Simulating timber production and properties in multi-species planted forests

Forest Research

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INTRODUCTION

- Great Britain is considering planting a wider range of species for sawn **timber production**. We want to provide guidance on this.
- Our foresters use a **decision support system** (ESC-DSS) when making a forest design plan. This estimates the tree species suitability, that is, what species grow where and how well (Figure 1).
- A new complimentary decision support system estimates timber properties based on the site plantation and length of rotation (Figure 2). Currently this only works for **Sitka spruce**.
- http://www.forestdss.org.uk/geoforestdss
- Our aim is to include **more species** in the timber properties decision support system for use in forest planning. This poster presents the first stage of the modelling process.

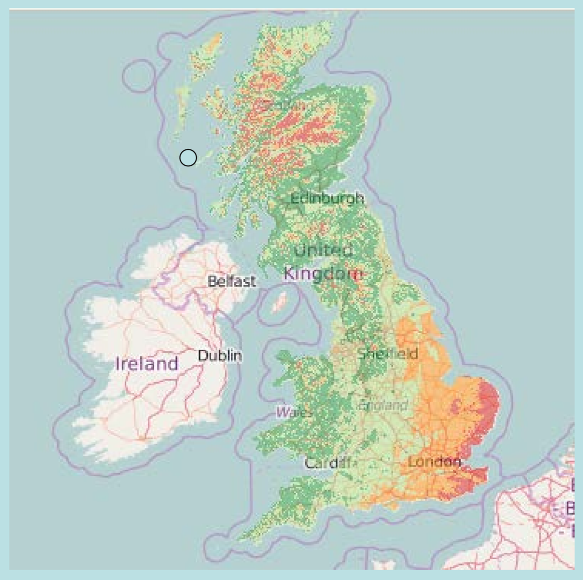

Fig 1. ESC-DSS suitability for growing productive Sitka spruce

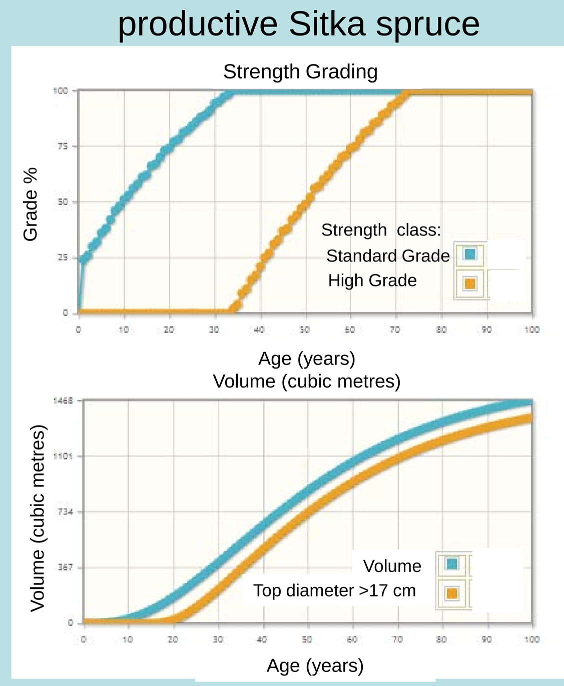

Fig 2. Example of outcomes for the timber properties decision support system

SAMPLE COLLECTION & PREPARATION

Four species:
Noble fir (*Abies procera*)
western hemlock (*Tsuga heterophylla*)
Norway spruce (*Picea abies*)
western red cedar (*Thuja plicata*)

Three sites per species (Figure 3).

Nine trees per site and species (***n*=108**).

Samples prepared from bark to bark, centred on the pith, to account for **radial variation** (Figure 4).

Samples destructively tested by three-point bending (Figure 5) for **stiffness** (the key wood quality requirement in Great Britain).

