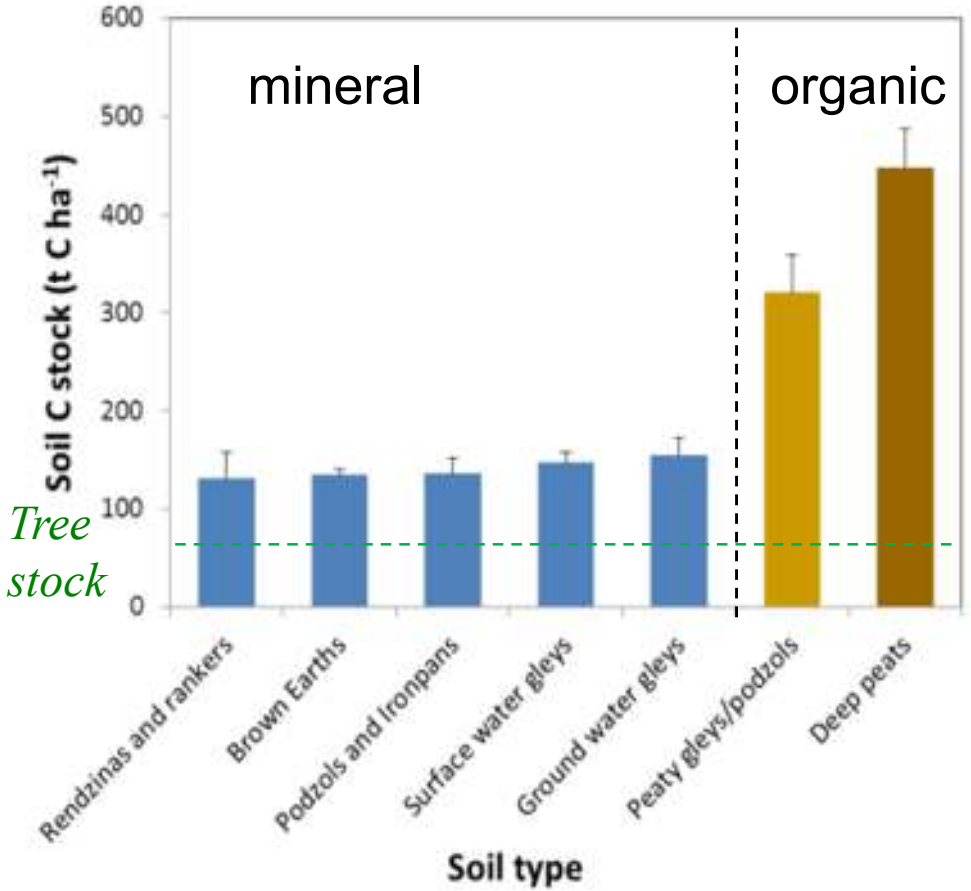
- 3.1 million hectares (13% of land)
- 0.8 Mha public forest estate
- 1.6 Mha conifer
- 1.5 Mha broadleaves

- Important ecosystem services
- Soil & water protection
- Biodiversity
- Cultural & recreational
- 8.4 Mt softwood, 0.4 Mt hardwood per year
- C stock and C sequestration

Woodlands Carbon stocks

Estimates from the National Forest Inventory (2010-14) & BioSoil survey (2005-10)





(Vanguelova et al., Soil Use & Man., 2013)

