



SOCIAL RESEARCH NUMBER: C160/2020/2021

PUBLICATION DATE: 23<sup>rd</sup> JUNE 2021

# Top Five Alternative Conifer Tree Species in Great Britain

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## Executive Summary

### 1. Research aims and methodology

- 1.1 The Welsh Government commissioned Woodknowledge Wales to conduct a review to identify the top five alternative commercial conifer tree species suitable to meet timber utilisation demands of the GB forestry sector, in light of increasing potential pest and pathogen pressures including the impact of new introductions and climate change. The major barrier to adoption of alternative conifer tree species within commercial plantation woodlands is the lack of holistic information to inform species selection. This needs to be supported by a robust evidence base that is produced through systematic assessment of ecological, silvicultural, economic and timber utilisation considerations.
- 1.2 There are eight principal conifer species and one hybrid that currently contribute 97% of the British commercial coniferous forest resource. The overall aim of this review was to assess all of the other conifer tree species that can be grown in Britain in order to identify the top five alternative species that can be incorporated practically into the commercial conifer forest resource across GB. The species chosen must fulfil the criteria of being suitable to either maintain or improve the social, economic, environmental and cultural benefits currently provided by commercial woodlands in GB.
- 1.3 It is important to have a robust understanding of the evidence base, including its scientific underpinning, relating to the potential of alternative conifer species to address these objectives, in order to guide the identification of the top five species. A systematic research protocol was designed, to allow the range of specialist information to be appropriately synthesised. Using multi-criteria analysis (MCA), the existing knowledge base was collated (including expertise from 38 expert stakeholders involved in forestry and timber production in GB) to identify the top five alternative conifer tree species for GB.
- 1.4 The three criteria for including species in our long list were applied in a preliminary review of relevant literature:
  - Include tree species that are naturalised in GB.
  - Include tree species that are used or have historically been used for timber production in their natural range.
  - Exclude tree species that are principal conifer species already widely used in British forestry.
- 1.5 The review identified a long list (n=56) of alternative conifer tree species that were then ranked based on:

- Their resilience to current and future pests and pathogens.
- Their suitability for a changing climate and a range of site conditions across GB.
- Their suitability for producing commercial timber products.

## 2. Key findings

### The top five alternative conifer species

2.1 The five highest scoring species based on the MCA are shown in Table 1. These five species scored well across the criteria as they are relatively resistant to a range of high and low risk pests and pathogens, they are tolerant of a range of site conditions, there is evidence of their high potential productivity when grown in GB, and their timber is suitable for a range of end uses and is likely to grade to strength classes required for use in construction.

**Table 1. Top five ranked alternative conifer species.**

Ranking	Scientific name	Common name	Multi-attribute utility value
1 <sup>st</sup>	<i>Sequoia sempervirens</i>	coast redwood	81.46
2 <sup>nd</sup>	<i>Cryptomeria japonica</i>	Japanese cedar	81.10
3 <sup>rd</sup>	<i>Thuja plicata</i>	Western red cedar	80.94
4 <sup>th</sup>	<i>Sequoiadendron giganteum</i>	giant redwood	80.88
5 <sup>th</sup>	<i>Abies alba</i>	European silver fir	71.65

2.2 A detailed and critical literature review was conducted on these top five alternative conifer species to determine the reliable evidence that is available on their native range and genetic diversity, ecology and silviculture, major pest and pathogen threats, and the potential utilisation of their timber. This is presented in the main report.

### Other alternative conifer species with merit

2.3 While the top five ranked species score well and are likely to be suitable for a broad range of site conditions across GB, they do not include the best species for all purposes and all locations. We therefore determined that the set of conifer species considered for productive use across GB should be broader. The multi-attribute utility values indicate that there is a top group of four species (1<sup>st</sup>-4<sup>th</sup> in rank in Table 1), with very similar scores (within one unit), followed by a second group of 12 similarly scored species (within a range of four score units) that perform well in relation to being resistant to pests and pathogens, being suitable for a range of site conditions and capable of producing commercial timber products, which are also worthy of active consideration, e.g. for acidic upland sites. The 11 species ranked 6<sup>th</sup>-16<sup>th</sup> are shown in Table 2. However, it was beyond the scope of this review to consider their suitability in more detail.

