Project number: **6519**
Funding source: Teagasc

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Alternative Conifers to replace Japanese larch in Irish Forestry

Key external stakeholders:

Forest service, DAFM, CoFord, Policy makers, forest industry

Practical implications for stakeholders:

The outbreak of *Phytophthora ramorum* identified in Japanese larch (*Larix kaempferi*) in 2010 has caused widespread damage to Japanese larch stands in Ireland and the species and Genus are no longer being grant-aided in the Irish afforestation programme. The species occurs predominately in mixture with Sitka spruce (*Picea sitchensis*) and is favored for landscape purposes. A range of alternative conifer species including western red cedar (*Thuja plicata*), grand fir (*Abies grandis*), western hemlock (*Tsuga heterophylla*), Norway spruce (*Picea abies*), European silver fir (*Abies alba*), noble fir (*Abies procera*) and Douglas fir (*Pseudotsuga menziesii*) were found to be suitable replacements offering similar or higher levels of productivity, acceptable timber properties, while affording reduced levels of risk from pest/disease outbreak.

Main results:

- A total area of 32,057 ha of larch occurs in Irish forests, Japanese larch is the predominant species occupying 27,859 ha.
- The species is used predominately in mixed forests with 86% occurring in mixed stands and 79% in mixture with Sitka spruce.
- The yield of seven alternative conifer species which were found growing in mixture with larch indicated the potential to choose these alternative species offering the opportunity to increase the productivity of forest stands.
- A practical tool was developed to predict growth performance of potential alternative species across a range of soil types which might be used to assess the potential for replacement of larch in forest stands.

Opportunity / Benefit:

The study succeeded in identifying a number of alternative species to replace larch that display higher levels of productivity on suitable sites and offer lower levels of biotic risk. Key among these are Douglas fir, Grand fir, Norway spruce, western hemlock and western red cedar, with noble fir and European silver fir also having some potential utility. Depending on the site type, there may be

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opportunities to choose alternative species that fulfil specific biological or silvicultural functions. Given the significance of Sitka spruce/Japanese larch mixtures in Irish forestry, this research shows the potential of using alternative conifers to replace larch in these mixtures that may enhance resilience while maintaining the productivity of the national estate.

Collaborating Institutions:

Teagasc project team:	Dr. Niall Farrelly (Project Leader/PI) Dr. Richard Walsh (Walsh Fellow)
External collaborators:	Dr. Andrew Cameron (Aberdeen University)

1. Project background:

Over the past decade, there has been a rise in the number of damaging invasive biotic agents detected in Irish forests including Phytophthora ramorum in Larix spp. and ash dieback disease (Hymenoscyphus fraxineus) in Ash and have highlighted the risk to our forest resource from pathogenic attacks. The rise in biotic risk has consequentially reduced the range of tree species available for afforestation and reforestation, with foresters increasingly dependent on a few species for establishment of commercial plantations (Read et al. 2009). Larch species are some of the most important commercial conifer tree species in Irish forestry providing durable, versatile timber, enhancing recreational amenity and improving the visual appeal of forest landscapes through the contrast of colour in autumn/winter foliage. These species have found favour in mixed species stands where they are commonly used as the second or third species, occupying 20% of the canopy in mixture with Sitka spruce.

The rise of damaging pathogens in Irish forestry has led to a reduction in the range of tree species available for commercial use and there is an ongoing need to replace damaged stands of diseased larch trees in the landscape.

2. Questions addressed by the project:

The objective of the study was to examine the range of alternative conifer species that may be suitable to replace larch in both restocking and new afforestation schemes without loss in production.

3. The experimental studies:

In order to identify the scale of the forests that may be vulnerable to P. Ramorum a database of private and state owned forests which contained larch species was examined which amounted to 165,362 ha. Of the area, 56% (93,048 ha) was classified as being in private ownership and 44% (72,314 ha) owned by Coillte.

Identifying potential alternative conifer species to replace larch requires an evaluation of the growth performance (yield class) of companion conifer species across a range of soil types. Suitable alternative species should show similar or higher levels of productivity on equivalent sites, and should represent a lower level of biotic risk.

Relationships were examined between the productivity of Japanese larch and, where relevant, hybrid and European larch, and the alternative conifer species growing within mixed stands (and it is thereby inferred under similar climate and soil conditions) by comparing the yield class of the

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species in the particular stand. Linear regression equations were developed and can be used to predict the productivity of alternative conifer species (e.g. Douglas fir, grand, western hemlock, etc.) based on the yield class of Japanese larch or other larch species and a series on a given site. The result is the likely yield that can be attainable by the substitute species on the same site.