total UK C stock 'in forest' = 987 Mt C

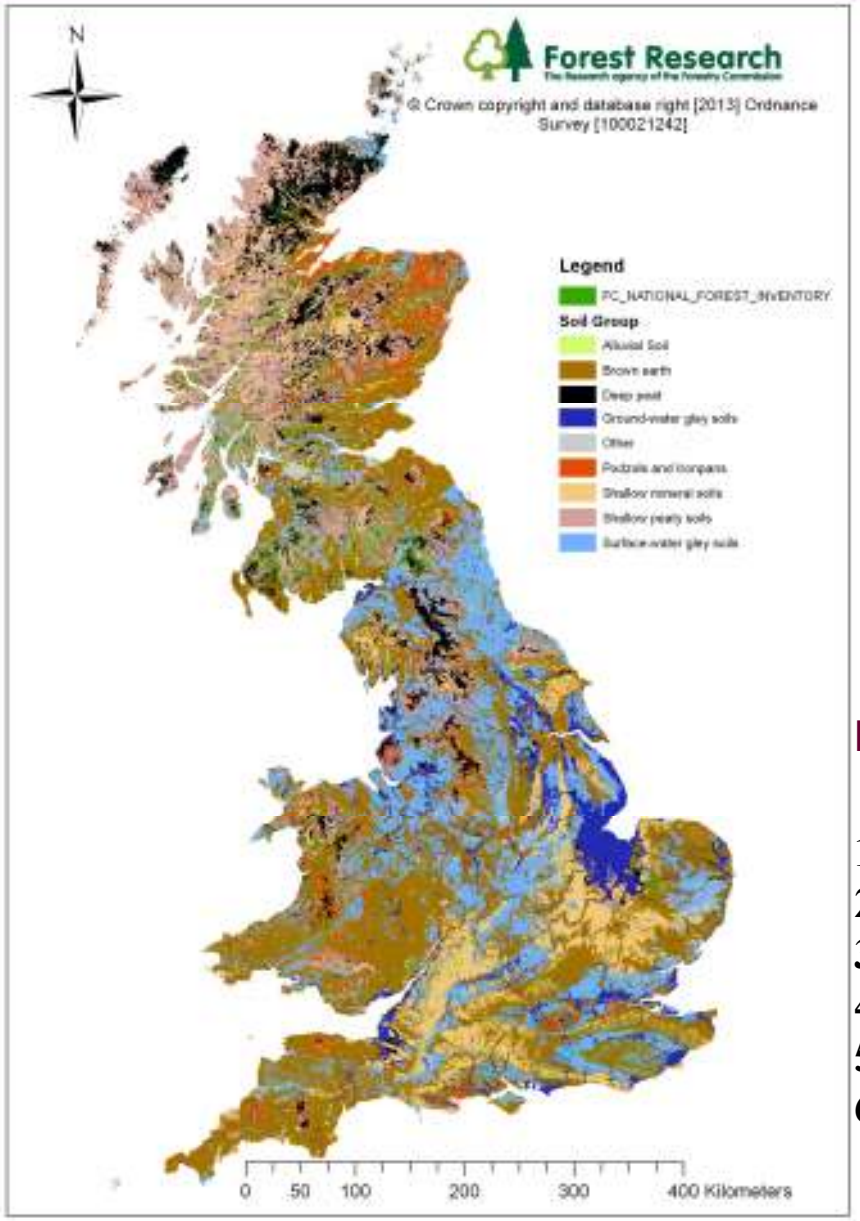
Woodland creation in the UK

- England - an increase in the area of woodland from 10 to 12% by 2060 (Government Forestry and Woodland Policy statement, 2013)
- Scotland - to increase woodland cover from 17% to 25% of land area by 2050 (Scottish Government)
- Wales, - a target of creating 100,000 ha of new woodland, e.g. from 10% to 13.5% land cover by 2020 (Welsh Government, 2012)

Drivers

- better management of existing woodlands with much more woodland in active management
- to integrate woodlands with other land uses,
- to maximise the delivery of multiple benefits (water, biodiversity, social, etc.) from woodland and forests
- For GHG abatement and climate mitigation, etc.

