

Monterey pine - a possible alternative species for commercial forestry in Ireland

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Abstract

In light of the effects of climate change on our forests, it is high time to consider alternative species which might be suitable for commercial forestry in Ireland. Given the limited number of species which might be suitable for establishment in this climate the choice is rather limited, however one such species is Monterey pine. This species is not new in Ireland and has been extensively planted here in the past. While the species natural distribution is very limited and confined to the coastal zone of central California and northern Baja, along with a few isolated island populations, it is grown in commercial plantations covering over 4 million ha throughout the world. However, in its country of origin it faces heightened conservation issues. From provenance tests undertaken with the species in Ireland, the most suitable for Irish conditions is the Guadalupe Island provenance. With greatest diameter growth rates, top heights and stem-form values, it is far superior to all other provenances tested and should be the recommended choice for future planting.

Keywords: *Climate change, alternative species, Monterey pine, provenance trial, Guadalupe Island provenance.*

Introduction

Climate change is increasingly recognised as one of the most important challenges facing society in the 21st century. A major feature of such change is its damaging impact on global ecosystems, particularly forests (Koskela et al. 2007, Black et al. 2010, Huss et al. 2016). According to the Inter Governmental Panel on Climate Change, likely changes in climate patterns could result in increases in average temperatures across Europe of 2–4 °C over the next 50 years and considerable changes in regional and seasonal patterns of climate. This is especially the case in relation to precipitation. Already these changes are being felt in some parts of Europe, for example the decline of pedunculate oak (*Quercus robur* L.) in the Loire region of France (Fennessy et al. 2016). These changes will alter the environmental conditions to which forest trees in Europe are adapted and will expose them to many new threats particularly new pests and diseases.

Already a number of tree species have become victims of the earlier onset of

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the effects of climate change and its damaging consequences and for some, their very survival may even be in doubt. An example of such change is the threat to ash (*Fraxinus excelsior* L.) from ash dieback disease (*Chalara fraxinea*) which has spread very rapidly across much of Europe. To counter these new challenges, foresters will, of necessity, have to consider new and alternative species which are suited to the new and changing climate patterns. In Ireland, the potential range of new commercial species is rather limited, never-the-less, in these changing climatic conditions, one such species worthy of reconsideration is Monterey pine (*Pinus radiata* D. Don). Monterey pine is not new to Ireland and has been widely planted here in the past and has already shown considerable potential. Monterey pine as a species is quite familiar in the Irish landscape and it has been extensively planted in arboreta and private gardens as individual specimens as well as a source of shelter in areas close to the coast. Irish foresters will be aware of its growth potential and its enormous productive capacity. It has many favourable attributes, including its short rotation length; it is a large volume producer and at the same time it provides excellent quality timber that is very durable. The species was originally introduced to Britain by David Douglas in 1833 (Savill 2013) and was probably brought to Ireland relatively soon after this date in the mid-1850s.

Monterey pine – a remarkable tree species

Alan Mitchell, in his *Gardener's Book of Trees*, suggests that the old name “*Insignis* pine” means “remarkable pine” and he suggests that in some ways, this is one of the most remarkable trees in the world (Mitchell 1981). Monterey pine is a forest tree species of great economic importance worldwide, although the species’ natural range is quite restricted (see below). Monterey pine has proved very successful as a commercial exotic forest tree species in many parts of the world. The species is grown in commercial plantations on over 4 million ha but in its country of origin it faces heightened conservation issues (Vergas-Hernandez et al. 2014). As a species it is of major economic importance in many countries including New Zealand, Australia, South America and Chile as well as parts of southern Europe including Spain and Portugal. Large wood industries have developed around the species in many of these countries, sometimes entirely based on this species alone.

