



What are the likely effects of climate change on forest soils and what can foresters do to help?

Andy Moffat



What are the likely effects of climate change on forest soils and what can foresters do to help?



Outline of talk

- The importance of forest soils
- How will GB forest soils change as a result of climate change?
- What measures can forest managers take to mitigate the unwanted effects?
- What tools and training are available to help the forestry sector?

Soil functions

Soils deliver ecosystem services that enable life on Earth





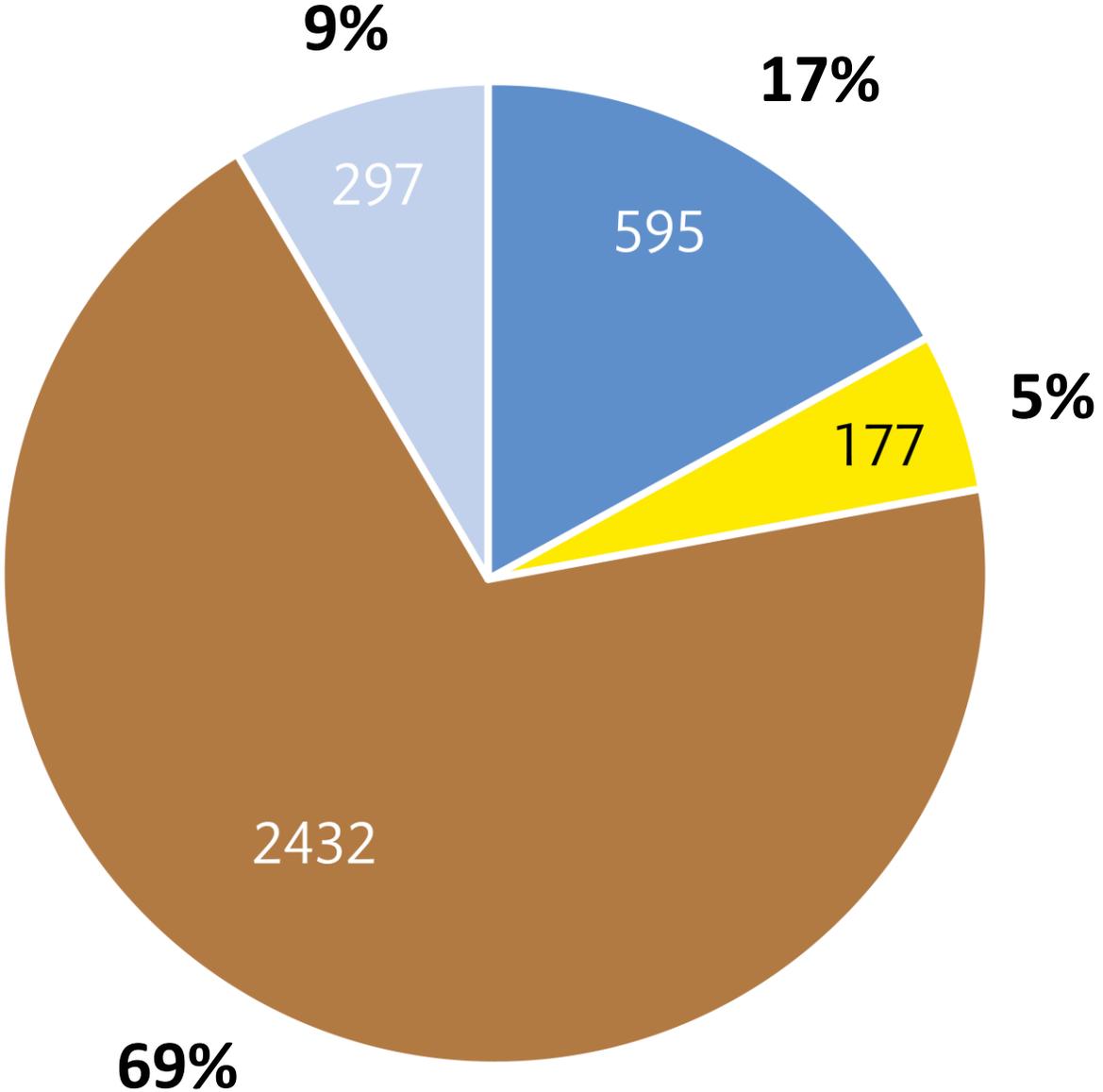
The UK Forestry Standard

The governments' approach to sustainable forestry

6.6 Soil

“Soil is a fundamental component of the forest ecosystem.……It is a vital resource that must be used in a sustainable way to ensure it can continue to perform its many functions”.

UK forestry organic carbon stocks (MtCO₂)



- soil to 1m adjusted
- tree biomass
- litter + deadwood
- harvested wood products

From Morison et al. (2012)