4. Main results:

- The majority of the larch in Ireland occurs in mixed species stands (27,272 ha) and a smaller amount (4,785 ha) in pure larch stands.
- Japanese larch has been the most widely planted of the larch species and 18,870 ha occurs in mixture with Sitka spruce.
- The productivity of Japanese larch in mixed crops (10.1 m^3 ha^{-1} yr^{-1}) was consistently greater than in pure stands 9.7 m^3 ha^{-1} yr^{-1}) across a range of elevation categories up to 550 m.
- Significant positive correlations were found between the yield class of Japanese larch and the yield class of alternative conifers growing on the same sites (r-values from 0.49 to 0.70; P <0.01).
- Overall the yield class of Japanese larch yield of western hemlock showed the strongest relationship with the yield class of western hemlock (r^2 = 0.48).
- Regression equations were developed for Japanese larch and a range of species including Douglas fir, noble fir, Norway spruce and Sitka spruce, all equations indicated an increase in yield was possible from switching to these species from Japanese larch.
- For certain soil types (e.g. basin peat) advantages were apparent from switching from Japanese larch to Norway spruce where relationships were strongest (r^2 = 0.71).

5. Opportunity/Benefit:

The primary stakeholder of the research is the Teagasc Forestry Development Dept. and DAFM. The strategic nature of this project means that it will be of particular interest to the forestry sector. The research has succeeded in developing a practical tool which can assist in species selection.

6. Dissemination:

Walsh, R. 2019. The potential of alternative conifers to replace larch species in Ireland. Poster presentation at Oakpark Forestry Research Day, October 16th 2019.

Farrelly, N. Walsh, R.,McG Wilson, S. O'Tuama, P. 2017. Minor Conifers: What's performing best Results of research trials and case studies. National Forestry Conference, Johnstown House Hotel, Enfield, Co. Meath, 31st May 2017.

Farrelly, N., Walsh, R. 2017.Alternative Tree Species in Irish forestry. Presentation to the JOINT EFI ATLANTIC & IEFC ANNUAL MEETING, Scotland. 10 MAY 2017

Farrelly, N. 2017. Irish experiences with Non-Native species. COST Action Seminar, 3rd October 2017, Dublin.

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Main publications:

Walsh, R., Cameron, A., Wilson Scott McG., and Farrelly, N. 2017. The potential of alternative conifers to replace larch species in Ireland, in response to the threat of Phytophthora ramorum. Irish Forestry. Vol 74. 1&2. 149-167.

7. Compiled by: Niall Farrelly and Richard Walsh.

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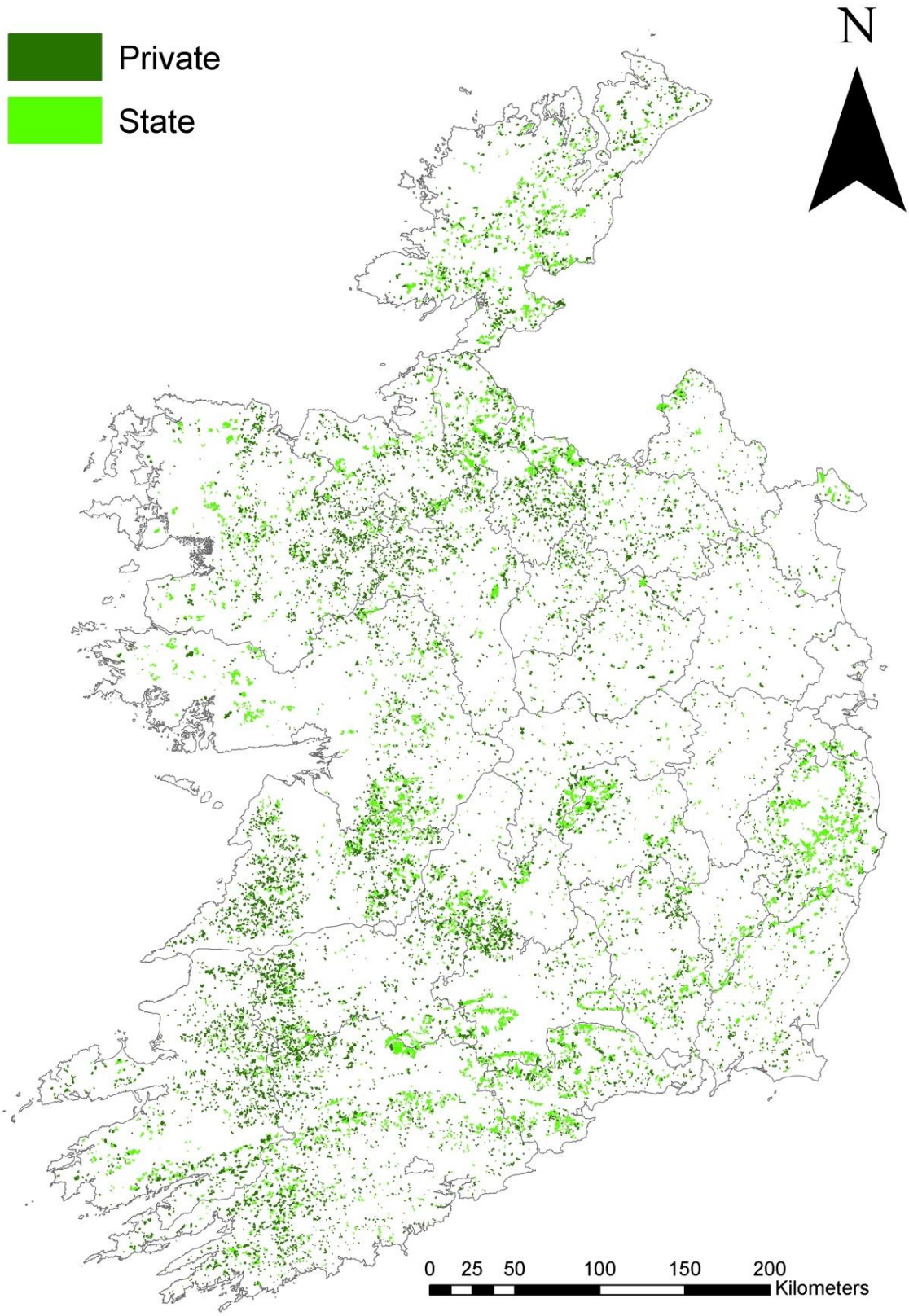

