PhD Proposal

The Biology of Heartwood Formation and the Influence on Conifer Timber Quality

A Forestry Commission PhD Studentship at the University of Edinburgh

Introduction

The shape and extent of heartwood formation in conifers is known to vary, as is the durability of heartwood from British grown conifers. Understanding heartwood formation is important from both a physiological ecology point of view and also for determining the potential of producing durable timber for cladding and fencing. Recent research suggests that heartwood may even develop irregularly, both radially and longitudinally in the trunk, to maintain a constant and optimal proportion of sapwood within the tree stem.

The PhD will focus on:

(1) Improving our understanding of the physiological ecology of heartwood formation
(2) Determine the durability of heartwood in British grown conifers
(3) Identify (commercially important) extractives available from conifer heartwood
(4) Improve the parameterisation of process based growth models.

The PhD will involve field work to obtain samples, x-ray and optical scanning of logs and discs, small sample measurement of oxygen and carbon dioxide concentration, hydraulic conductance and extractive concentrations, statistical modelling and growth model parameterisation. This will provide the student with comprehensive training in a range of techniques.

Provisional start date is February 2007, but an earlier start could be arranged for a suitable candidate.

For further information contact:

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Supervisors

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Objectives

(1) Improving our understanding of the physiological ecology of heartwood formation;
(2) Determine the durability of heartwood in British grown conifers;
(3) Identify (commercially important) extractives available from conifer heartwood;
(4) Improve the parameterisation of process-based growth models.

Research Plan

(1) Describe heartwood formation and its variation with tree height;
(2) Clarify the relationship between heartwood, sapwood and leaf area; and impact of wind exposure;
(3) Measure the characteristics of heartwood and sapwood: strength, carbon dioxide and oxygen concentration, hydraulic conductivity, chemical extractives and durability;
(4) Develop models of heartwood formation, link with and improve the ForestGROWTH process-based model.

Methods

(1) Field studies: Logs and discs will be cut from two spacings of Sitka spruce and larch including trees of all dominance classes. In addition Douglas fir and Scot pine trees from a single spacing will be cut. X-Ray, CT scanning of all logs and optical scanning of all discs will be performed;
(2) Statistical model development using new data and validation against existing data;
(3) Small sample testing: O2 and CO2 concentration measurements, hydraulic conductance and extractive concentrations. Comparison with similar measurements in sapwood;
(4) Improve parameterisation of sapwood area in ForestGROWTH, which currently uses pipe theory. Test new model parameterisation against an independent data set.

Research Training

The studentship is at University of Edinburgh, with funding provided by the Forestry Commission for three years. Collaboration between the School of GeoSciences at Edinburgh University and Forest Research will provide the PhD student with training in a wide range of ecophysiological and forestry techniques. The student will be part of a group of post-doctoral fellows and other PhD students working on carbon and water-related issues. The student's participation in workshops and MSc courses within the School will be encouraged. There is also a strong possibility of liaison with Napier University who are investigating the durability of larch for commercial application. This will provide the student with an industrial link to their research.

Skills Required

The candidate (from UK or Europe; overseas candidates need additional support for tuition fees) should have a strong biological, wood science or forestry background (to A-level or equivalent), and needs to be practical, self-motivated, organised, enjoy fieldwork, and hold a clean driving licence valid in the UK. Ideally, the student should be computer literate, with working knowledge of the use of databases. Suitable first degrees are Biology, Environmental Science, Wood Science, Forestry or Geography. Provisional start date is February 2007, but an earlier start can be arranged. Deadline for applications (CV and covering letter to Barry Gardiner): 18th December 2007. The studentship covers all maintenance, tuition fees and research costs for 3 years.

Summary

Why does conductive sapwood turn into heartwood? Which endogenous and environmental factors control the relative proportions of these two tissues? Can this information inform our knowledge on the durability of British-grown timber?

References

See citations at website: http://www.geos.ed.ac.uk/abs/research/forestsci/homepage.htm