

Indicator name			Version
NB36 Proportion/area of Caledonian pine woodland exposed to <i>Dothistroma</i> needle blight (DNB)			24/03/16
Indicator type:	Risk/opportunity	Impact	Action
	X		
SCCAP Theme	SCCAP Objective	CCRA risk/opportunity	
Natural Environment	N2: Support a healthy and diverse natural environment with capacity to adapt	BD4 Risks of diseases to biodiversity FO1a Forest extent affected by red band needle blight	

At a glance

- Caledonian pinewood is of principal importance for biodiversity conservation in Scotland.
- *Dothistroma* needle blight (DNB) has become the most significant disease affecting coniferous trees in the UK and is being increasingly detected in Scots pine stands.
- Climatic changes may optimise conditions for spore dispersal and infection.
- To limit the spread and potential impact of DNB, the DNB Action Plan stipulates that no pine is to be planted proximate to known uninfected pine crops or in Caledonian pinewood areas.

Latest Figure	Trend
9% (1614 ha) of total (core) Caledonian Pinewood (Forestry Commission Scotland National Forest Estate only)	Increasing

Why is this indicator important?

Largely confined to less-fertile soils, Caledonian pinewoods typically support a lower diversity of plants and animals than more fertile woodland types; however they do support species with very limited ranges. Iconic bird species such as the capercaillie and black grouse, as well as Britain's only endemic bird species, the Scottish crossbill are to be found in these woods, along with important ground flora, invertebrates and fungi. As a consequence, native pine woodlands are included in the Scottish Biodiversity List of habitats and species considered to be of principal importance for biodiversity conservation in Scotland and have been listed as an endangered habitat in the EC Habitats Directive (SNH, 2014).

It is estimated that post-glacial natural forests, at their maximum extent (approximately 4,000 years ago) covered approximately 1.5 million hectares (ha) of the Scottish Highlands. Pine trees were a critical, dominant component of these forests, often occurring in association with birch and other

deciduous species. Over the centuries large areas were cleared and regeneration prevented by both grazing as well as replanting with other species. Currently, less than 18,000 ha remain of core Caledonian pinewood, primarily made up of Scots pine along with a range of other trees, including junipers, birches, willows, rowan and aspens (Forestry Commission, 2014). For a detailed definition of woodland classified as Caledonian pinewood see Forestry Commission (1998).

Whilst remaining Caledonian pinewoods are now well protected from further clearance, these pinewood areas are still susceptible to other pressures such as the pests and pathogens that threaten other forestry areas.

The fungal disease *Dothistroma* needle blight (DNB), often referred to as 'Red Band Needle Blight', has become the most significant disease affecting coniferous trees in the UK. The fungus affects the needles of the infected tree, which eventually shed. As well as generally weakening the trees, it can also eventually lead to mortality. Whilst it was first recorded in the UK in the 1950s, it was not known in Scotland until 2002. Although non-native species such as Corsican and Lodgepole pine are more highly susceptible, it is being increasingly detected in Scots pine stands (Forestry Commission 2010).

Although it is currently not clear to what extent changing climate is contributing to the spread of DNB, it is thought that an increase in intense rainfall episodes coupled with warmer springs may have optimised conditions for spore dispersal and infection (Brown & Webber, 2008). Long distance dispersal of the fungus is believed to occur via moist wind and mists; therefore proximity to known locations of the disease is a vulnerability factor when assessing the risk to Scotland's native pine woodland. The indicator utilises the Caledonian Pinewood Inventory and annual DNB surveys of the Forestry Commission Scotland National Forest Estate (NFE) to calculate the proportion and area of woodland which lies within 1km of a known outbreak of DNB. Although the data covers the NFE only, changes in the abundance of DNB in these areas is likely to be indicative of DNB abundance across Caledonian woodland in Scotland as a whole.

Related indicators:

NF7 Proportion and area of pine woodland exposed to *Dothistroma* needle blight

NF9 Forest area and proportion of stands infected by *Dothistroma* needle blight

What is happening now?