Soil distribution in the UK

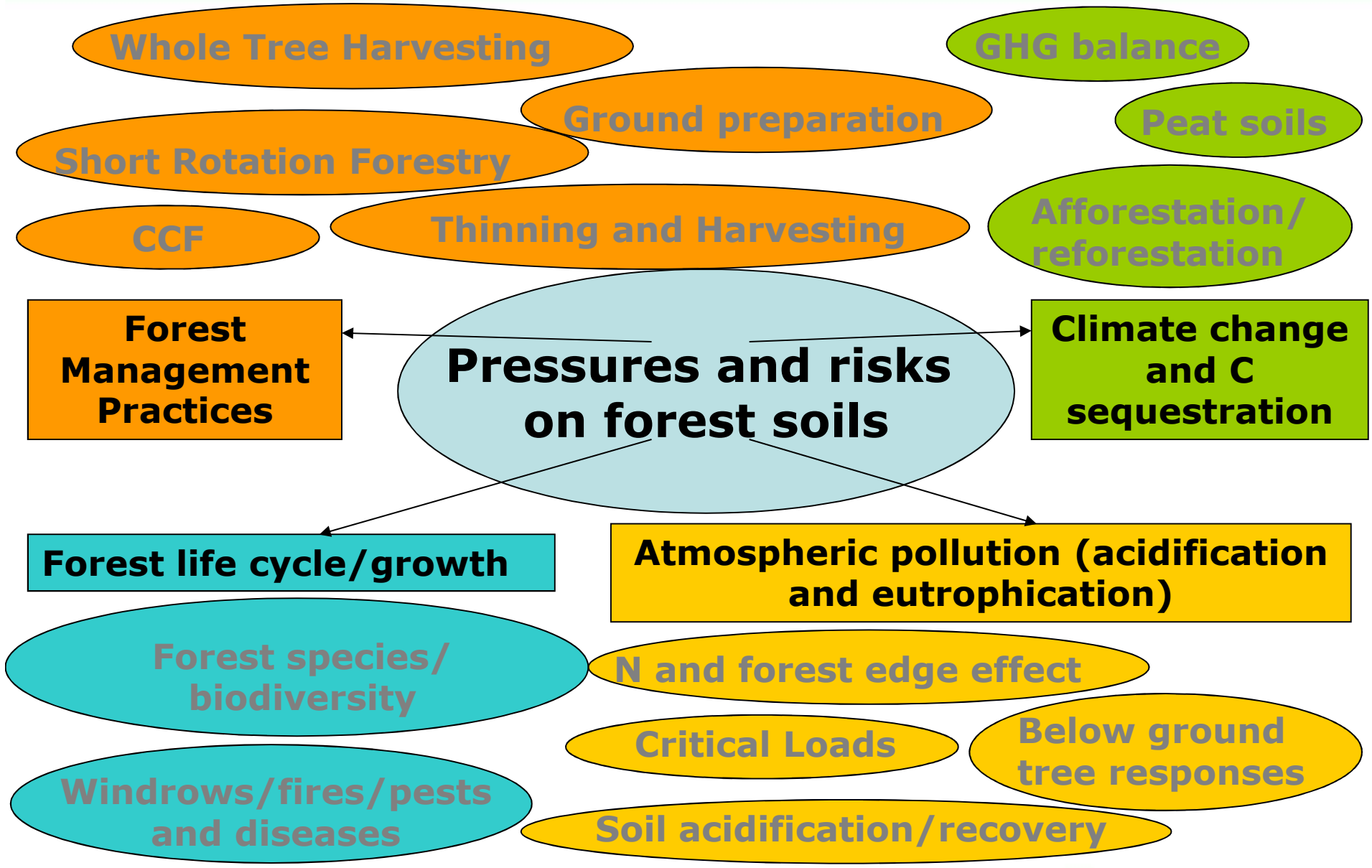


- Plantation forestry historically mainly on poor and highly organic upland soils
- Native and broadleaved woodland in lowlands and more productive soils
- Drainage and ploughing at establishment
- Fertilisation at the poor soils

Forest soils differ from agricultural soils

1) well developed organic layers
2) higher acidity and organic matter
3) better soil structure
4) large spatial variability
5) different biotic balances
6) less disturbed compared to agriculture

Forest soil pressures and risks



Forest management

'Forest Management Alternatives' Concept

5 **"Wood Biomass"**
Objective: optimize revenue from biomass production

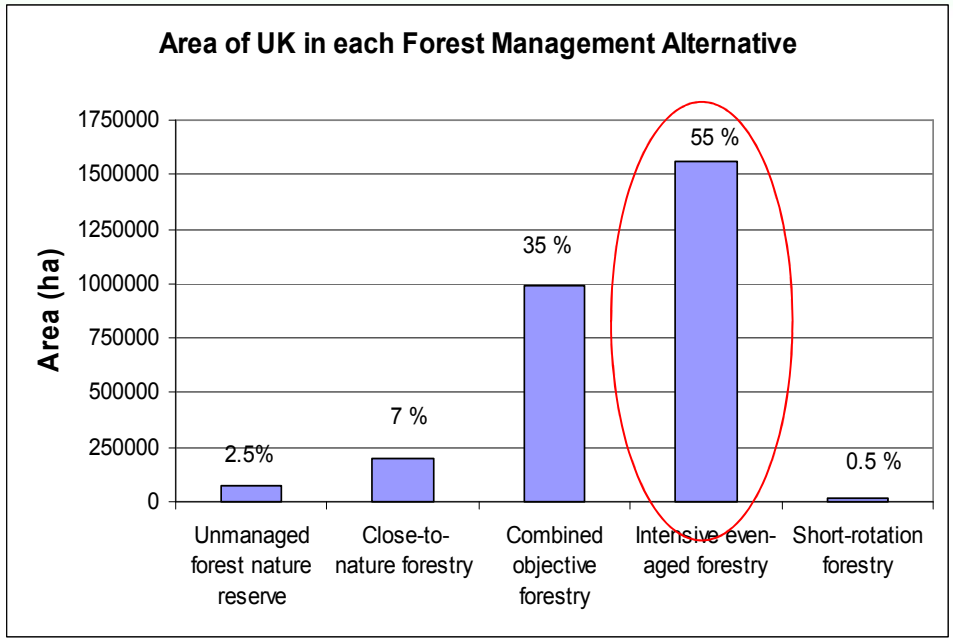
4 **"Intensive even aged"**
Objective: optimize revenue from (saw-) timber production

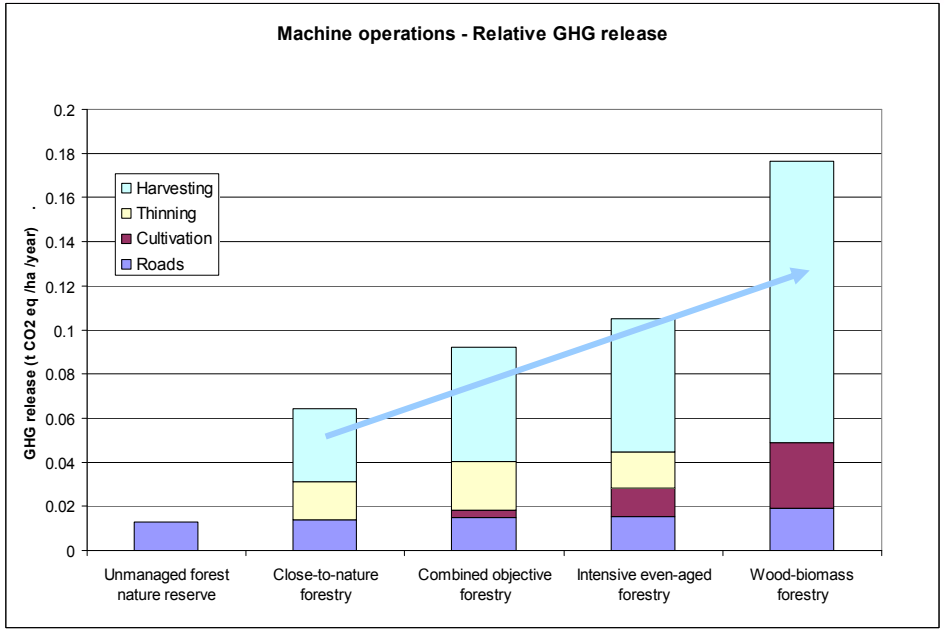
3 **"Combined objective"**
Objective: multiple objectives (e.g. revenue, biodiversity, water protection, soil protection, recreation…

