

Indicator name			Version
NF8 Proportion and area of larch within <i>Phytophthora ramorum</i> Risk Zone 1			24/03/16
Indicator type:	Risk/opportunity	Impact	Action
	X		
SCCAP Theme	SCCAP Objective	CCRA risk/opportunity	
Climate Ready Natural Environment	N3: Sustain and enhance benefits, goods and services that natural environment provides	FO1 Risk of tree pests and diseases	

At a glance

- The *Phytophthora ramorum* (*Pr*) pathogen has spread rapidly in recent years and is causing significant damage and loss of Japanese larch (*Larix kaempferi*)
- With climate change projections indicating wetter, milder conditions on average there is an enhanced risk of damage to forests and biodiversity from this pathogen
- The indicator monitors the proportion and area of Scotland's larch within the highest risk area (Risk Zone 1) within Scotland's national forest estate

Latest Figure	Trend
<p>10341 ha of larch (Japanese, European and Hybrid) in the Forestry Commission Scotland's (FCS) National Forest Estate (NFE) lies within the current Risk Zone 1.</p> <p>This represents 41% of the total¹ larch stock within the whole of the FCS National Forest Estate</p> <p>For Japanese larch alone this figure is slightly higher at 45% (6386 ha).</p>	No observable trend.

Why is this indicator important?

¹ Total larch stock includes larch which are components of mixed stands

Larches are important timber species for Scotland and account for around 10% of conifer growing stock in Great Britain (35.6 million m³)². Scotland accounts for approximately half of this (17.1 million m³), with the Forestry Commission Scotland's National Forest Estate (NFE) holding around 28% of this volume (4.8 million m³) (Forestry Commission, 2014).

Phytophthora ramorum (*Pr*) is a fungus-like pathogen which is causing serious damage and mortality to trees and other plants. Although the disease can infect around 150 plant and tree species, in Britain, larches (Japanese, European and Hybrid) have been found to be particularly susceptible and can die within one to two seasons after infection.

Studies indicate that the UK is currently climatically a very suitable area for *Pr* establishment and survival, but it is not yet clear how climate change will impact upon its prevalence (Moffat et al., 2012). However, there is an east-west climatic divide, with increased risk in the moister west of the UK, with the lowest risk noted for Eastern Scotland (DEFRA, 2012). This climatic division is reflected in the three Forestry Commission Risk Zones (Figure 1) and are used to guide forestry management (Forestry Commission Scotland, 2015a):

- Zone 1 encompasses the general area of higher climatic risk where infection has been, or is considered most likely to be, found on larch.
- Zone 2 remaining areas of higher climatic risk, but where isolated or no infection has yet been found
- Zone 3 Areas of lower climatic risk where isolated or no larch infections has yet been found

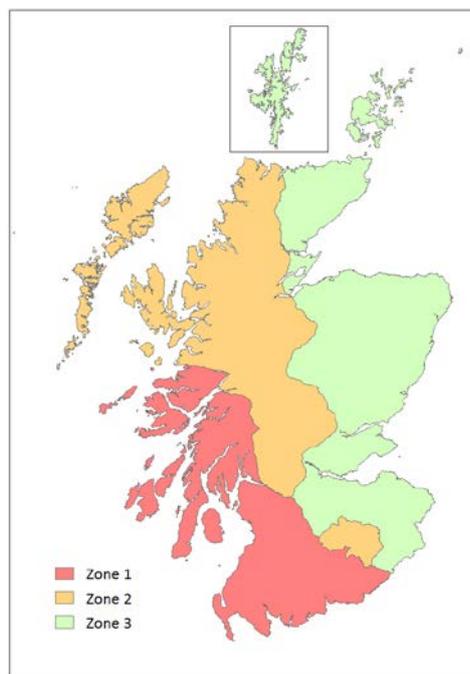


Figure 1 Map of *Phytophthora ramorum* Risk Zones

There are three species of larch in Scotland, the European (*Larix decidua*), the Japanese (*Larix kaempferi*) and the Hybrid (*Larix x eurolepis*). To date, it is Japanese larch which has shown by far the greatest susceptibility to the disease, as well as being the most prevalent species of the three (Figure 2). However data on all three species is presented here as it is known that both the European and

² Areas at 31 March 2012. These measurements are for 'overbark standing' which is a term used as a qualification when the volume of wood includes the bark.