The latest available figure shows that 9% (1614 ha) of all (core) Caledonian Pinewood lies within 1km of known DNB infection (Figure 1). 'Core' areas are those which already contain fragments of Caledonian pinewood, however it is also critical to examine the risk to 'regeneration zones' which typically extend 100 m from pinewood fragments and represent areas into which it could be expected that the woodland would naturally expand. 'Buffer zones' typically extend a further 500 m, and are intended to protect the pinewoods' genetic integrity (only native genotypes of Scots Pine should be planted in these areas) - exposure to DNB in these areas can provide advance warning of a potential threat to the core Caledonian pinewood. Figure 1 shows the extent of exposure to these critical areas also.

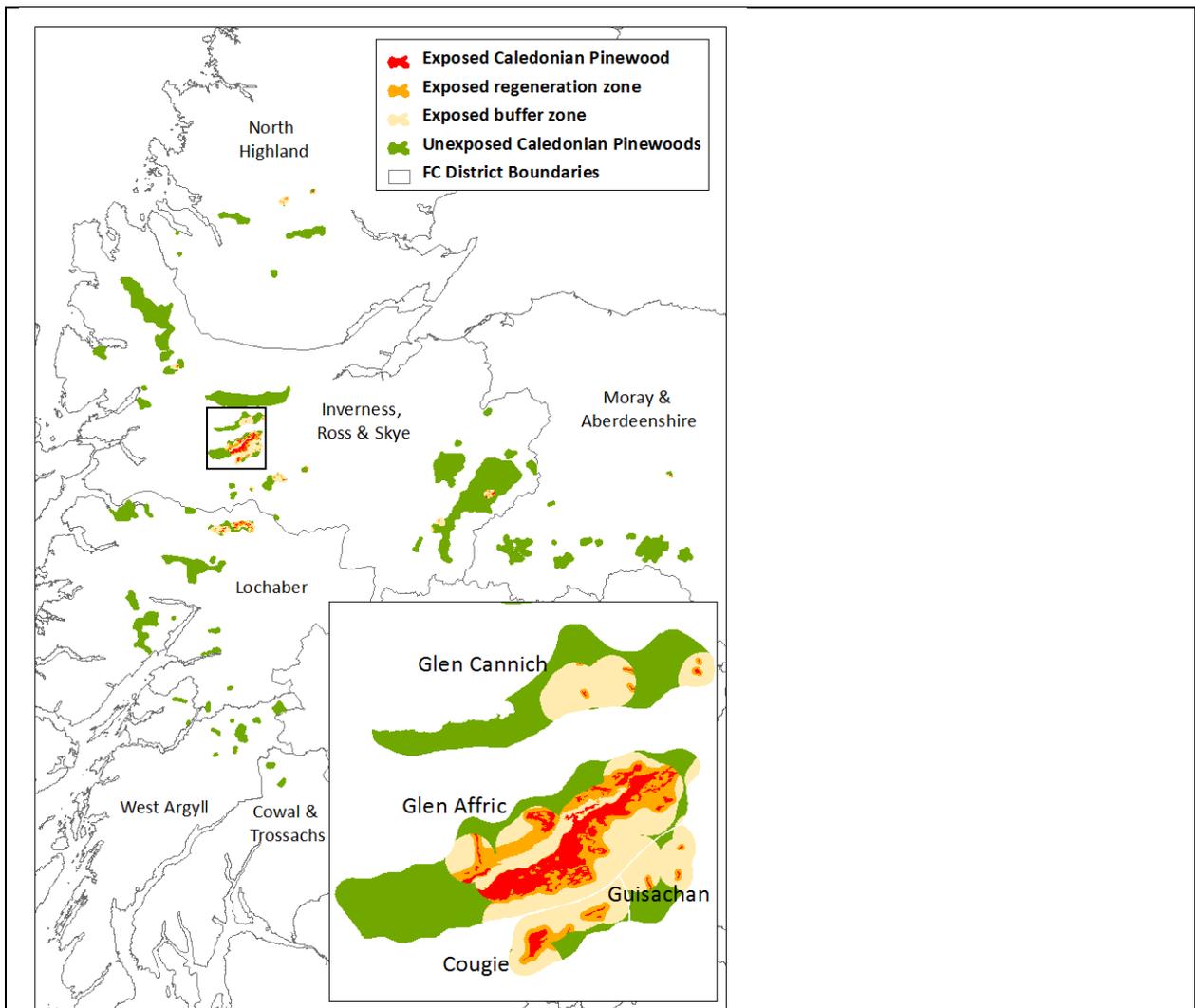


Figure 1 Exposure of Caledonian pinewood (core, regeneration zone and buffer zone) to DNB infection. Insert shows Glen Affric which has the greatest exposure of all Caledonian pinewoods. Exposure is based on proximity of 1km to detected infection (detection survey for the NFE only). For further detail of Caledonian Pinewood Inventory zones see Forestry Commission (1998).

Table 1 provides further detail of the exposure of individual pinewoods. This shows that approximately two-thirds (1086 ha) of this exposure is in one woodland area, Gen Affric (see Figure 1 insert).

Many Caledonian pinewood areas have until recently had a poor regeneration record, and there is concern that impacts of DNB on young trees could further threaten the age class structure, and hence continuity of these woodlands (Forestry Commission 2012). Mature pine in Caledonian pinewoods currently appear to be less susceptible to the disease but there is concern that this could change as there is considerable potential for genetic exchange due to the presence of two mating types, a high number of genotypes of *Dothistroma septosporum*, and the possible introduction of *D. pini*, which is responsible for DNB in North-Central America, Russia, Ukraine, France and Hungary (Forestry Commission Scotland 2013).

What has happened in the past?

