

# Building from England's Woodlands

Key Species for Research



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# Key Species for Research

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## Introduction

Edinburgh Napier University has been researching the properties of the current and future home-grown timber resource since 2003. This has covered the effects of growth conditions (including tree improvement and forest management) on key mechanical properties, segregation and strength grading. However, to date this work has focussed mostly on the main commercial softwood species and the likely softwoods that could be planted to complement Sitka spruce. The one exception is Scots pine, although this is now being researched as part of the Strategic Integrated Research in Timber (SIRT) project.

For structural timber, home-grown hardwoods are much less well researched, with only a small amount of birch and sycamore and beech having been studied in the modern context. One aim of the "Building from England's Woodlands" project is to address the lack of knowledge about key home-grown hardwoods, alongside the continuing research on commercial softwoods being undertaken by SIRT, and allied projects.

## Current knowledge

The current strength grading options for home-grown timber are covered in (Ridley-Ellis et al. 2022) and (Transforming Timber 2022). A more general overview of species is given in (TRADA 2022). With the exception of some recent testing of "alternative and minor species" (Adams and Ridley-Ellis 2021) what little data that does exist is from historical testing (e.g. Lavers 2002, first published in 1967). This was done to older standards, and on a timber resource that may have since changed in properties, due to changing growth conditions. For this reason, the data (that can be found) is of limited usefulness, and (at least until confirmed by new data) an inadequate basis for most structural timber design. There are preliminary efforts to infer likely properties from historical data (Ramsay and Macdonald 2013), but this has so far been limited to softwoods.

## Research needs

The most important current research questions for home-grown hardwoods include:

- Which species have most potential for use in construction, and what sampling strategy would be needed to develop full strength grading rules?
- What means and coefficients of variation can we expect for the three primary grade determining properties: bending strength, bending stiffness and density?
- How well do existing visual grading rules and machine grading approaches work, and would it be appropriate to develop new ones?
- Do the existing D and C strength classes in EN338 work well for home-grown hardwoods, or will it be necessary to develop new strength classes?
- Do the standard equations for secondary properties, and adjustments work for home-grown hardwoods, or will it be necessary to develop new ones?
- Does new sampling and testing to modern standards match the expected properties from historical studies?
- Are there ways of establishing sufficient properties data for safe structural design (by construction methods and/or new grading approaches), that do not require the extensive testing necessitated by current standards?
- Are existing strength grading routes for home-grown hardwoods (oak and sweet chestnut) fit for purpose?

The properties that can be studied in this project are the ones relating to structural design (bending strength, bending stiffness and density and key secondary properties, such as compression strength perpendicular to grain). Undertaking the research to obtain this data, and trial construction options will also provide data on ease of processing and use.

While important, natural durability, treatability, potential for manufacture of engineered wood products, and other matters relevant to timber in construction generally, are out of scope. It is nevertheless the intention to collect material to help this kind of research, as a coproduct of the project.

Full testing to obtain visual grading assignments, or machine grading settings, requires testing of hundreds of pieces of timber. While it might be feasible to achieve this amount of testing for one or two species within this project, it is not a sensible objective because:

- We do not yet know which species are best to focus on
- We do not yet have an adequate research basis for obtaining a representative sample for the work
- Sufficient timber is likely not available at present
- It would come at the cost of broader knowledge

That said, it is also not sensible to cover a large number of species, because the data for each would be based on too small a sample to be able to draw useful conclusions. The variability within a species (between sites, trees and within trees) is such that datasets need to cover a least 100 pieces to be useful.

## What species should the project focus on?

The considerations for selecting the species to study include:

- Current and future industry relevance (availability, and priority for future planting in forests capable of contributing to the wood value chain)
- The availability of representative timber for sampling now
- Synergy with other ongoing research projects
- A range within the species selected to be able to answer research questions
- The availability for sampling is perhaps the primary determiner, although that is also linked to industry relevance.

Since softwoods are being addressed by other research projects, and data on hardwoods is lacking, the project should focus on hardwoods. Political and public expectations of forests mean this should lean towards native hardwoods, but recognise the potential for non-native hardwoods for timber production and forest health & resilience.

A hardwood availability forecast has been produced by Forest Research (Forest Research 2014) combined with annual forestry statistics (Forest Research 2022) indicates the relative potential for home-grown hardwoods according to volume. The main species by available volume being:

**Beech** (for which a small amount of recent data has been collected (Ridley-Ellis 2019))

**Oak** (which can be visually graded for construction based on historical data)

**Birch** (for which a small amount of data has been collected by the SIRT project)

**Sycamore** (for which a small amount of data has been collected by the SIRT project)

**Ash**

**Willow**

**Sweet chestnut** (which can be visually graded for construction based on historical data)

**Alder**

A useful research plan would cover a range of hardwood densities, with one or two lightweight species (e.g. **poplar/aspens**, **alder** or **willow**) and one or two denser species (e.g. **birch**, **sycamore** or **beech**). An established species (**oak** or **sweet chestnut**) would be included to provide conformation data for current grading correctness. The project could usefully study four to six species in total.

Species such as eucalyptus and paulownia may have future potential, but there is unlikely to be sufficient home-grown timber to usefully sample in the time frame of this project. Ash may be appropriate to study for the immediate need, but due to ash dieback is not promising for the longer term.

For comparison, there have recently been several large projects on hardwoods in Europe, opening up new grading routes for traditional species from new sources and bringing new species to market. They include poplar (nigra, candensis and cultivars), beech, birch, sycamore, sweet chestnut, ash, and eucalyptus (globus and nitens).

A softwood availability forecast has also been produced by Forest Research and this inventory data (Forest Research 2014), combined with annual forestry statistics (Forest Research 2022) provides a solid picture of the main species.

British spruce (Sitka spruce and Norway spruce), pines (Scots and Corsican) larches (European, Japanese and hybrid) and Douglas-fir make up the vast majority of the resource. With the exception of pine, these have been well researched, and continue to be covered by other projects. Minor species may become a greater part of the future resource, but these are also being addressed by other research projects: noble fir, western hemlock, western red cedar, Serbian spruce, Pacific silver fir, Japanese red cedar (sugi), grand fir, European silver fir and Nordmann fir. Of these, the ones of most interest for additional timber in construction research are the ones that are sufficiently similar to spruce to be used as a substitute for the spruce, or as a minor component of the mixture (in particular: western hemlock, Pacific silver fir, European silver fir.)

### Do you agree with the target species list?

If you think we should be prioritising other species or research questions, please get in touch. We are still planning the work and there is an opportunity to adjust. We are particularly keen to hear from people who can help supply timber for the research, or need particular data in order to be able to build with home grown timber in new ways.

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Beech



Oak



Birch



Sycamore



Ash



Willow



Sweet Chestnut



Alder

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