Figure 1: Distribution of stands in the Republic of Ireland containing larch species under threat from *P. ramorum* distinguished by public and private ownership

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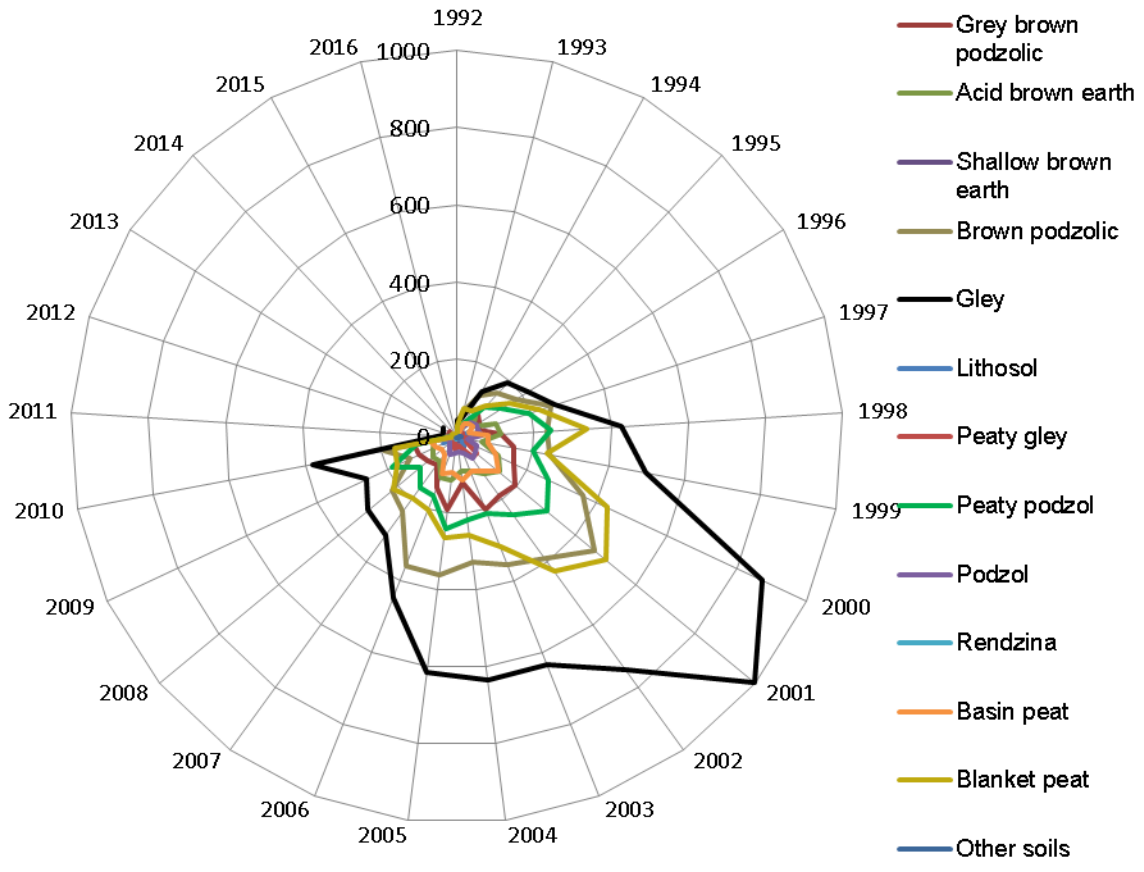