**Table 2. Other alternative conifer species with merit.**

Ranking	Scientific name	Common name	Multi-attribute utility value
6 <sup>th</sup>	<i>Taxodium distichum</i>	swamp cypress	71.39
7 <sup>th</sup>	<i>Chamaecyparis lawsoniana</i>	Lawson's cypress	71.24
8 <sup>th</sup>	<i>Abies amabilis</i>	Pacific silver fir	71.10
9 <sup>th</sup>	<i>Taxus baccata</i>	yew	70.91
10 <sup>th</sup>	<i>Cupressus arizonica</i>	Arizona cypress	70.68
11 <sup>th</sup>	<i>Metasequoia glyptostroboides</i>	dawn redwood	70.44
12 <sup>th</sup>	<i>Calocedrus decurrens</i>	incense cedar	70.35
13 <sup>th</sup>	<i>Abies grandis</i>	grand fir	69.15
14 <sup>th</sup>	<i>Tsuga mertensiana</i>	mountain hemlock	68.54
15 <sup>th</sup>	<i>Abies procera</i>	noble fir	68.40
16 <sup>th</sup>	<i>Tsuga heterophylla</i>	Western hemlock	68.19

### **3. Conclusions**

- 3.1 Using a systematic review methodology, 56 alternative conifer tree species were selected and ranked based on their potential suitability for commercial timber production in GB in the face of growing pest and pathogen threats and this ranking was used to identify the top five.
- 3.2 While this approach did not account for every issue that may be considered for site-level selection of tree species, the ranking method covered the broad range of ecological, silvicultural, economic and timber utilisation factors appropriate for strategic national-level exercises such as this.
- 3.3 The top five alternative conifer species will not meet all of the broad range of purposes and site conditions relevant to woodland creation policy and practice in GB, and this review identified over 50 other alternative conifer species that merit further attention. Of these, a group of 11 species were identified that should be the next priority for further investigation, to build a larger set of complementary species that would be suitable for the full set of site environmental conditions across GB. This will be important to provide an enhanced evidence base for the Ecological Site Classification decision support system and to fill the key knowledge gaps that exist in relation to alternative conifers in GB.
- 3.4 This review identified the most important gaps in the existing evidence that is required specifically for the rigorous selection of a full set of complementary alternative tree species. These knowledge gaps include the suitability of species for management under alternative silvicultural systems, and their timber properties when grown on the range of site conditions across GB, including their suitability for future wood product markets.
- 3.5 A second key priority for future research is the identity of the pests and pathogens that are most likely to enter GB, or already are here but increase in importance, and the relative susceptibility of different tree species to these.
- 3.6 The third identified priority is the effect of the range of climate change impacts, including increased risk of drought and fire, and interaction with pest and pathogen effects, and how these will influence the relative performance of alternative conifer species, as reflected by the concept of resilience.
- 3.7 A key consideration is to increase resilience at the scale of the production forestry system, through development of a diverse portfolio of conifer species, rather than relying on the evidence of this review to select a single alternative species for large-scale planting. History teaches us that each of the five alternative conifer species identified by this research are likely, as others previously, to have a period of unprecedented growth and yield, before a pest or pathogen species starts damaging the crop.

### **4. Recommendations**

- 4.1 This review led to eight key recommendations:
  - Maintain, restart or set up species trials to test the suitability of the five identified alternative conifer species, as well as the second set of 11 highest priority complementary species.
  - Evaluate (or in some cases re-evaluate) the potential provenances of the top five species and their suitability for different sites across GB.
  - Extend the analysis presented in this report to evaluate the suitability and performance of alternative broadleaf species.
  - Investigate the suitability and performance of the alternative tree species across a range of silvicultural systems and when grown in a range of species mixtures.
  - Assess potential long-term future market needs as new wood-based technologies become more mainstream.
  - Evaluate the timber properties of structural-sized pieces of timber from the identified top five alternative conifer species.

- Investigate the potential for novel methods, e.g., biological control or silvicultural approaches, to mitigate the threat of invertebrate pest and pathogen species most likely to attack the five identified species.
- Investigate the extent to which the five species depend on specific mycorrhizal microbial symbiont species or can associate with microbial species already abundant in current and future plantation sites in GB.

## Top Five Alternative Conifer Tree Species in Great Britain

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Full Research Report: Peters, T. D., Hardaker, A. R., Dauksta, D., Newman, G., Lellig, C., & Healey, J. R. (2021). *Top Five Alternative Conifer Tree Species in Great Britain*. Cardiff: Welsh Government, GSR report number C160/2020/2021

Views expressed in this report are those of the researchers and not necessarily those of the Welsh Government.

**Please note this a corrected version of the report published on the 23rd June 2021 which now lists the top five ranked species in Table 1 in the correct order (*Thuja plicata* and *Sequoiadendron giganteum* were in the wrong order in the previous version).**

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