2 **"Close-to-nature forestry"**
Objective: to produce wood by emulating natural processes and cycles

1 **"Forest nature reserve"**
Objective: unmanaged forest to allow development of natural processes without human intervention

Managing the Forest Carbon resource



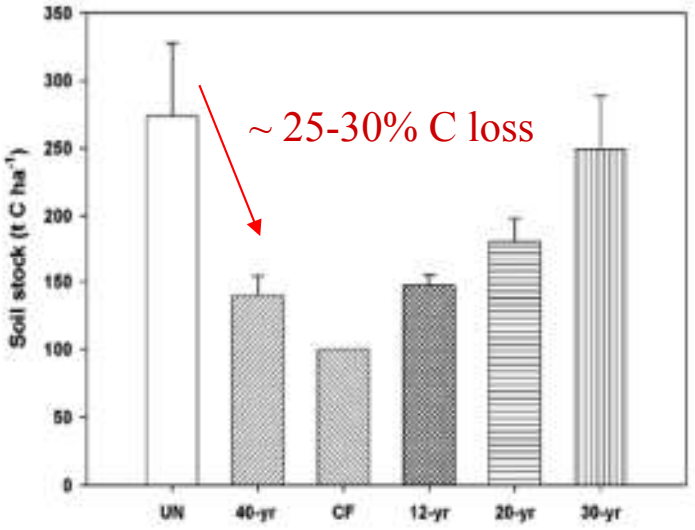


Ground preparation

Method	Volume disturbed m3/ha	% of 0-30cm disturbed
Hand turfing, screefing	<60	2.0%
Drains at 250m/ha - 360° excavator with a draining bucket	134	4.47%
Drain mounding – 360° excavator with a drainage bucket	246	8.20%
Trench mounding + drains @250m/ha - 360° excavator	380	12.67%
Turfing – Double throw rotary mouldboard, shallow, plough	560	18.67%
Patch scarification	630	21.00%
Turfing – Double throw mouldboard, shallow, plough	710	23.67%
Disc trencher/scarifier	840	28.00%
Turfing – Double throw mouldboard, deep, plough	1,030	34.33%
Turfing – Single throw mouldboard plough	1,030	34.33%
Tine – Double throw mouldboard plough	1,430	47.67%
Tine – Single throw mouldboard plough	1,575	52.50%
Trench mounding + drains @250m/ha + de-stumping 50% area	2,232	74.40%
Agricultural ploughing	2,500	83.33%

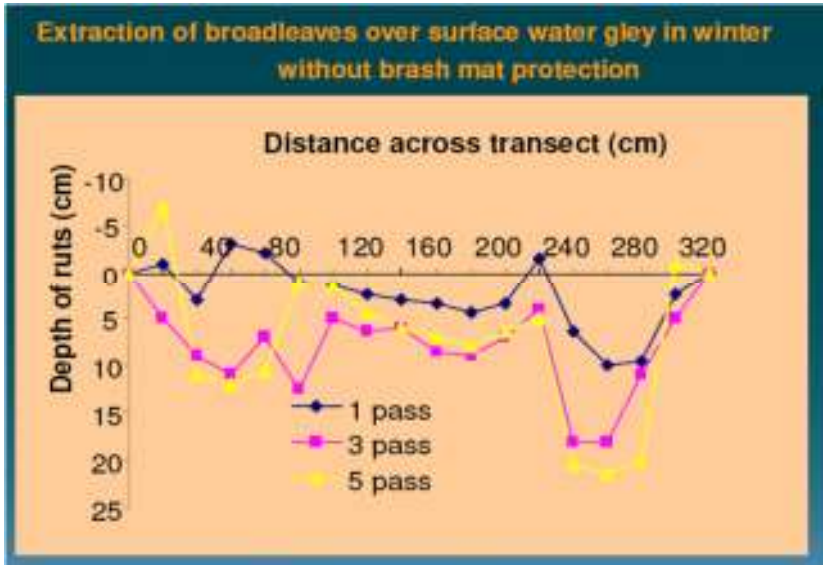
Soil disturbance by different ground preparation techniques and practices

Soil carbon dynamics in Sitka spruce chronoseqeunce study on peaty gley soils in Kielder, North of England (Zerva et al., 2005, For. Eco. And Man.)