Hybrid types are susceptible (Defra, 2014) and an outbreak was detected in European larch in Cornwall in 2011 (Forestry Commission, 2011a).

This indicator considers the risk to larch of infection based on both the absolute area and proportion of Scotland’s larch which lies within the Risk Zones. Areal data provides a metric of the amount of larch at high risk of exposure to the disease; whereas the proportional data enable the identification of any change in the potential threat to Scottish larch based forestry and timber products as a whole. Larch area data are based upon the primary, secondary and tertiary species data available in the Forestry Commission Scotland Sub-compartment Database 2014.

Related indicators:

NF10 Forest area infected by *Phytophthora ramorum*

NF11/NF12 Number of forest sites served with a Statutory Plant Health Notice (SPHN) for *Phytophthora ramorum* (Pr); Area of forest felled under Special Plant Health Notices (SPHNs) for *Phytophthora ramorum* (Pr)

What is happening now?

The latest data (2014) shows that 10341 ha of larch in the National Forest Estate (NFE) lies within the current Risk Zone 1 (Figure2; Table 1). This represents 41% of all larch stock within the estate. For Japanese larch alone this figure is slightly higher at 45% (6386 ha). Of the three species, only European larch is predominantly grown in the lower risk areas.

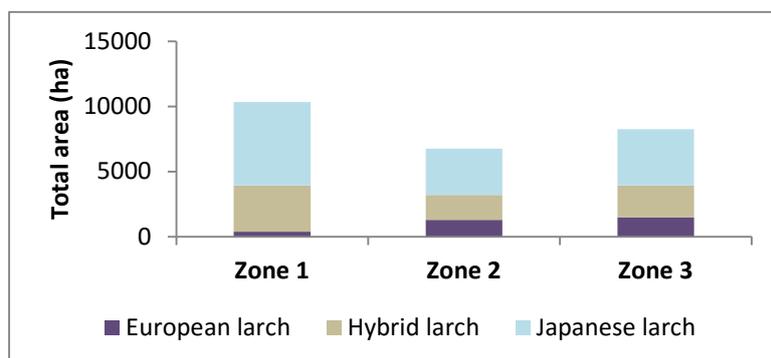


Figure 2 Total area (ha) of larch (in the National Forest Estate) in the *Phytophthora ramorum* Risk Zone. Data is based on the primary, secondary and tertiary areas contained in the Forestry Commission Scotland Sub-compartment Database 2014

Table 1 Proportion (%) of total area in Scotland covered by the three larch species in each *Phytophthora ramorum* Risk Zone (National Forest Estate 2014).

Proportion (%) of species total area in the National Forest Estate				
	Japanese larch	European larch	Hybrid larch	All larch
Zone 1	45	12	45	41
Zone 2	25	41	24	27
Zone 3	30	47	31	33

What has happened in the past?

Prior to 2009, *Phytophthora ramorum* was limited in its extent and impact in the UK. However during 2009 it was found infecting and killing large numbers of Japanese larch trees in South West England. In 2010 it was found on Japanese larches in Wales, Northern Ireland and the Republic of Ireland, and in Scotland at one site on the Craignish peninsula. During 2011 further infection sites were found on Mull and in Dumfries and Galloway (Forestry Commission Scotland, 2015b). As a consequence, Risk Zones were revised in 2011, expanding Zone 1 to include north west England and the area around the island of Mull (Forestry Commission, 2011b).

There was a significant expansion of outbreaks in Dumfries and Galloway in 2012 and 2013, following a wet autumn and mild winter in 2011/2012 then extremely wet and windy conditions in summer and autumn 2013 (Forestry Commission, 2011c). The current extent of Risk Zone 1 reflects this expansion and the zone now covers a significant portion of Scotland (Figure 1).