UK Climate Change Risk Assessment 2017

Synthesis report: priorities for the next five years

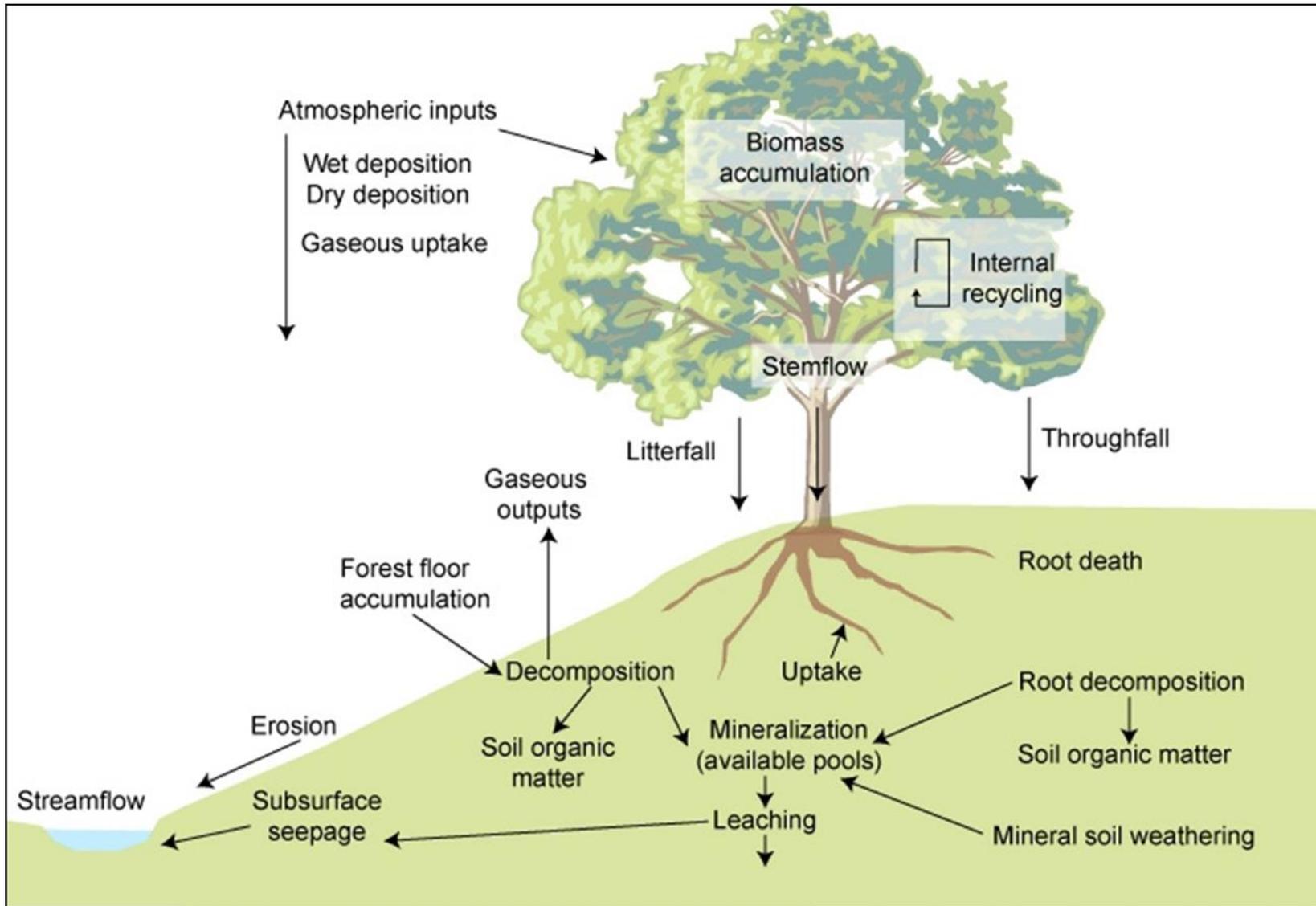


Climate change risks for the natural environment

3.3: Soils and Land

Ne 4: Risks to soils from seasonal aridity and wetness

Ne10: Risks to agriculture, forestry, wildlife and heritage from change in frequency and/or magnitude of extreme weather and wildfire events



Forest ecosystem interlinkages

Climate change – everything must adjust – but how?

Likely impacts from progressive changes in climate and atmospheric CO₂

- Elevated atmospheric CO₂ can reduce litter decomposition and enhance accumulation of organic matter on forest floor → *reduced* tree growth
- Soil warming will increase microbial activity leading to greater decomposition of organic matter and enhanced nutrient availability → *increased* tree growth
- Elevated soil moisture deficits have significant effects on many soil processes, tree growth and survival
- Elevated rainfall may *increase* leaching of base cations and nitrogen from soil
- Soil warming can *reduce* germination success of some tree species