The Forestry Commission DNB surveys have taken place annually since 2006. Using a comparison date of 2007 (accumulative with 2006) shows that only one Caledonian pinewood area was at that time within close proximity of known DNB infection- Glenmore (in the western area of the Inverness, Ross and Skye district) (see Table 1).

In 2011, the disease was found in Abernethy, an RSPB-owned native pinewood, bringing to the fore the threat to native pinewoods (Forestry Commission, 2012).

What is projected to happen in the future?

Analysis for the Climate Change Risk Assessment for the Forestry Sector (Moffat *et al*, 2012) indicated that potentially by the 2020s, between 12% to 25%¹ of pine forest area in the UK may be affected by DNB, with this figure rising to between 49% to 98%² in the 2050s and 100%³ in the 2080s.

As the DNB affected area increases, there will be an associated increase in the area of woodland at risk of infection due to proximity to infected trees. In addition to the currently exposed core area of Caledonian pinewood, a larger area of important, connected land is also already exposed: regeneration zone (2970 ha) and buffer zone (12345 ha), these areas are potentially critical to enable natural regeneration and expansion of the native woodland.

To help limit the spread and potential impact of DNB on Scottish forestry the FCS Dothistroma Needle Blight Action Plan, addresses risks to both biodiversity and commercially important forestry. As well as increasing awareness, research and detection effort, the action plan also covers preventative measures including buffer zones around Caledonian pinewoods (FCS, 2013). It is recommended that no pine species be planted within 600m of core native pinewood areas.

Patterns of change

Despite the earliest detection of DNB in the proximity of Glenmore, there has been a relatively small increase in the amount of exposed Caledonian pinewood in this area. By far the greatest change has been as a result of the detection of DNB infection in a wide area in and around Glen Affric (Fig. 1, Table 1)

Table 1 Exposure of core Caledonian pinewood to DNB infection. Exposure is based on proximity of 1km to detected infection (detection survey for the NFE only).