The indicator is currently not able to include an analysis of these former extents in conjunction with sub-compartment data.

What is projected to happen in the future?

It is now considered that the eradication of *Phytophthora ramorum* on larch in Scotland is 'no longer achievable and the aim now is to contain and slow down new outbreaks' (Forestry Commission, 2015c). In order to manage the spread of *Pr*, Statutory Plant Health Notices (SPHNs) are issued by the Forestry Commission in *Pr* affected areas and require the felling of infected trees and those in a surrounding buffer zone. It is recommended that the felling is followed by a fallow period to further minimise risk of reinfection. Infected timber can still be used commercially, but early felling reduces the potential yield from the stock. Whilst restocking can occur after this period, it is recommended that larch (of any type) is not planted (Forestry Commission, 2011c³). New legislation introduced in 2014, brought in a change in restrictions to a smaller area of Risk Zone 1. Within this 'Management Zone' (Figure 3), an area where *Pr* is particularly prevalent, SPHNs are no longer issued for infected trees as this had become an impracticable way to manage the disease. However, movement of infected timber can only occur freely within the Management Zone, with strict controls on whether and how timber is moved outside of the area (Forestry Commission Scotland, 2015d). It is intended that this approach will make procedures in the most infected areas simpler and less time consuming, and will help in the management of *Pr* not only here but also in the rest of Scotland.

