Specialty Wood Products Research Partnership

A Regional Approach to Matching Specialty Timber Species to Sites

A report to summarise the Specialty Wood Products Partnership workshop on site-species matching

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EXECUTIVE SUMMARY

A workshop on the theme of matching specialty timber species to sites was held in Wellington in November 2016. The Specialty Wood Products programme has selected specialty timber species able to produce high quality hardwoods and softwoods with properties suitable for a diverse range of applications. Species included in the programme are: a) Naturally durable eucalypts b) Non-durable eucalypts c) Douglas-fir and d) cypresses.

Specialty timber species are typically more sensitive to soil and climatic conditions than *Pinus radiata.* The direct benefits of matching specialty timber species to sites therefore include successful forest establishment and optimal productivity with indirect ecological benefits such as increasing species diversity. A map that matches tree species to site is a deliverable under the SWP programme. This meeting was held in order to determine priorities and to determine how this might be achieved.

The University of Canterbury is developing juvenile growth models for more than ten durable eucalyptus species. Scion has developed hybrid process-based and empirical modelling approach for spatial mapping productivity for several eucalypts.

Feedback from workshop attendees listed maps, decision support systems and demonstration plots as effective delivery methods for getting research results to industry members.
The following recommendations are made:

1. Establish commercial-scale demonstration trials throughout New Zealand
2. Establish additional permanent sample plots (PSPs) for specialty timber species throughout New Zealand
3. Continue the monitoring of existing PSPs of specialty timber species throughout New Zealand
4. Elicit site-species matching knowledge from existing experts and papers and incorporate into decision support systems

The current SWP programme does not include any provision to fund the above industry priorities. The consensus at the meeting was therefore that additional funding was required to meet the SWP deliverable of a site/species map and to meet the desires of industry. It was agreed that a joint proposal between University of Canterbury and Scion would be written at the next SFF round to ensure that this would happen.

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1. INTRODUCTION

1.1. Workshop details

A workshop on the theme of matching specialty timber species to sites was held at the Miramar Links Conference and Function Centre in Wellington, NZ on 1 November 2016. The workshop was chaired by Marco Lausberg, facilitated by Nick Ledgard, and included presentations from researchers and industry stakeholders (**Table *1***).

Table 1 – Speakers and topics presented at the workshop

Speaker	Topic
Heidi Dungey (on behalf of Dean Meason), Scion	*Alternative Species Site Mapping Review and Analysis*
Heidi Dungey, Scion	*Species ecology and relevance to New Zealand sites*
Justin Morgenroth, University of Canterbury	*Characterizing the growing environment*
Euan Mason, University of Canterbury	*Species Selection Decision Support System*
Paul Millen, New Zealand Dryland Forests Initiative	*Industry perspectives*
Sean McBride, Juken New Zealand	*Industry perspectives*
Angus Gordon, New Zealand Farm Forestry Association	*Industry perspectives*

1.2. Intended Audience

This report is intended for stakeholders interested in planting trees, specifically specialty timber species. The workshop outputs are relevant to national governmental organisations including Ministry for Primary Industries (MPI) and Ministry for Business, Innovation and Employment (MBIE), and especially regional organisations, including regional governments, land managers, iwi land owners, farm foresters, and small forest growers.

2. SPECIALTY TIMBER SPECIES

The SWP has selected specialty timber species able to produce high quality hardwoods and soft woods with properties suitable for a diverse range of applications. These include:

- Naturally durable eucalypt species (e.g. *Eucalyptus bosistoana*, *E. globoidea*) that are adapted to the North Island and the Northern South Island's East coast
- Non-durable eucalypt species that can be grown nationwide, but the current resource is primarily found in the Central North Island (CNI) and the East Coast of the North Island (e.g. *E. fastigata*, *E. regnans*). *E. nitens* was historically grown in the CNI, but with the impact of the defoliator *Paropsis charybdis*, it is not principally grown in Southland.
- Douglas-fir (*Pseudotsuga menziesii*), has primarily been grown in southern areas (Southland, Otago and Nelson), where snow and frost precluded the success of radiata pine. With the impact of Swiss Needle cast, it is now not being re-planted in northern areas, particularly the CNI.
- Cypresses (e.g. *Cupressus macrocarpa*, *C. lusitanica*, *C. guadalupensis, Chaemacyparis nootkatensis Cupressus x leylandii*, *Chamaecyparis lawsoniana* and their hybrids) can be grown nationwide on sites with deep soil and good rainfall. The current resource is primarily found in CNI, Otago, Southland and West Coast.

3. SITE-SPECIES MATCHING

Matching specialty timber species to sites comprises two components. The first is identifying a range of species that will meet stakeholder objectives on a given site (e.g. farm forester wondering what to plant on their block of land), while the second is identifying sites that will support a given species (e.g. a corporate forester seeking to make a forestry investment under MPI's afforestation grant scheme).