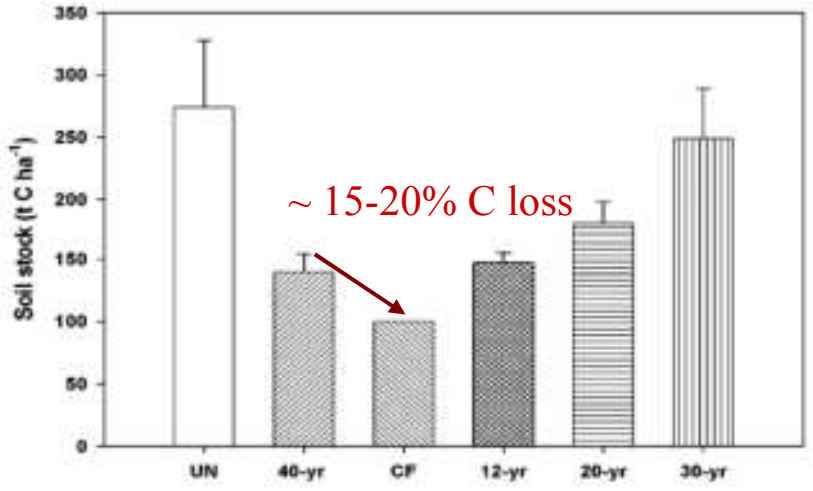


Harvesting impacts

Soil physical damage due to wood extraction (Oaks on water gleys)