³ NB This is an advice document targeted at forestry within England

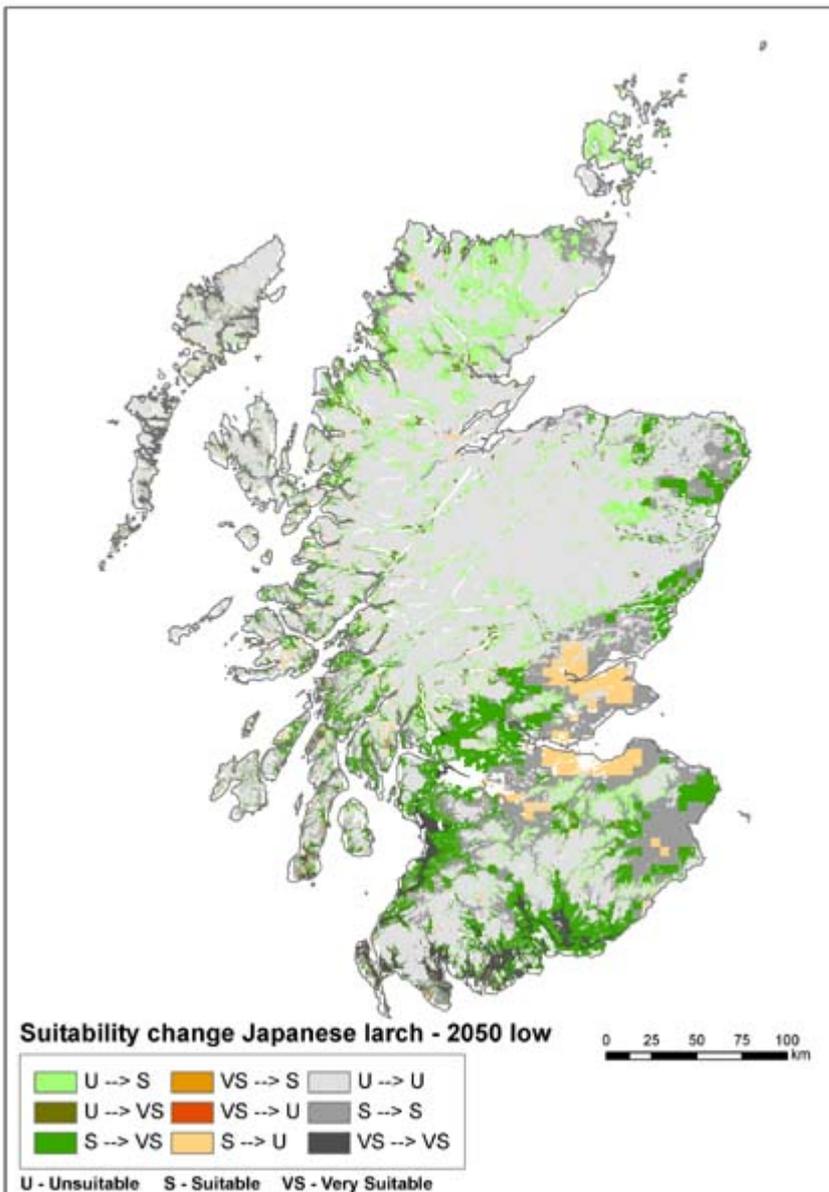


Figure 4 Projected change in suitability for Japanese larch in Scotland (2050) under a low emission scenario (Forest Research, 2015)

Patterns of change

In order to provide further detail to assess any change to the proportion of Scotland's larch within Risk Zone 1, this indicator will also be informed by analysis of the proportion of new planting (including restocking) of larch species within the NFE that occurs within each Zone (Figure 5) and monitor the changing levels of new planting of larch species within Risk Zone 1 (Figure 6).

Figure 6 shows a decline in the planting of the most susceptible species (Japanese larch) from a high of around 200 ha in 2011, but it is currently too early to assess whether the downward trend is a response to the increased risk from *Pr* as there was a peak in planting at the start of this period.

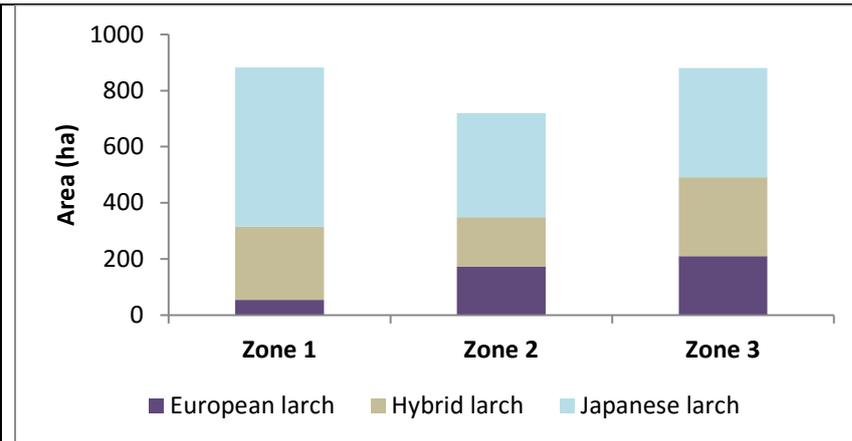


Figure 5 New planting of larch (2009-13) in the National Forest Estate

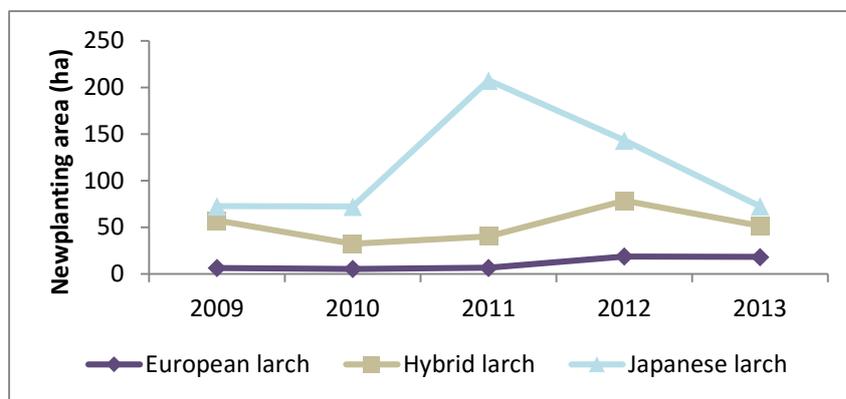


Figure 6 New planting of larch (2009-13) in *Phytophthora ramorum* Risk Zone 1 (NFE data only).

Interpretation of indicator trends

Whilst the prevalence of *Phytophthora ramorum* is showing an increasing trend (Forestry Commission, 2015b), the indicator analysis is currently unable to show whether there has been any change in the amount of NFE larch that is situated within the climatically vulnerable zone, nor how this has changed as a proportion of all NFE larch.