3.1. The benefits of site-species matching

The direct benefits of matching specialty timber species to sites include successful forest establishment and optimal productivity with indirect ecological benefits such as increasing species diversity. Stakeholders can maximise productivity by selecting optimal species to match site conditions, while at the same time mitigating their risks, relative to selecting a single generalist species for all sites (e.g. radiata pine). Specialty timbers have a diversity of natural wood properties that can meet market demands for high quality hardwood and softwood timbers. These market opportunities are recognised by forest industry, with one industry member stating their intention is to have 30% of their log volume come from species other than radiata pine.

3.2. Site-species matching and the SWP Partnership

A goal of the Specialty Wood Products Partnership is to increase plantation forests in New Zealand; **Table *2*** lists the targets for the area of new planting with specialty timber species over the next fifteen years. Site-species matching research will help meet these planting area objectives by giving stakeholders the confidence to (a) plant trees, and (b) select specialty timber species for planting.

Table 2 – Targets for newly planted forests of specialty timber species in New Zealand

Year	planted area ha
2024	25,000
2027	60,000
2032	100,000

Meeting these targets will certainly require effective research into site-species matching, and subsequently, appropriate dissemination of the research findings (see section 4.3). But, in addition to research, efforts will need to be devoted to strategically promote the planting of specialty timber species. This could include:

- Using the Ministry for Primary Industry's (MPI) Afforestation Grant Scheme (AGS) to target funds specifically for specialty timber species;
- Encouraging applications for MPI's Sustainable Farming Fund for small growers interested in specialty timber species;
- Working with processing facilities to drive the demand for specialty timber species, thereby encouraging local land owners to plant them;
- Working with commercial growers to act as regional leaders in specialty timber species growing, with the expectation that smaller growers will follow the lead of commercial growers;
- Encouraging the commercial scale planting of speciality timbers to give confidence to growers in that area to plant these species. Landcorp did express interest in supporting this approach through the AGS scheme. It is very easy for growers to select radiata as there is an abundance of information on where and how to grow and what products/income are likely. We need to have some demonstrations with the specialty species to compete with that.

4. ONGOING SITE-SPECIES MATCHING RESEARCH IN NZ

Matching species to sites is not a new concept, the forest industry in New Zealand has historically sought optimal sites for specialty timber species establishment and productivity. Currently, research in this area is being conducted by the University of Canterbury and Scion.

The University of Canterbury is developing juvenile growth models for more than ten durable eucalypt species. This research is based on measuring permanent sample plots (PSPs) at NZDFI trials throughout NZ and modelling tree height and basal area growth as a function of environmental conditions (climatic, edaphic, topographic) present at the PSPs. Juvenile growth models for *E. bosistoana* and *E. globoidea* incorporate micro-site description of environmental conditions, such that species-site matching can be achieved at a fine scale. In contrast, juvenile growth models for the other durable eucalypts only incorporate macro-site description of environmental conditions, resulting in site-species matching most appropriate for coarse regional or national scales.

Scion has developed a process-based modelling approach for spatial mapping productivity for *E. fastigata*, *E. globoidea*, and *E. regnans*, in addition to existing empirical models. Currently productivity maps are accurate at a regional and national scale, but Scion have the potential to model at a finer scale. Scion has collected tree growth and productivity data for many of the specialty timber species during the Future Forests Research program. These data could be used as a foundation to develop effective site-species matching.

4.1. Limitations to effective site-species matching in NZ

Past and current efforts to optimise site-species matching have been hampered by poor data availability and, where data is available, coarse data resolution (both spatially and temporally coarse). Further, specialty timber species are typically more sensitive to soil and climatic conditions than *Pinus radiata*, and this sensitivity has not been sufficiently investigated. With the exception of Douglas-fir there is an insufficient number of PSPs for specialty timber species, particularly in regions outside of the Central North Island, which could be more suitable for specialty timber species. Even where PSPs are sufficient and well distributed, environmental data suffers from poor spatial and/or temporal resolution. Soil descriptions are available nationwide from the Fundamental Soil Layers (FSL), which map 16 soil properties at a coarse 1:50,000 scale, which corresponds to a raster with a spatial resolution of 25 m (Tobler, 1988) and a minimum mapping unit of 0.0625 hectares. The FSL is progressively being replaced by S-map, which is purported to provide more reliable soil descriptions, however, current coverage is very limited outside of historically productive agricultural areas. Climate data are similarly limiting. The best climate data available nationally is NIWA's Virtual Climate Station Network (VCSN), which has a temporal resolution of 1 day, but a spatial resolution of only 5 km, and a minimum mapping unit of 2,500 hectares. Nationally available topographic data is limited to the 1:50,000 contours (NZTopo50 series) and the 25 m resolution digital elevation model (DE) derived by Landcare Research, or the peer-reviewed 15 m resolution digital elevation model (Columbus, Sirguey, & Tenzer, 2011). Even the 15 m resolution DEM results in a minimum mapping unit of 0.0225 hectares, which assumes no changes in topography within that area. Such coarse scale environmental data is best used in regional or national scale site-species mapping and cannot be used to meet stakeholder objectives of fine-scale site-species matching.