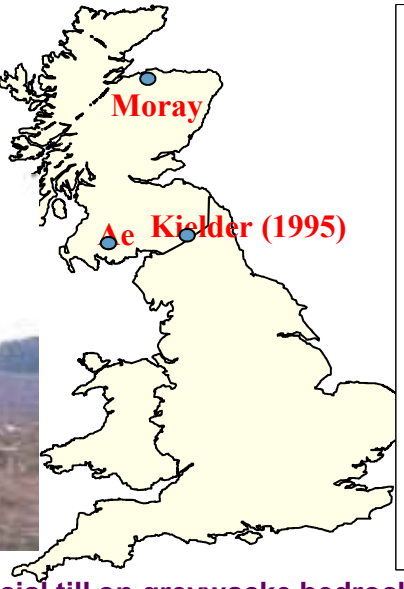


Soil carbon change due to clearfell of Sitka spruce on peaty gleys

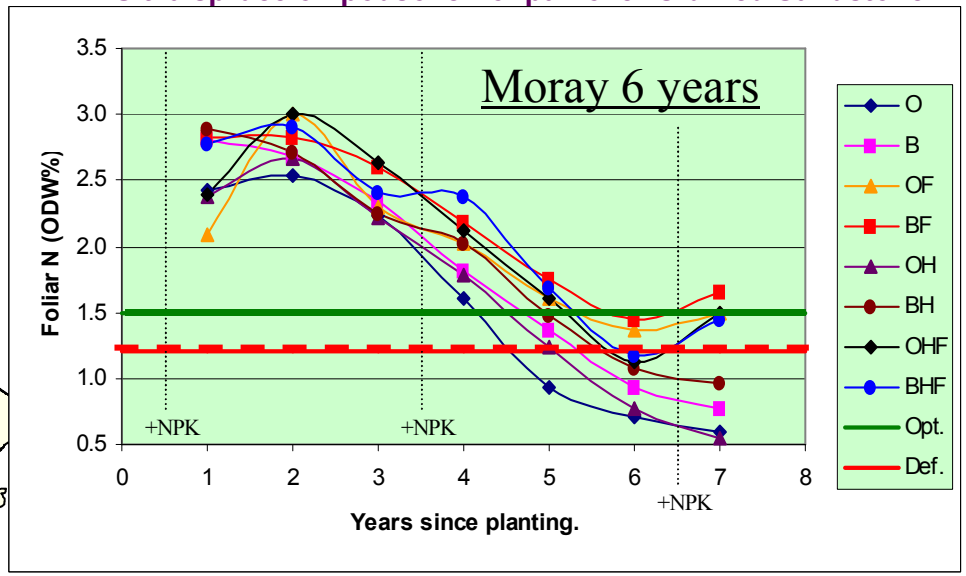


Soil sensitivity to whole tree harvesting

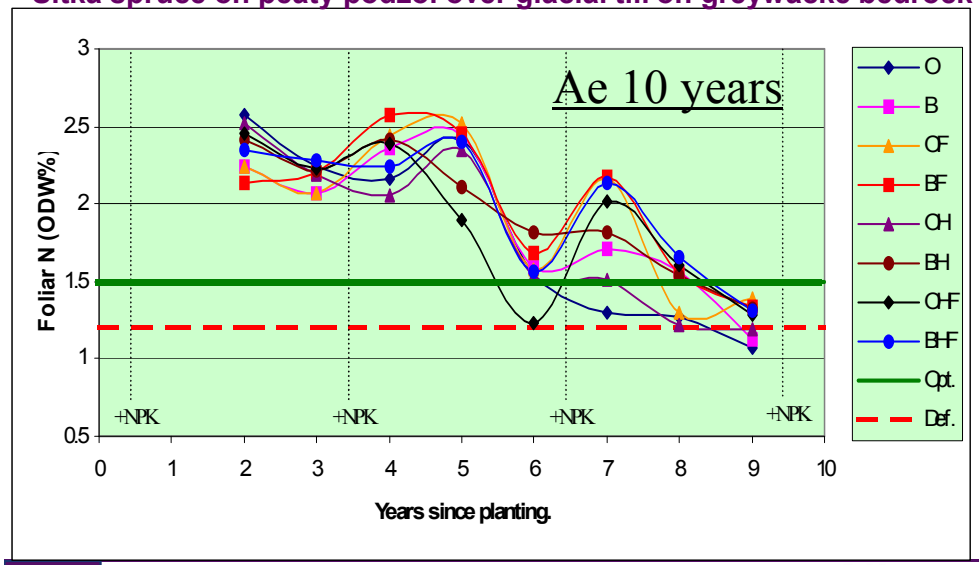
WTH practices on nutrient poor soils and its effect on tree nitrogen uptake



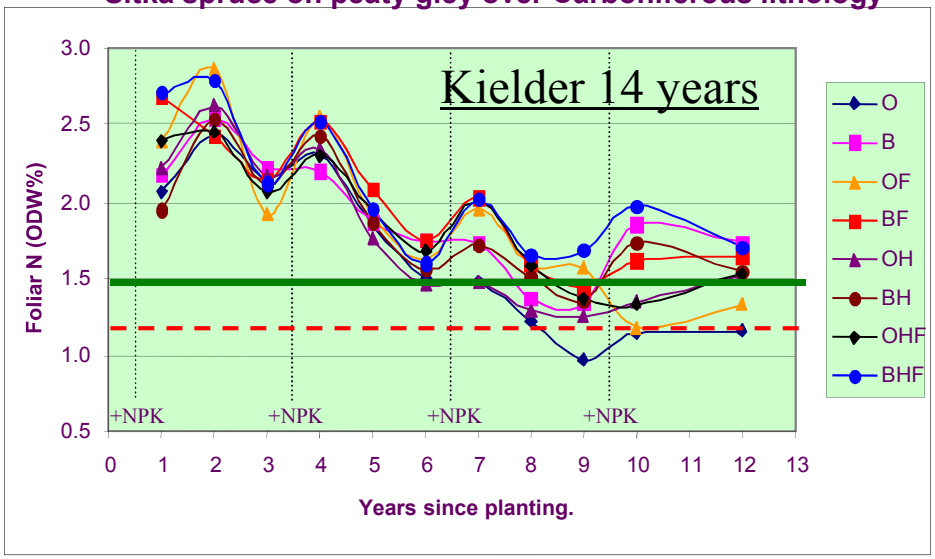
Sitka spruce on podsolic ironpan over Old Red Sandstone



Sitka spruce on peaty podzol over glacial till on greywacke bedrock

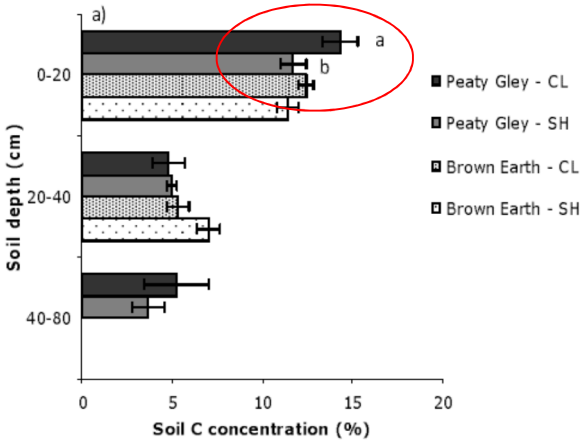


Sitka spruce on peaty gley over Carboniferous lithology

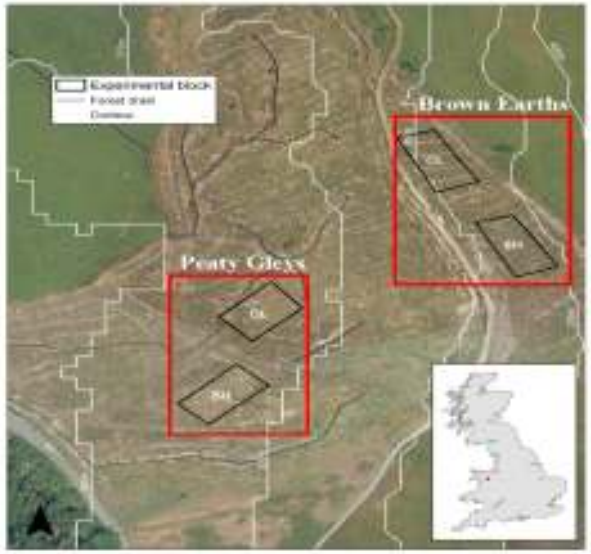


Risks to soils by Energy forestry

- 1) Ground damage,
- 2) Soil infertility,
- 3) Soil acidification
- 4) Soil carbon