Extreme weather events



Erosion from bare soil after harvesting, then severe rainfall



Loss of soil after landslide



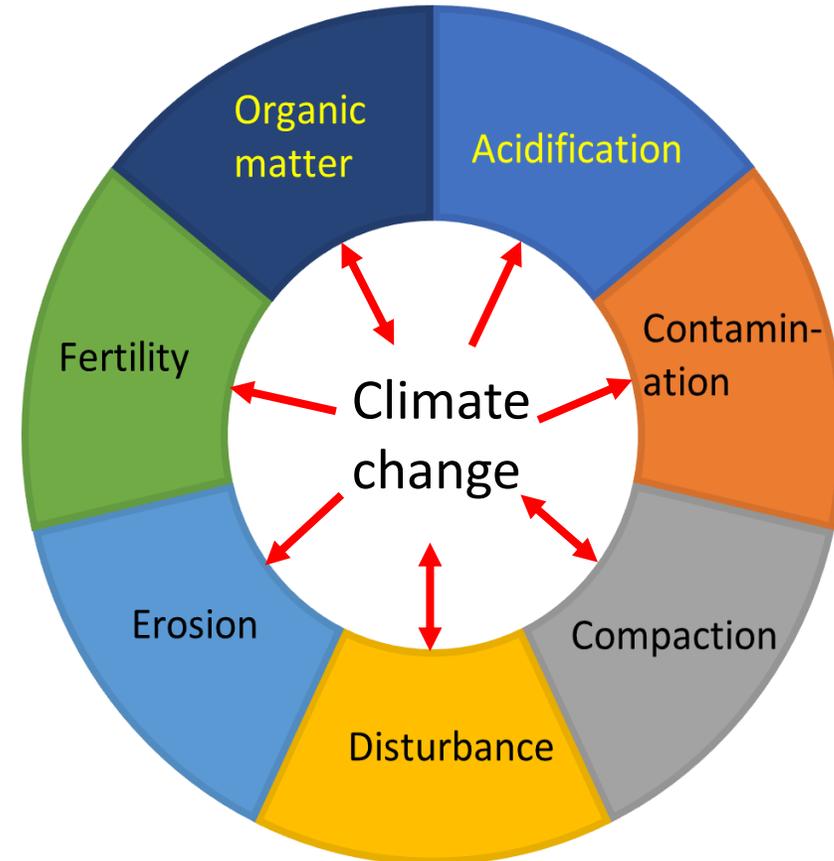
Burning of peat soils during wildfire

The UK Forestry Standard

The governments' approach to sustainable forestry

UKFS Guidelines on Forests and Soil

Based on seven principal factors with potential to impact on forest soils





The UK Forestry Standard

The governments' approach to sustainable forestry

UKFS Guidelines on Forests and Soil

On sites vulnerable to compaction and erosion, consider the weather and aim to carry out operations during dry periods; plan ahead for changes in the weather that could affect site conditions.

Consider the potential impacts of soil disturbance when planning operations involving cultivation, harvesting, drainage and road.

Address the risks of soil erosion as part of the forest and operational planning processes.

Consider projections of changes to rainfall patterns when specifying designs for culverts, drainage systems and roads.

**More
from
UKFS**

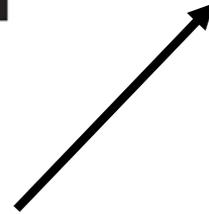
Plan for forest resilience using a variety of ages, species and stand structure; consider the risks to the forest from wind, fire, and pest and disease outbreaks.

Consider alternatives to clearfell systems, such as continuous cover forestry, where suitable sites and species combinations allow and management objectives are compatible.

Leave a proportion of standing and fallen deadwood in each forest management unit, concentrated in areas of high ecological value, where there is existing deadwood and where linkages can be provided between deadwood habitats.

Sustainable forest management

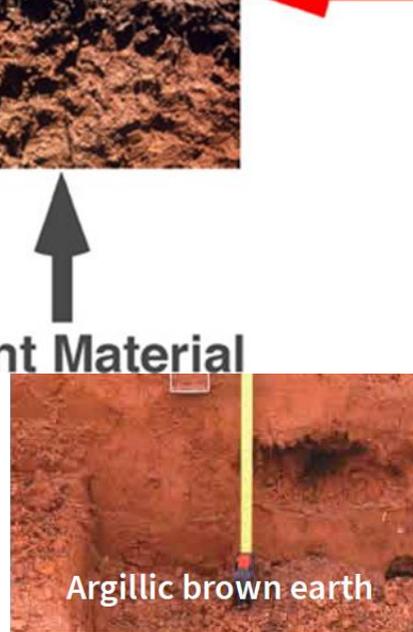
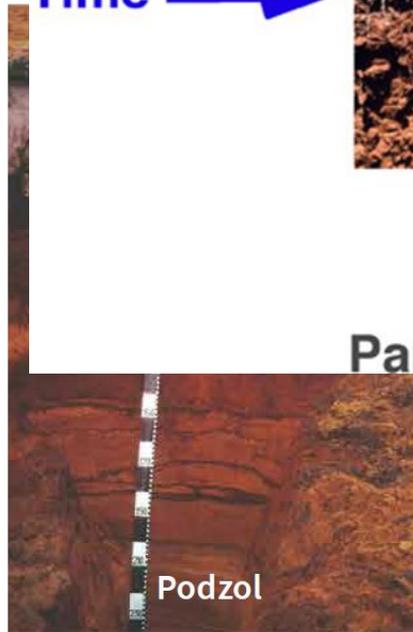
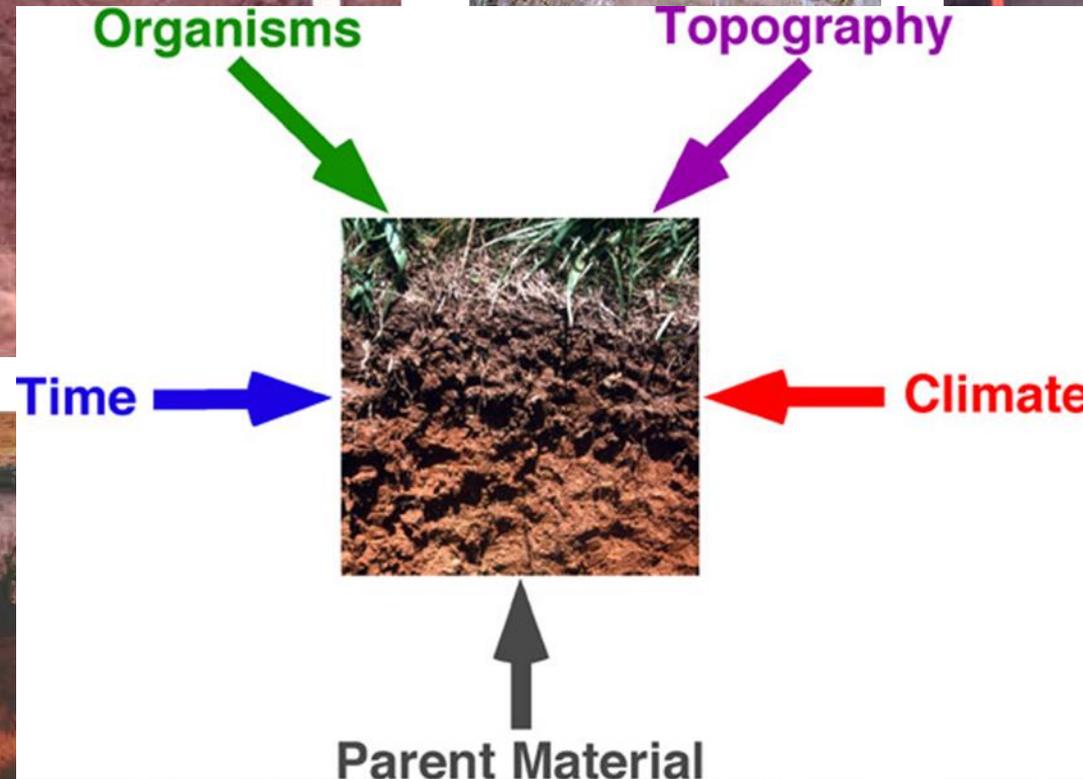
THE **right tree** FOR
THE **right place**