The natural range of Monterey pine

Monterey pine’s native range is restricted to the coastal zone of central California and northern Baja, also in California, and a few isolated island populations (Vergas-Hernandez et al. 2014). However, the species formerly had a much wider distribution, as shown by fossil records, but due to an increasingly dry climate, the species declined to a few localities along the humid coastal belt of central California (Collingwood

and Brush, 1979) with a latitudinal range of 35° to 37°. This limited natural range consists of scattered populations in small areas of Monterey County in California around the towns of Ano-Nuevo, Monterey and Cambria - the “fog belt” on the coast of California (Savill 2013) - and a further two populations on the Mexican islands of Cedros and Guadalupe (Figure 1). Collingwood et al. (1979) differentiated between the mainland populations (*Pinus radiata* D. Don) and the Guadalupe population, which they classified as Monterey pine (*Pinus radiata* var. *Binata* (Englm.) Lemmon), a related form to the mainland populations.

Monterey pine in Ireland – past experience

Monterey pine has been described as one of the most vigorous species ever introduced into Ireland and has been widely planted throughout the country. For what he termed the “British Isles”, Mitchell (1972) lists no less than twelve of the largest recorded trees of *Pinus radiata* in Ireland out of a total of sixty-four in this special category. These are recorded in a wide range of sites from Derreen Estate in Co. Kerry to Headfort Estate in Co. Meath and include Adare Manor, Co. Limerick; Collattin Estate, Co. Wicklow; Fota Island, Co. Cork; Muckcross Estate, Co. Kerry; Powerscourt Estate, Co. Wicklow;



Figure 1: Distribution of Monterey pine (red circles) along the west coast of North America.

Inistioge Park, Co. Kilkenny and Emo Park, Co. Laois. While exceptional individuals can be found in the Irish countryside, very few fully stocked stands of good form exist and limited information on volume production potential in Ireland is available. Monterey pine accounts for 0.04% of the total Irish forest estate (NFI 2013). Although it grows almost year round, providing air temperatures are high enough, it does not suffer unduly from serious frost injury. Its vigorous growth-habit necessitates close spacing and continuous pruning for the production of high quality timber. For this reason it may also serve as an excellent agro-forestry species. Over the years, foresters have witnessed the spectacular growth rate of Monterey pine in Ireland and this has created much interest in the species, but difficulties in (1) establishment and (2) needle loss (yellows¹) have been a major deterrent to the species being planted on a much wider scale in Irish commercial forestry.

Towards the end of the 1970s, a number of tree breeding programmes were established in Ireland including one focusing on Monterey pine (Pfeifer 1991) and although only a few provenance trials were established over the years (e.g. John F. Kennedy Arboretum in 1966), they were generally rather limited and did not cover the entire range. However, in 1978, tree breeders in Australia organised a provenance collection covering the entire range of the species which resulted in several trials in countries where it is of significant economic importance. As a consequence of this collection, a new provenance trial was established in Ireland at Bree Forest in Co. Wexford on a rich alluvial soil on the banks of the River Slaney in 1979. Here, thirteen sources were tested under Irish growing conditions from the species' natural range (source confirmed) along with one first generation Irish seed source from Shelton Forest in Co. Wicklow (unknown origin), as well as a source from a seed stand near Canberra in Australia. Results from the Bree trial suggest that the Guadalupe provenance from Guadalupe Island (Figure 1) achieved diameter growth rates, top heights and stem-form values far superior to all other provenances tested and this provenance has subsequently been considered the best and most suitable for use in Irish forestry (Lally and Thompson 2000). This provenance has the advantage that it does not suffer from needle loss (yellows), the needle cast disease which reduces productivity in Monterey pine. With an estimated yield class of 20 m³ ha⁻¹ yr⁻¹, this material would seem like the obvious choice in the event of a planting programme commencing at any time in the future. A past breeding programme also resulted in the selection of a large number of plus trees in older stands showing resistance to "yellows". As a follow on from this programme, open pollinated seed was collected

¹ A disease sometimes associated with the fungus *Cyclaneusma minus* or with climatic stress. The disease results in the yellowing and loss of the previous year's needles and a considerable loss in growth rate. The disease usually manifests after three to four years following planting. The consequent dying-off of immature trees can give rise to very open and heavily-branched stands. However, trees of the Guadalupe Island provenance appear not to suffer from this disease.

from these trees and over two hundred families were established in half-sib progeny tests. This programme commenced in 1979 and continued until 1985 when, due to a policy change, the programme was terminated.