4 year old stump harvested site Bala, middle Wales



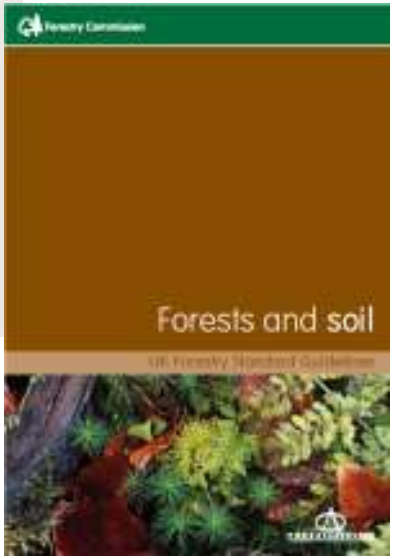
- Soil C stocks significantly reduced in Peaty Gley soil (0-80 cm depth) but only at surface soil of Brown earths.

-Changes in soil C stocks driven by physical disturbance and less by oxidation

Soil protection

The UK Forestry Standard is the reference standard for **sustainable forest management in the UK**

Guidelines



Soil protection

Current guidance for best practices of brash and stump removal in the UK

1) Soil types
2) Four risks
3) Combined risk

Soil group	Soil type	Ground damage	Soil carbon	Soil infertility	Soil acidification	*Combined Risk*
Brown earths	1, 1d, u	L	L	L	L	L
	1z	L	L	M	M	M
Podzols	3, 3m	L	L	H	H	H
	3p	M**	M	H	H	H
Ironpan soils	4, 4p	M**	M	M	M	M**
	4b	M	L	M	M	M
	4z, 4e	M	L	H	H	H
Calcareous soils	12b, t	L	L	L	L	L
	12a	L	L	H*	L	H*
Ground-water	5	M	L	L	L	M
	5p	M**	M	L	L	M**
Peaty gleys	6	M	M	M	M	M
	6z	M	M	H	H	H
	6p	H	M	M	M	H
Surface-water	7, 7b	M	L	L	M	M
	7z	M	L	M	M	M
Juncus bogs	8a, b,	H	H	L	L	H
Molinia bogs	9a, b	H	H	M	M	H
	9c, d, e	H	H	H	H	H
Unflushed	11a, b,	H	H	H	H	H
Rankers	13b, z	L	L	H	H	H
	13g	M	L	H	H	H
	13p	M	M	H	H	H
Skeletal soils	13s	L	L	H	H	H
Littoral soils	15s, d,	L	L	H	H	H
	15g, w	H	L	H	H	H

L: low risk; M: medium risk; H: high risk. *Only for conifer stands, otherwise low risk. **3p, 4p and 5p are high risk where the depth of the peaty surface layer is >25 cm.

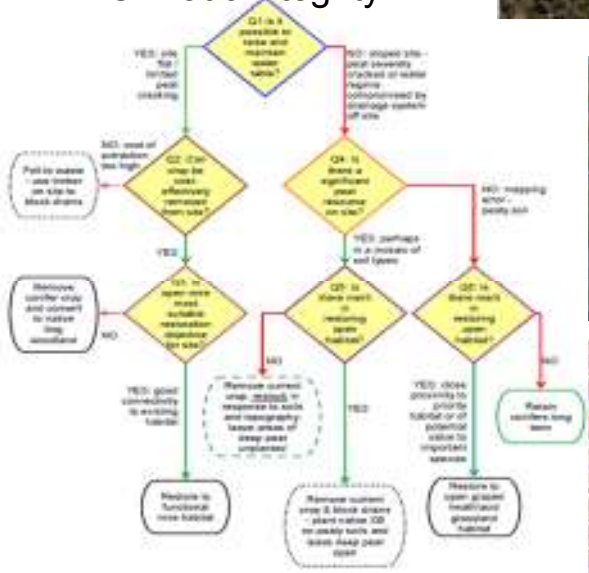
Future directions and needs:

1) Comprehensive scientific underpinning
2) Site specific soil nutrient balances
3) National mapping of forest nutrient balances