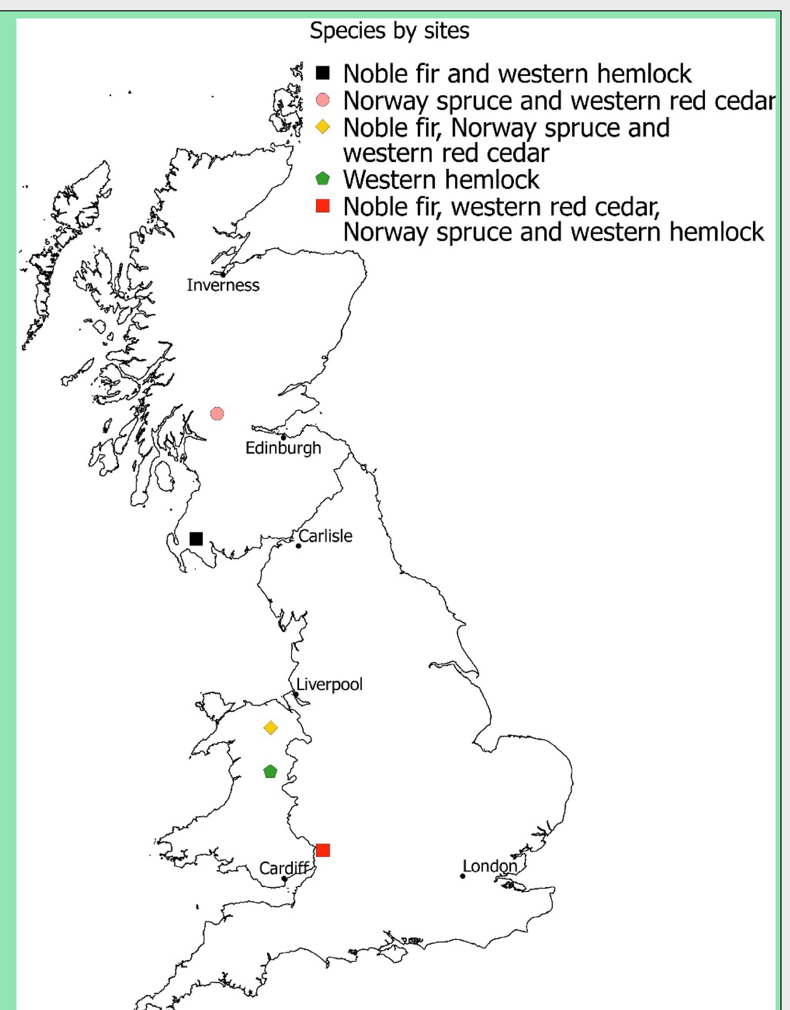

Figure 3. Location of sites sampled.

Figure 4. Sawmilling of clears, bark to bark.

Figure 5. Three-point bending test .

An **exponential model**, previously used for Sitka spruce was applied to the four species using **cambial age** (ring number from the pith) as the sole predictor variable.

$$MOE = \frac{\alpha_0}{-e^{\alpha_1 \times Age}} + \alpha_2$$

where α1 indicates the rate of change; α2 the maximum value; and α2 – α0 the starting value, *Age* is cambial age and *MOE* is bending stiffness. The variation by species and by trees will be investigated.

MODELS OF WOOD STIFFNESS

The largest proportion of the overall variance in MOE is due to the variation in MOE **within a tree** (Table 1), but species also has an important role.

Source	% Variation in Stiffness
Species	23
Sites within species	16
Tree within site	13
Within tree	48
Total	100

Table 1. Variance components for stiffness.