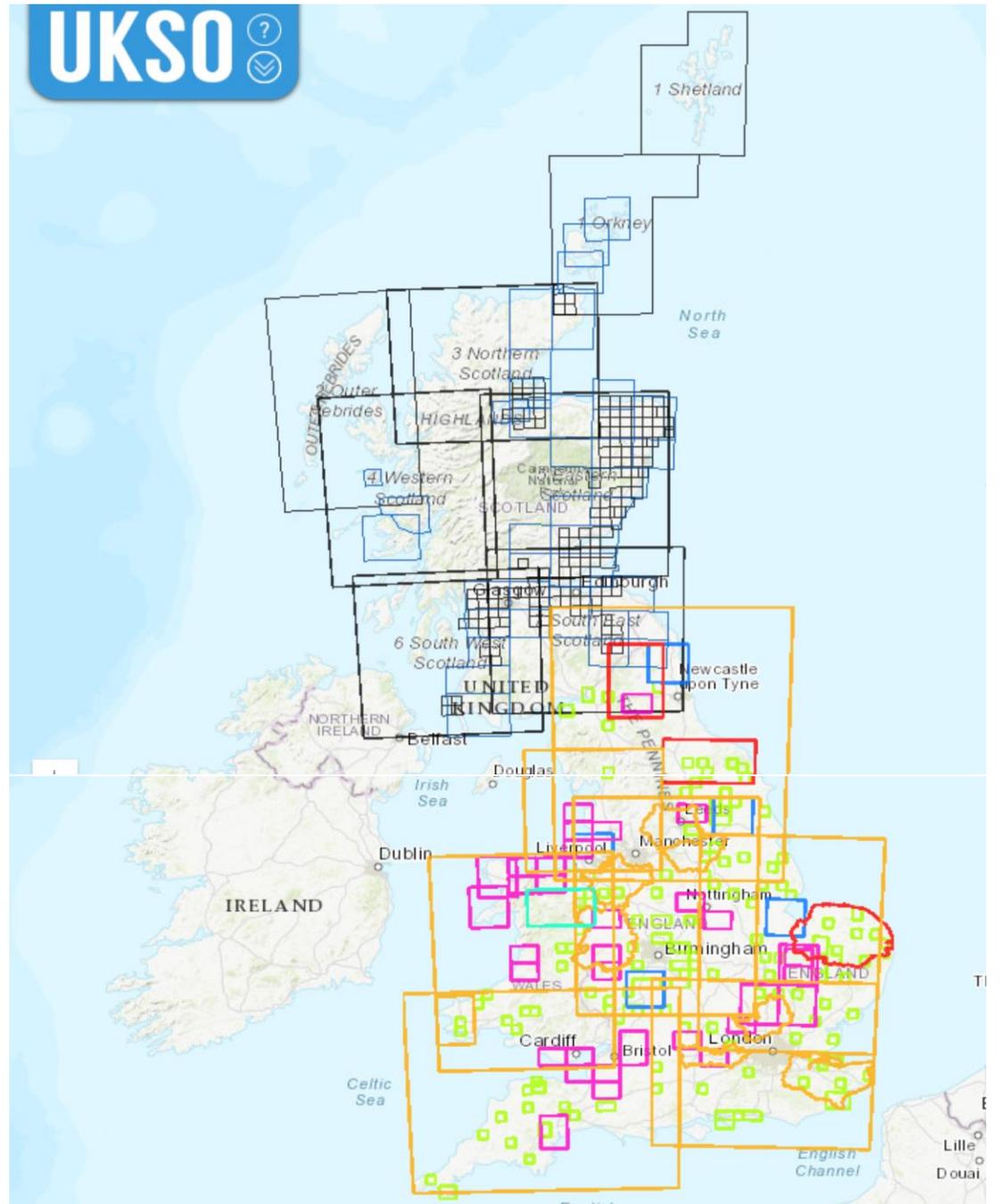
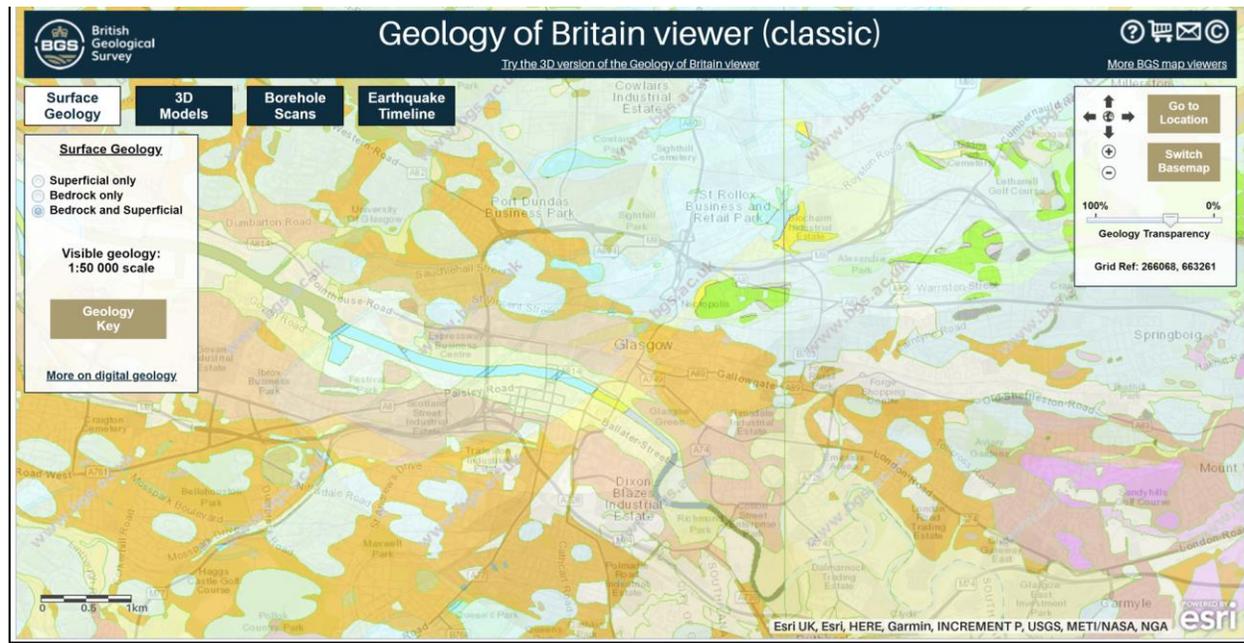
'Place' implies a knowledge of soil type