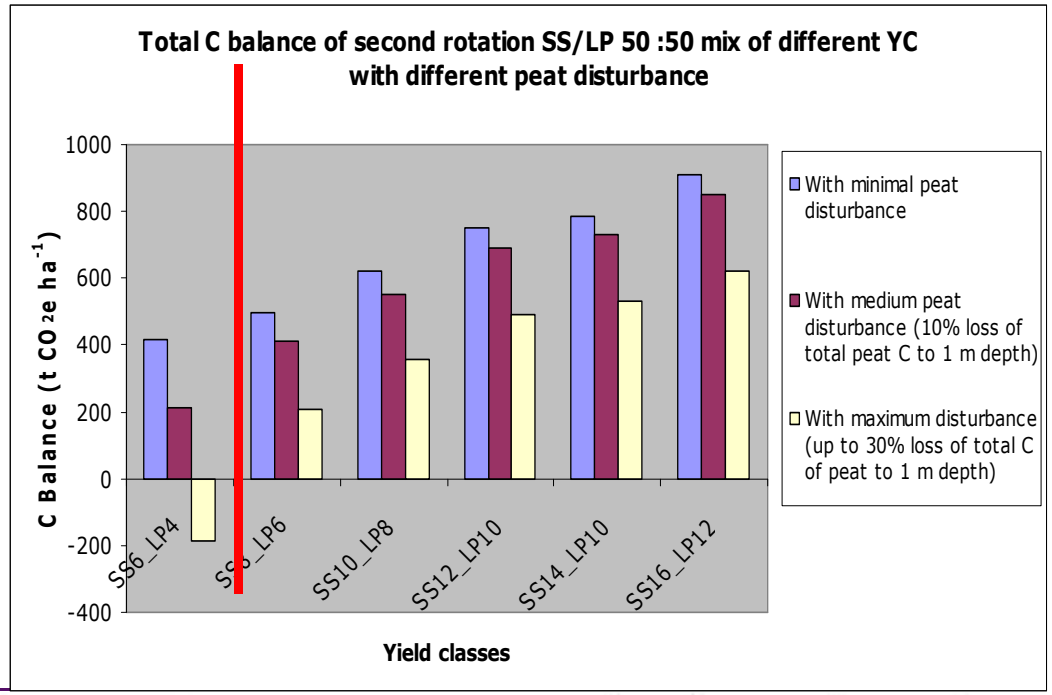
Forestry and Peat

1) Past guidance for planting on deep peat to 1m depth
2) Current revised guidance on forest planting on peat only to 50 cm depth
3) New guidance to be out soon on afforested peat restoration and replanting

Afforested Deep Peat Restoration in Wales
- Current status of peat
- Hydrological integrity
- GHG consequences
- Ecological integrity
- Climatic integrity

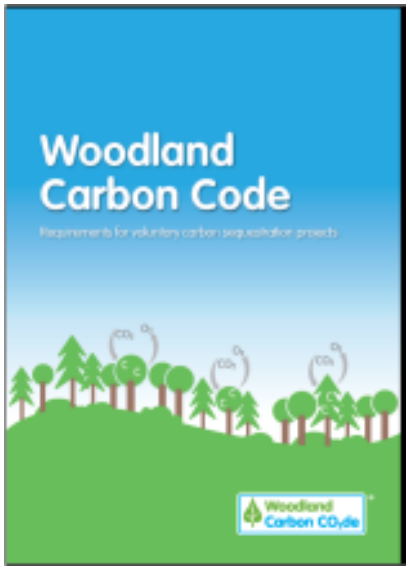


Afforested Deep Peat Restoration or replanting in Scotland
- GHG consequences



Soil protection

Alternative management practices and initiatives for soil protection



Woodland Carbon Code

voluntary standard for woodland creation projects in the UK which make claims about the carbon they sequester

http://www.forestry.gov.uk/carboncode

Soil benefits through
New woodland creation/
Short Rotation Forestry

Less Intense Forest Management practices, e.g. Continuous Cover Forestry

Forest Management Certification

- **As a forest manager or owner, certification is a way of ensuring that your careful and long term forest management is recognised. Certification is voluntary. It involves an inspection of the forest management by an independent organisation to check that it passes the internationally agreed principles of good forest management.**

- Forest Management Certification (Forest Stewardship Council) – Principle and Criteria for sound forest management at international level.

- The FSC UK forest management standard is based on the UK Woodland Assurance Standard (UKWAS) is an independent certification standard for verifying sustainable woodland management in the UK.

- UKWAS is a national standard which is consistent with FSC Principles and Criteria whilst at the same time reflecting local ecological, social and economic circumstances. The standard is drafted in such a way as to refer to existing Forestry Commission standards and guidelines as far as possible.

- UKWAS certification is only approved by FSC when an FSC accredited certification body carries out the inspection. Many forest managers see the UKWAS as a useful document to check for themselves how far they already meet FSC certification requirements

Some Conclusions

- Targets for woodland expansion across the UK
- Drive to develop renewable energy from forestry
- Drive for peatland restoration and protection
- No large scale soil damage in the UK, with the exception of the likely impact from historical planting on deep peat (drainage, deep cultivation, etc.)
- Long term forest productivity depends predominately on soil conditions rather than forest management
- UK protect their forest soils by developed specific guidances for best practices
- Overall soil protection for sustainable forestry by developed Soil Guidelines under the UKFS and controlled by UK Forest Certifications
- Research is ongoing to continue to scientifically underpin guidelines and guidance and protect our forest soils