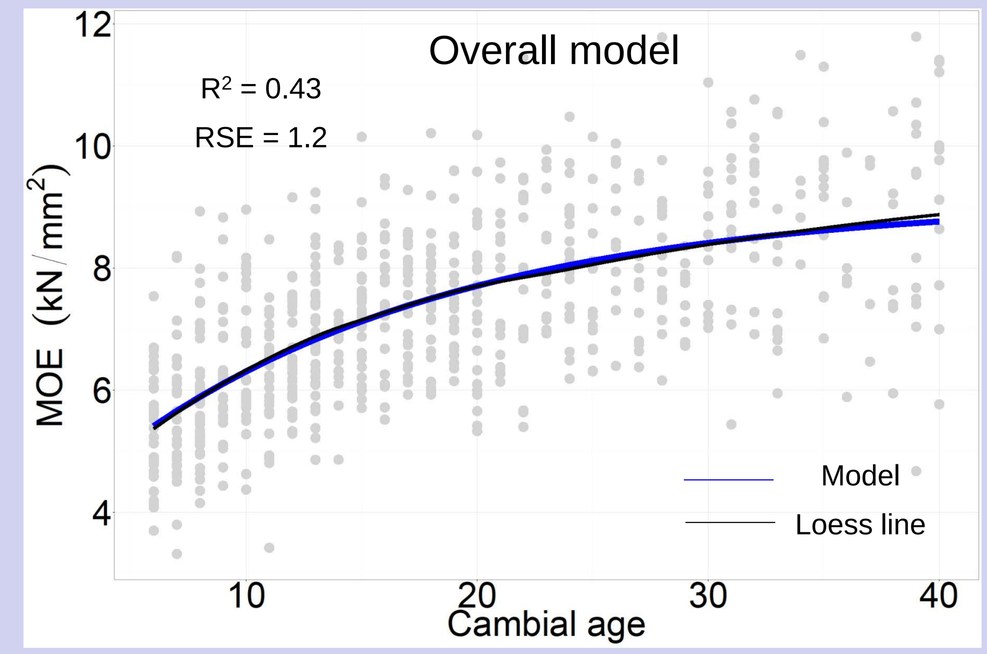

Fig 6. Model and loess trendline for the four species together

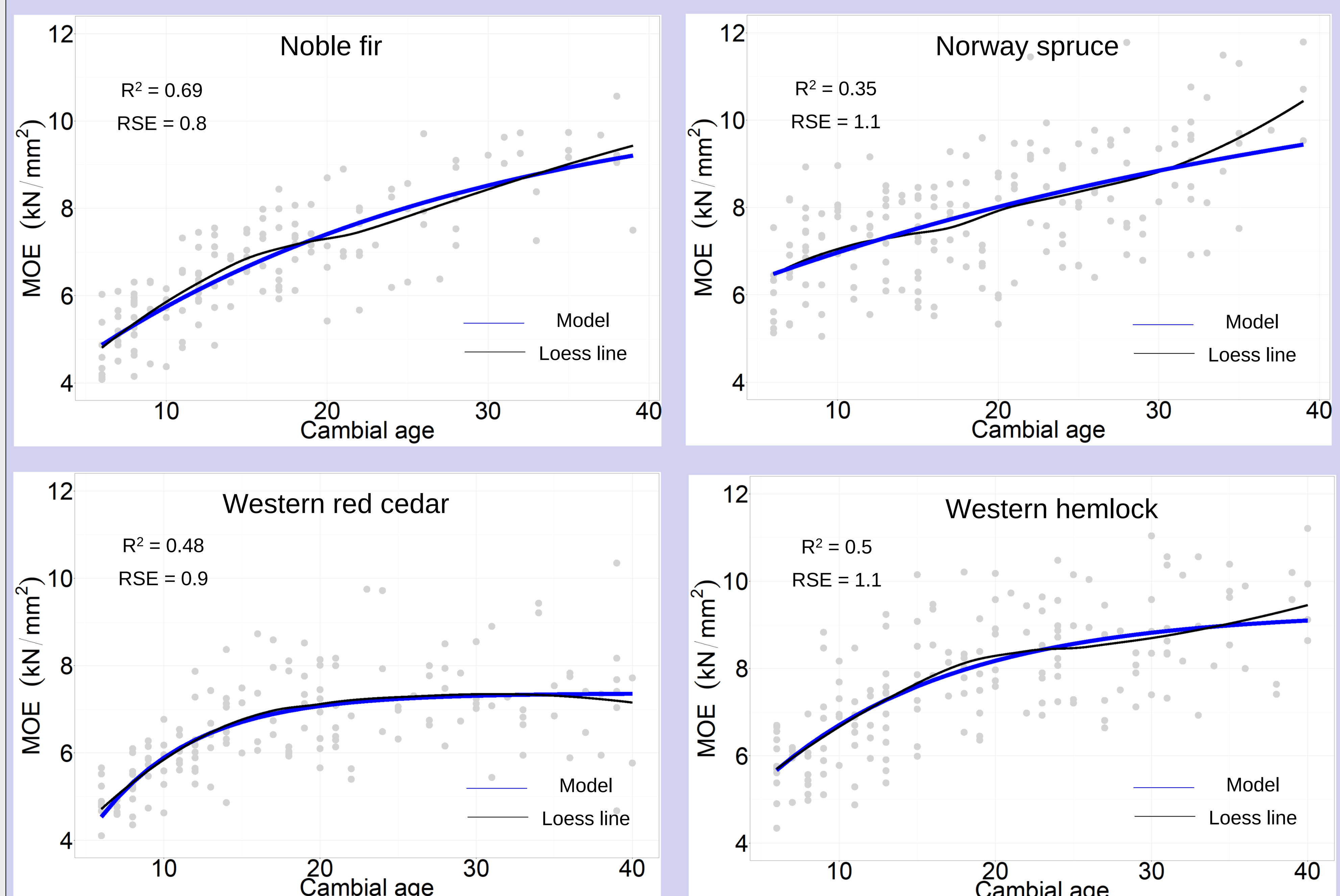

Fig 7. Model (blue) and trendline (black) by species

SIMULATED GRADING

Our model allows to predict the variation of timber allocated to a strength class at different ages using MOE as reference (Figure 8 and Table 2).

Age of Forest	% Standard Grade
20	61
25	78
30	90
35	97
40	100

Table 2. Example of yield of structural grade timber

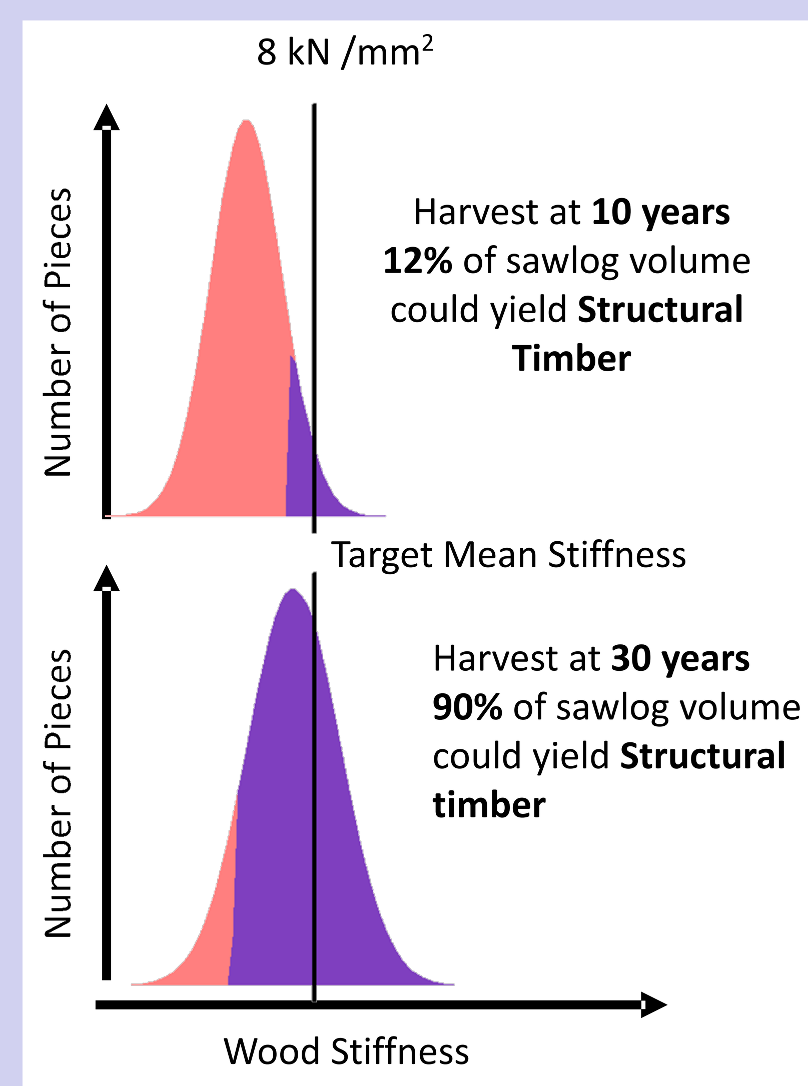

Fig 8. Grading timber at different forest ages

DISCUSSION

We aim to look at the environmental variation and simulate the timber properties of forest compartments with a varying ratio of different species in their sub compartments. Results will be compared with tests from structural size timber, and together with other commercial species of interest incorporated into the online DSS so that planners and processors can forecast the future resources.

Acknowledgements

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