AND some understanding of soil : plant relations throughout the forest rotation

Soils vary considerably in their properties

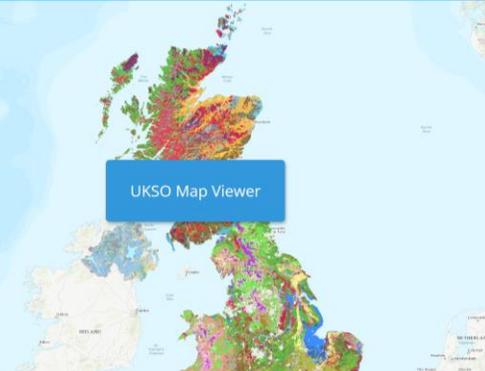


From:
*Geoarchaeology:
using earth sciences to understand
the archaeological record*



UKSO

UK SOIL OBSERVATORY



UKSO Map Viewer



Other Resources

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A man with a beard and glasses is speaking. A blue speech bubble is overlaid on the image.

Dig a
pit!



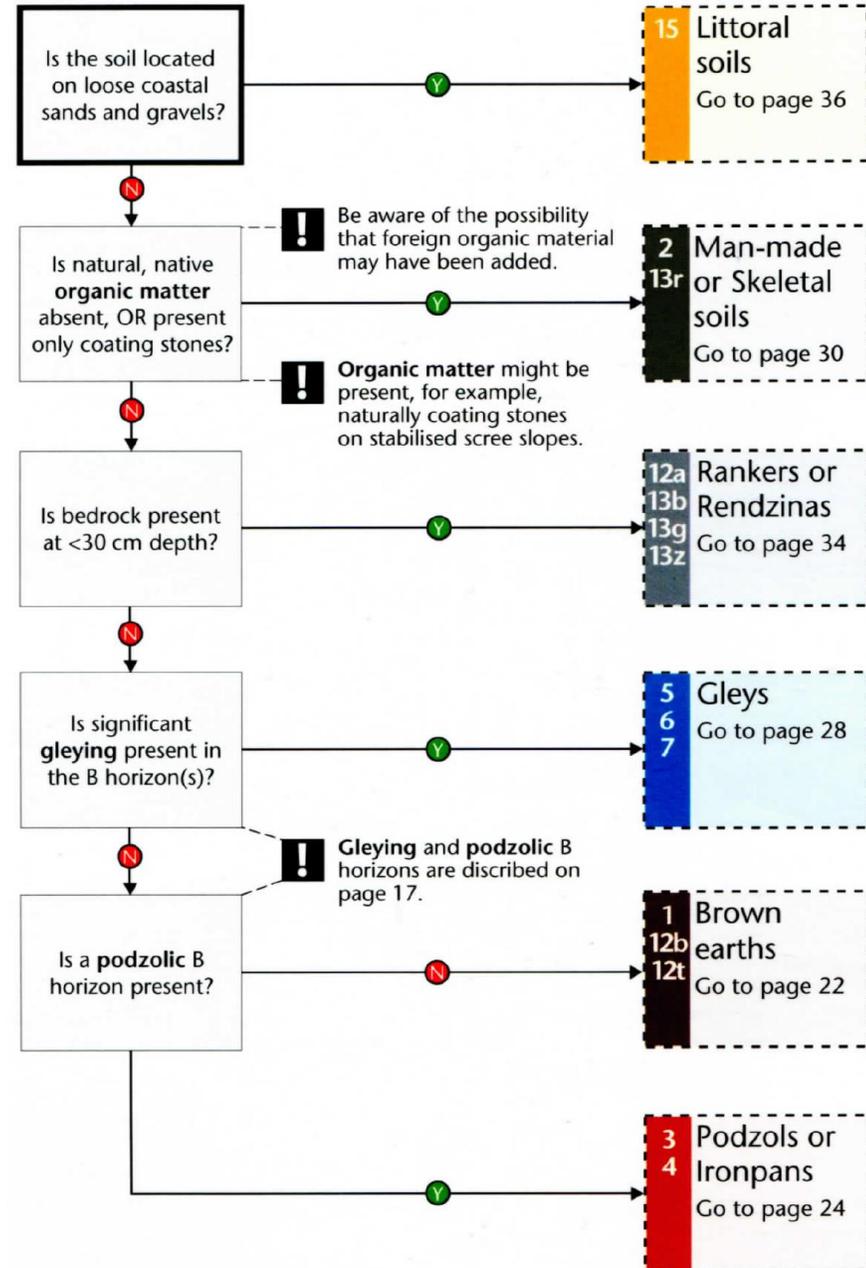
Bill Rayner
Forester/Site Surveyor

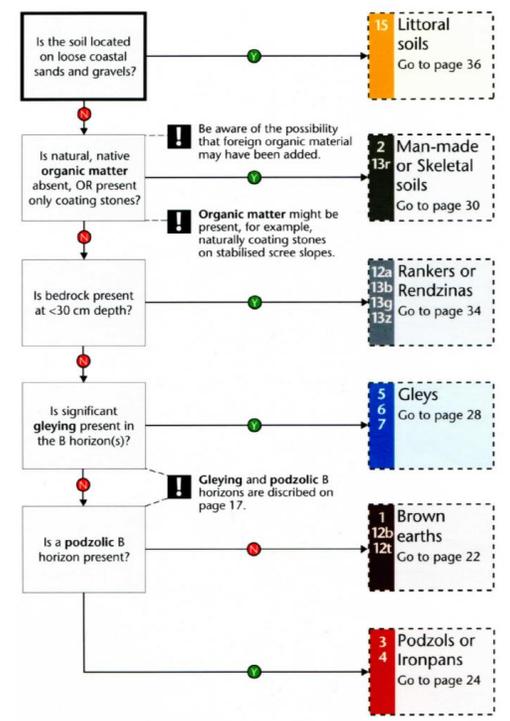
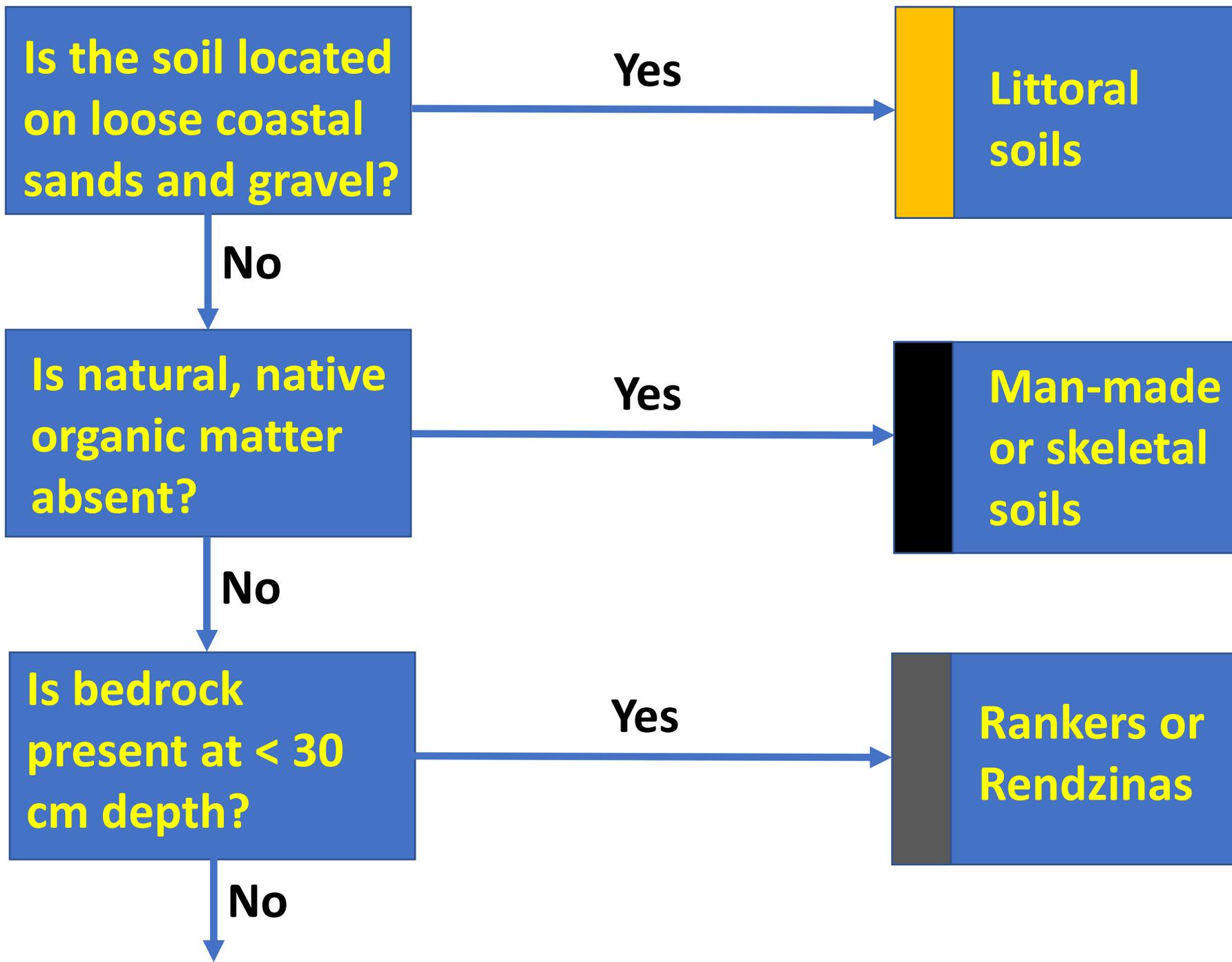