4.2. Additional considerations for site-species matching research

While much of the current research is focussed on optimally matching species to sites with respect to establishment and productivity, effective site-species matching extends beyond this. Other considerations when matching species with sites include optimising for multiple goals, appropriate silviculture, harvesting systems, and processing facilities. Such considerations may influence decisions regarding the delivery of site-species matching research (see section 4.3).

4.3. Effective dissemination of site-species matching research

The effective delivery of the research is critical to meeting the needs of stakeholders. Ongoing research into site-species matching that is being undertaken by the University of Canterbury and Scion should be made available to stakeholders in various following forms:

- Maps
- Decision support systems
- Demonstration plots

Maps showing suitability/productivity of a species within a given area (e.g. region) are a common way to deliver site-species matching knowledge. Given data of an appropriate resolution, maps can be produced for national or regional areas of interest (large scale), forests (medium scale), or even stands (small scale). Maps are common and simple to interpret – for these reasons, they are an effective way to communicate site-species matching knowledge.

Alternatively, site-species matching can be delivered via a decision support system (e.g. http://www.treesandstars.com/euan/sppchc/). Decision support systems lack the simplicity of maps, but allow for stakeholders to define objectives, site characteristics, and receive species suitability tailored to any given site. Importantly, a DSS allows users to override the inputs used to model species suitability. For example, a stakeholder could override the soil depth value if they did not believe the soil depth specified by the DSS was appropriate. Given that the soil data, climatic data, and even topographic data used to model species suitability typically has a coarse resolution, it can be highly erroneous (e.g. Pearse, Moltchanova, & Bloomberg, 2015). So, the ability to override DSS input data with 'expert' knowledge is an advantage of a DSS over a map.

A final means to deliver site-species matching knowledge is via demonstration trials. These trials are planted with a variety of different species or genotypes in order to showcase a range of suitable species (or genotypes) that can be grown successfully within a geographic region.

Long term success of our strategy to research and develop SWP forest species, modes of delivery must be aligned with what the industry needs. An industry member present at the workshop cited the need for an output that would allow them to identify the best parts of their estate for planting specialty timber species. They noted the potential to include a range of species within a compartment and also that spatial resolution is an important consideration due to a topographically varied landscape and an average stand size of 15 – 20 hectares. Such needs are likely best met by a DSS or a high resolution map (and associated GIS layer).

5. FUTURE WORK

Input from workshop participants was supportive of the current SWP research programme, though recommendations were made to strengthen the outcomes of SWP research. Specifically, four additional actions were recommended:

1. Establish commercial-scale demonstration trials throughout New Zealand

   Demonstration trials consist of a variety of species or genotypes; they can give local stakeholders the confidence to grow trees and, especially, to choose a specialty timber species. They can also be targeted for planting in new regions so as once established they can extend the network of PSP's throughout New Zealand (see below).

2. Establish additional permanent sample plots (PSPs) for specialty timber species throughout New Zealand

   The current network of PSPs limits the modelling that can be undertaken for some specialty timber species. Regions outside of the CNI are not well represented by the current network

of PSPs. There are existing stands in some of these regions that represent an opportunity to expand the set of data that can be used for site-species matching throughout NZ, rather than being limited by the current geographic extent of PSPs.

3. Continue monitoring existing PSPs of specialty timber species throughout New Zealand

   Re-measuring existing PSPs will improve our understanding of site limitations to growth of speciality timber species and thus will improve the accuracy of growth models, maps, and decision support systems. Re-measuring existing PSP's will also help with refining what is required for point 2 above in terms of new PSP's.

4. Elicit site-species matching knowledge from existing experts and the existing literature

   Though demonstration trials and permanent sample plots will eventually lead to increased knowledge in site-species matching, some anecdotal and written knowledge already exists. Extracting knowledge from existing sources to integrate into site-species modelling is an important step. This can be achieved via formal interviews with local experts, for example local farm foresters and tree growers. This can also be achieved by extracting existing knowledge from print publications; one such example is a series of publications called 'Zone studies', published by the former Ministry of Forestry. Zone studies exist for many regions and/or sub-regions in NZ and may contain valuable information relevant to site-species matching (e.g. Ministry of Forestry, 1996).

These additional action items were recognised by workshop participants as important steps in site-species matching research going forward. Action item number 1, is an important way to disseminate existing research findings to stakeholders and will extend our PSP network. Action items 2 and 3 are of interest to researchers currently involved in the SWP research programme and fits within existing areas of research expertise. In contrast, Action item number 4 is of interest to SWP researchers, but falls outside the purview of existing research expertise of the current team. Questions of whether to incorporate and, if so, how to incorporate these action points in the future SWP research programme will form a basis for discussion at the April 2017 SWP review.

Given existing resources, it is unlikely that all action items can be addressed, while continuing current research directions. Soliciting additional funding from sources other than the current Specialty Wood Products Partnership will be necessary to achieve all action items. Potential avenues for future funding include the Sustainable Farming Fund and the NZ Forest Growers Levy Trust. The current principle researchers Justin Morgenroth, Euan Mason, and Dean Meason who are involved in ongoing SWP site-species matching research will collaborate to identify the best team and determine new funding sources and timing for applications to support these additional action items and circulate this by 31 March 2017.

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