Silvicultural dynamics that may drive any change in these indicators include:

- a reduction in area of established larch in plantations as a result of sanitary felling when Pr has been identified;
- a reduction of restocking and new planting with larch, given the risk of Pr infection
- the diversification of species composition within the whole National Forest Estate- an overall strategy identified by FCS as critical to “help the Estate to adapt to climate change and become more resilient to pressure” (FCS, 2013)

Limitations

The indicator currently does not include an analysis of the former extents of Risk Zone 1 in conjunction with sub-compartment data.

The indicator currently covers the FCS National Forest Estate only, and shouldn't be used as a guide to private forestry sector behaviour.

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Moffat, A.J., Morison, J.I.L., Nicoll, B., & Bain, V. (2012) *Climate Change Risk Assessment for the Forestry Sector*. DEFRA, available online at: <http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=15747>

Moffat, A. (2015) Personal communication

Further information

Phytophthora ramorum:

<http://www.forestry.gov.uk/forestry/INF-D-5UBESN#isthereanything>

Acknowledgements

Advice regarding indicator development and review- Forest Research: Anna Brown and Andy Moffat; Forestry Commission Scotland: Colin Edwards.

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Appendix One: Indicator metadata and methodology

Table 1: Indicator metadata

	Metadata
Title of the indicator	Proportion and area of larch within <i>Phytophthora ramorum</i> Risk Zone 1
Indicator contact: Organisation or individual/s responsible for the indicator	Anna Moss (CXC, University of Dundee)
Indicator data source	Forestry Commission Scotland
Data link: URL for retrieving the indicator primary indicator data.	Sub-compartment database (SCDB): http://www.forestry.gov.uk/datadownload Risk Zone map supplied by FCS

Table 2: Indicator data

	Indicator data
Temporal coverage: Start and end dates, identifying any significant data gaps.	DNB sub-compartment data copied from FCS district servers Mar 2015. Pr Risk Zone map supplied April 2014
Frequency of updates: Planned or potential updates	Risk Zones updated in response to significant change in <i>Pr</i> risk SCDB updated throughout the year
Spatial coverage: Maximum area for which data is available	Scotland (NFE only)
Uncertainties: Uncertainty issues arising from e.g. data collection, aggregation of data, data gaps	Data covers FCS National Forest Estate only FC Metadata: The SCDB is constantly being edited. This caused problems when the spreadsheet data from 2006 and 2012 were used to derive a spatial dataset. Approximately 5% of records could not be linked over this period. In 2013 grid references were included for two thirds of the samples sent to FR. This has improved the ability to link samples to a location but it has highlighted the fact that most samples are collected very close to sub-compartment boundaries.

Spatial resolution: Scale/unit for which data is collected	FCS sub-compartments
Categorical resolution: Potential for disaggregation of data into categories	By larch species; by planting year
Data accessibility: Restrictions on usage, relevant terms & conditions	Any maps produced using this the FCS SCDB data should contain the following Forestry Commission acknowledgement: "Contains, or is based on, information supplied by the Forestry Commission. © Crown copyright and database right [Year] Ordnance Survey [100021242]".

Table 3 Contributing data sources

Contributing data sources
Data sets used to create the indicator data, the organisation responsible for them and any URLs which provide access to the data.
Sub-compartment database (SCDB): http://www.forestry.gov.uk/datadownload
Risk Zone map supplied by FCS

Table 4 Indicator methodology

Indicator methodology
The methodology used to create the indicator data
The indicator combines primary, secondary and tertiary larch component areas as contained within the sub-compartment database. A spatial join was conducted between the SCDB and the Risk Zone layer to associate <i>P.ramorum</i> risk zone field information to the SCDB. Area of primary, secondary and tertiary larch calculated as well as total larch area within each Risk Zone. Area of primary, secondary and tertiary larch calculated with planting date 2009 or later (NB first detected on larch in UK in 2009), within each Risk Zone.