According to Savill (2013), Monterey pine grows well on deep, dry, infertile sandy soils in the south of England and grows on loams and clay loams, but wet and shallow calcareous soils should be avoided. Similar soil and site types are considered suitable in Ireland but peats should be avoided. In Ireland, the mean yield class for the species has been estimated between 16 and 17 m³ ha⁻¹ yr⁻¹, while the maximum mean annual increment occurs before the age of 30, which makes it a short rotation species and as a coastal species, it has a high level of exposure tolerance (Lally and Thompson 2000). Trees of up to 35 m tall occur in Britain and growth is rapid where the tree survives, while yield classes of 18-22 m³ ha⁻¹ yr⁻¹ are common in the south-west of England (Savill 2013).

As already mentioned above, the Guadalupe Island provenance has proved the most suitable for Irish conditions, however, this source has been under severe pressure for many years and its very survival was, until recently, very much in doubt.

The Tree Council of Ireland, in its publication *Champion trees – A selection of Ireland's Great Trees* (2005) lists a number of *Pinus radiata* trees in the champion category. A specimen in Muckross, Killarney in Co. Kerry is recorded as a height champion with a circumference of 4.9 m and a total height of 45 m. Another specimen is recorded in Dereen Estate, also in Kerry, with a circumference of 9.0 and with a height of 31 m. In the section on girth champions for conifers, Monterey pine is recorded as having a circumference of 7.65 m and a total height of 33.5 m.

Future potential of Monterey pine in Ireland

The best information on suitable seed sources for Monterey pine for planting in Ireland suggest that only Guadalupe Island provenance be used in commercial forestry. However, in common with all populations of the species, this source faces heightened conservation issues. While the species in general has lost over 50% of its natural habitat, it is also threatened by various human-related disturbances. Monterey pine is on the IUCN (International Union of Conservation of Nature) Red List of threatened species, and the FAO Panel of Experts on Forest Genetic Resources has identified it as a species with high global, regional and/or national priorities for genetic conservation (Vergas-Hernandez et al. 2014). The Guadalupe Island provenance, which hosts one of the five remnant populations of Monterey pine, is considered particularly vulnerable. This population which is 250 km off the coast of Northern Mexico has survived under particularly harsh environmental conditions, with annual rainfall averaging less than 200 mm, although dense fogs are common in winter, especially at higher elevations. The evolution of the Monterey

pine population on this island has remained isolated from the other island and mainland populations and has become genetically differentiated from them, showing distinctive morphological and adaptive traits (Vergas-Hernandez et al. 2014). The original pine population once occupied an extensive area on the northern end of the island however, even though the island has not been permanently inhabited by people, the pine population shrank dramatically in the last two centuries because of goats that were introduced in the mid-nineteen century preventing successful regeneration of the pines. The current tree population is down to somewhere over 200 over-mature individuals growing isolated in small patches in an environment hostile to establishment of new seedlings (Vergas-Hernandez et al. 2014). In 1981, the Guadalupe Island population of Monterey pine was declared “endangered” by the FAO Panel of Experts on Forest Genetic Resources, largely because of the grazing pressures from the introduced goats.

Conclusion

In the context of climate change and identifying suitable species for Irish commercial forestry, Monterey pine should be considered an important tree species and be given serious consideration. However, establishment difficulties and needle loss (yellows disease) have been recognised and need to be addressed. While it is an exotic pine which has been planted extensively in the past, it has shown tremendous potential in Ireland. Recognising the results from an earlier provenance trial, Guadalupe Island provenance has shown best overall performance in Ireland and is considered the most suitable provenance to plant. Seed sources may prove scarce however, as a species that has been widely planted throughout the world, securing a seed supply should not be too difficult. However, the choice of best provenance is vital to the success of the species.

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