The identification of soils for forest management

2002





Is significant gleying present in the subsoil?

Yes

Gley soils

No

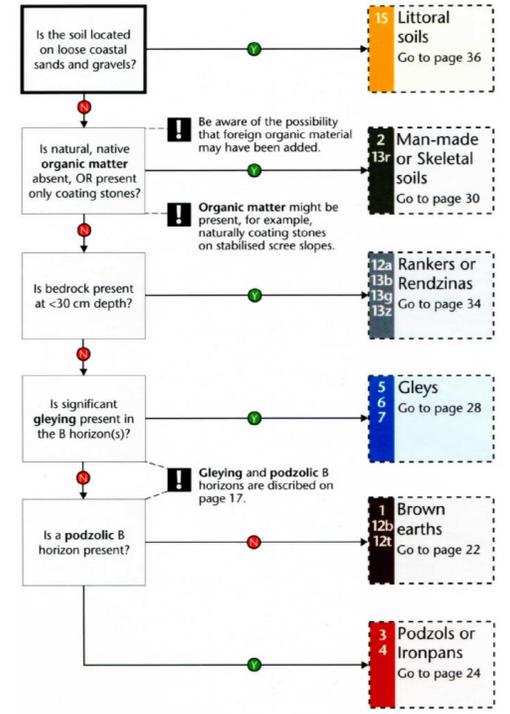
Is a podzolic B horizon present?