Figure 2: Annual planting area (ha) for larch species on principle soils from 1970 to present

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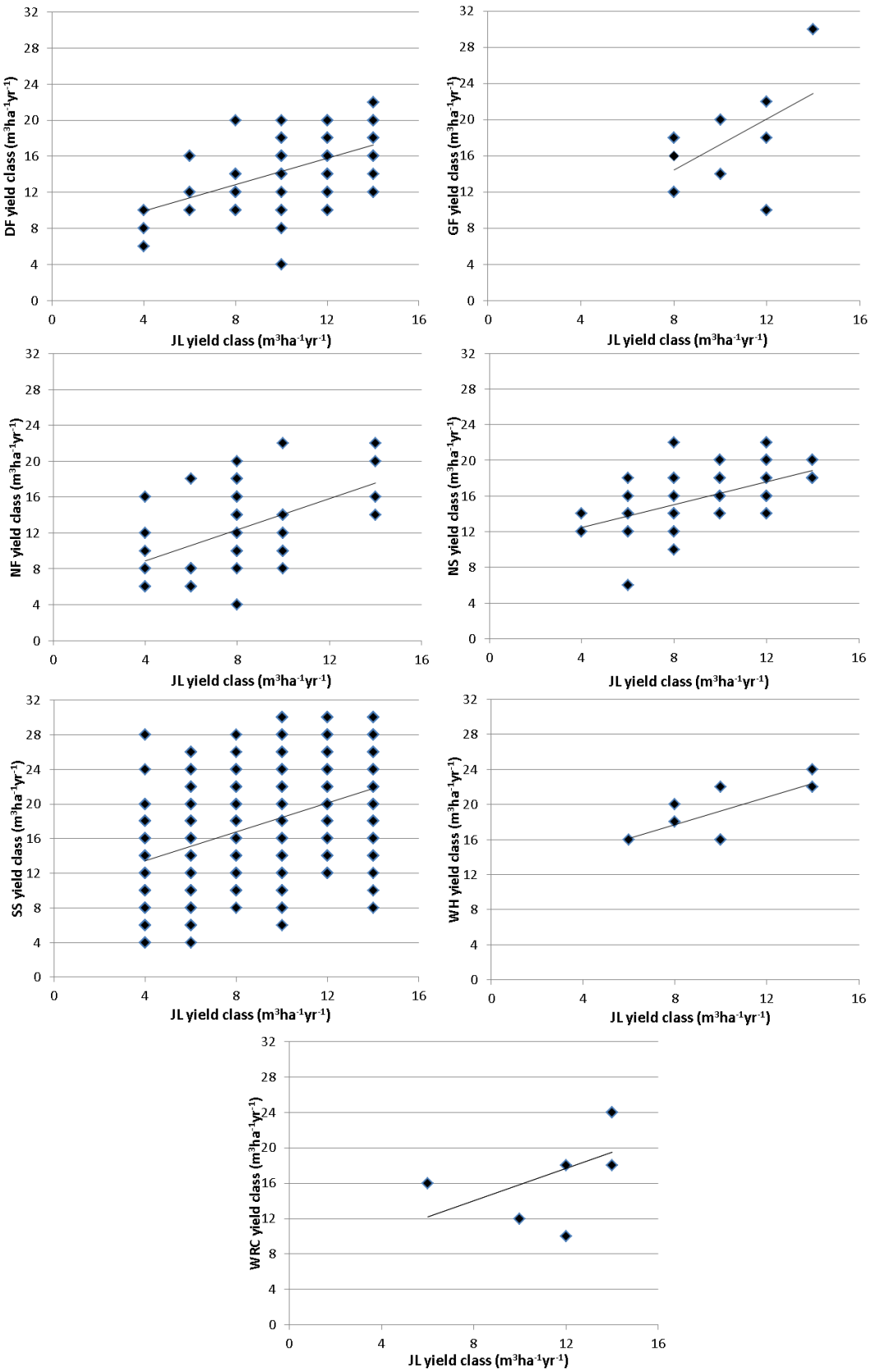

Figure 3: A comparison of productivity (Yield class: m^3 ha^{-1} yr^{-1}) of Japanese larch (JL) with that of seven alternative species growing the same site

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