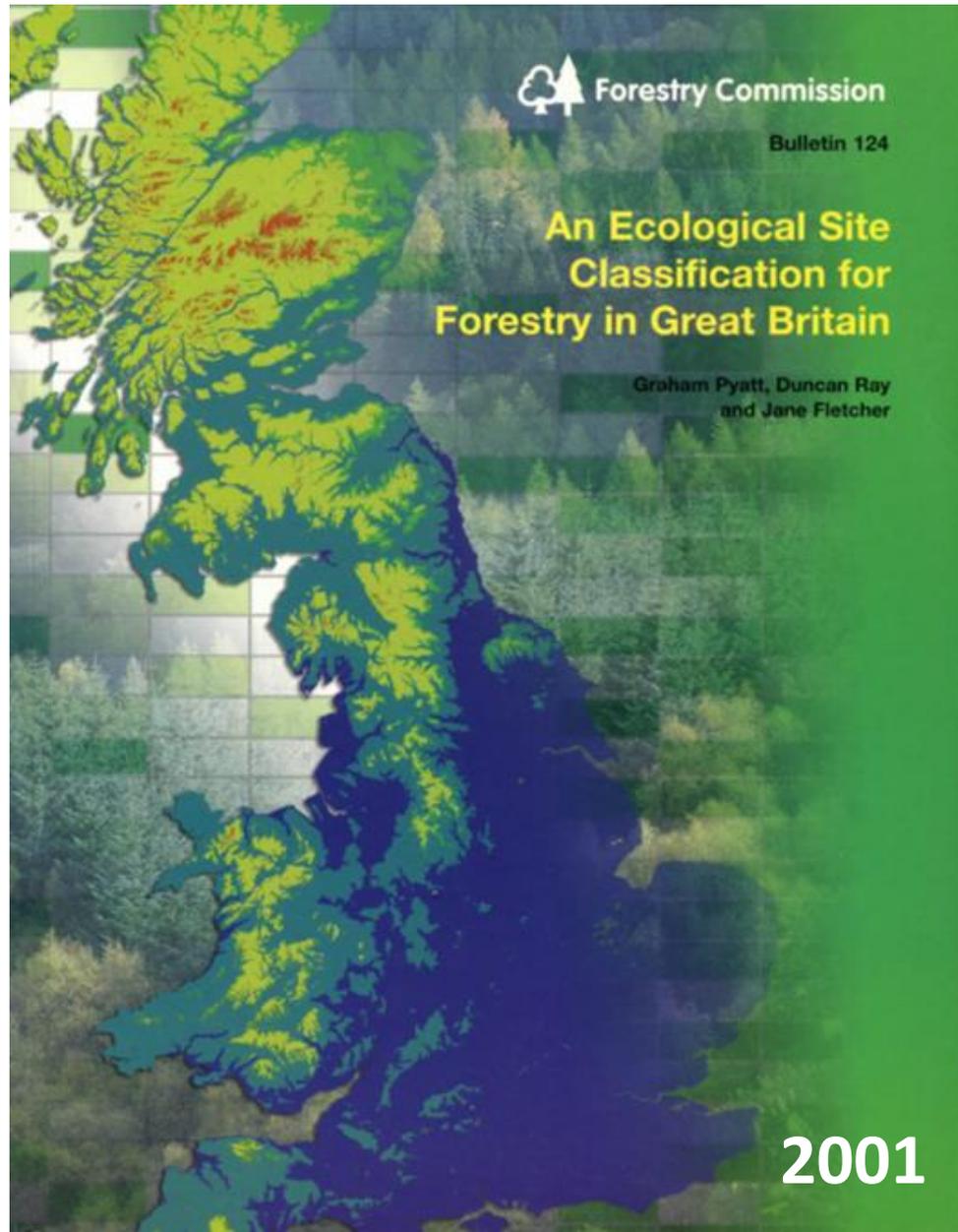
No

Brown earths

Yes

Podzols or Ironpan soils





How to find the Right Tree for the Right Place for future climates - Ecological Site Classification (ESC)

- A decision support tool to match tree species to soil and site type
- In-built climate projections up to 2080 allow evaluation of future species suitability

Forest Research

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 [ESC Video Tutorials \(external site\)](#) |
 [Climate Matching Tool \(external site\)](#) |
 [FR Tree species database \(external site\)](#) |
 [Contact email](#)

Enter Grid Reference (e.g. NT090950) Go Select decision support tool: **Ecological Site Classification (Tree**

Ecological Site Classification : Amend site/management variables below then click on map for species suitability analysis.

[Input vegetation survey.](#)

Soil properties [Input soil survey.](#)

Soil Moisture Regime (SMR):

Soil Nutrient Regime (SNR):

Site Management [\[+/-\]](#)

Options [\[+/-\]](#)

Update Results

[Download results as a CSV file](#) |
 [Download results as a PDF file \(numeric\)](#) |
 [Download results as a PDF file \(symbols\)](#)

Adjustments	Eastings(m)	Northings(m)	Site Grid Reference	Climate Scenario	Site Class	Filter	Brash	Drainage	Fertiliser
Site defaults	259202	663579	NS592635	Baseline climate 1961-1990	Warm - Moderately exposed - Moist	All species	No brash present	No drainage installed	No fertiliser

Enter Grid Reference (e.g. NT090950)

Go

Select decision support tool:

Ec

Ecological Site Classification : Amend site/management variables below then click on map for species suitability analysis.

[Input vegetation survey.](#)

Soil properties

[Input soil survey.](#)

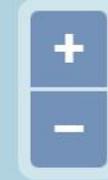
Soil Moisture Regime (SMR):

Default (modelled data)

Soil Nutrient Regime (SNR):

Default (modelled data)

Enter soil information here



Soil training for foresters



11 NOV

Introduction to Soil Identification for Scottish Foresters

🕒 11 November 2020 14:00 - 11 November 2020 16:00
📍 Online Event

Continuous Professional Development



14 DEC

ICF & FFF: Introduction to Soil Identification for Foresters

🕒 14 December 2021 @ 09:30 - 14 December 2021 @ 11:30
📍 Online Event

Continuous Professional Development



26 JAN UK Forestry Standard
The governments' approach to sustainable forestry

Soil

Institute of Chartered Foresters Forestry Commission

UKFS Webinar Series: Soil

🕒 26 January 2022 09:00 - 26 January 2022 11:00
📍 Online Event

Continuous Professional Development

fs.org.uk/events/an-introduction-to-soil-identification-for-foresters/

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June 23, 2022, 10:00 am - 4:00 pm

An introduction to soil identification for foresters

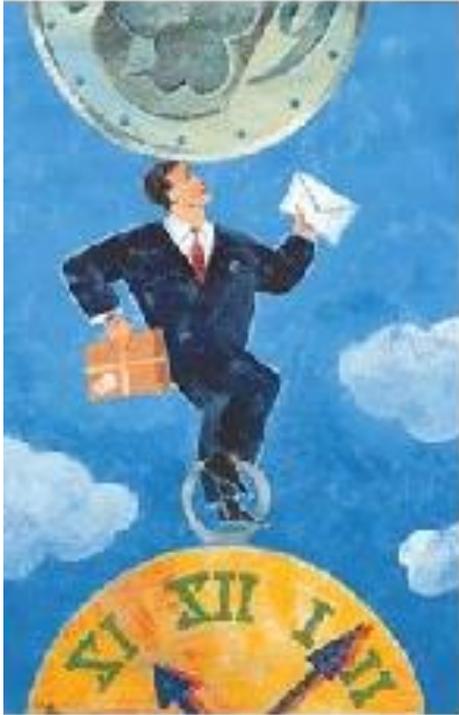
Dr Andy Moffat's perennially popular introduction to forest soils course, combining classroom theory and outdoor practical sessions.

Main conference room, Alice Holt Research Station, Forest Research, Alice Holt Lodge, Farnham, GU10 4LH



Take home messages

- Changes to forest soils are inevitable; the greatest challenge for SFM will come from 'extreme events'.
- UKFS contains invaluable guidance on what foresters should do. They should follow it, not just 'consider' it. Planning for climate change is **essential**.
- You can't manage what you don't know. Get digging and find out.



THANKS FOR LISTENING!

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