Caledonian Pinewood	Exposed area (ha)*	
	2007	2013
Glen Affric		1086
Glen Garry		237
Glenmore	84	113
Cougie		69
Glen Einig		27

¹ Estimated range of 11% to 98% for the p10 to p90 probability levels for the medium emissions scenario

² Estimated range of 11% to 100% for the p10 probability level low emissions scenario to the p90 probability level high emissions scenario

³ Estimated range of 12% to 100% for the p10 probability level low emissions scenario to the p90 probability level high emissions scenario

Dundreggan		18
Achnashellach		17
Strath Oykel		14
Glen Cannich		10
Glen Feshie		7
Guisachan		6
Breda		6
Achnaconeran		4
Achlain		1
Total	84	1614

* Area within 1km of known DNB infection on the NFE

Interpretation of indicator trends

There has been a rapid increase over the last 6-7 years in the potential exposure of Caledonian pinewood to DNB infection due to proximity to known outbreaks. Whilst this is partially a result of the increase in surveyed area/effort, it also reflects the rapid increase in infected areas across Scotland.

The current extent of all pine woodland in the NFE that is known to have been infected with DNB is 13722 ha, from 1661 infected sub-compartments (for more detail see associated impact indicator 'NF9 Forest extent affected by *Dothistroma* needle blight'). Whilst reasons for the increase in the disease are presently unclear, there is some evidence to suggest that increased rainfall in spring and summer coupled with a trend towards warmer springs is optimising conditions for spore dispersal and infection (Brown and Webber, 2008).

The increase in geographic extent and intensity of the disease across the whole of Britain is probably due to a combination of factors including an increase in favourable climatic conditions, as well as availability of suitable hosts, a genetically diverse fungal population, and movement of the pathogen through the plant trade.

There is still uncertainty regarding the susceptibility of Scots pine. Whilst it is still seen as being less susceptible than some other pine species, increasing levels of infection and mortality are being detected in commercial forestry. Even less is currently known regarding the susceptibility of native Caledonian pinewoods, though there is some evidence to suggest a greater susceptibility amongst younger trees (though this may be a reflection of the relative difficulty in sampling the crowns of mature trees) (Confor, 2013).

Limitations

- The buffer distance of 1km is a fairly arbitrary distance and may need to be revised (NB buffer distance for the planting of Scots pine near native Caledonian pine woodland is currently 600m).
- The buffer was applied to the boundary of all sub-compartments which have been positively surveyed for DNB, though it is possible that infection is limited to smaller areas of these compartments.
- Data covers the NFE only, however, changes in the abundance of DNB in this forestry is likely to be indicative of DNB abundance across Scotland.

- Positive survey results are applied to the whole sub-compartment, though detection may only have been at the edge of a sub-compartment.
- Positive status has been assumed to remain for a compartment for all subsequent years until a negative survey result occurs.

References

Brown, A. & Webber, J. (2008) *Red band needle blight of conifers in Britain*. Forestry Commission Research Note 2, Forestry Commission, Edinburgh.

Confor (2013) *A Douglas Consultancy for Confor – Chalara Ash Dieback and Dothistroma Needleblight*. Available online at:

http://www.confor.org.uk/Upload/Documents/30_ConforFINALChalaraDothistromareportFeb13.pdf

Forestry Commission (1998) *Caledonian Pinewood Inventory*. Available online at:

[http://www.forestry.gov.uk/pdf/Pinewood.pdf/\\$FILE/Pinewood.pdf](http://www.forestry.gov.uk/pdf/Pinewood.pdf/$FILE/Pinewood.pdf)

Forestry Commission (2010) *Red band needle blight in Scottish tree nurseries*. Available online at:

<http://www.forestry.gov.uk/>

Forestry Commission (2012). *Dothistroma Needle Blight GB Strategy*. Available online at:

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Forestry Commission Scotland (2013). *Dothistroma needle blight action plan– Scotland (2013/14)*.

Available online at: <http://www.forestry.gov.uk/>

Forestry Commission (2014) *Caledonian pinewood*. Available online at:

<http://www.forestry.gov.uk/forestry/pinewood>

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://www.defra.gov.uk/environment/climate/government/>

Scottish Natural Heritage (2014) *Caledonian Pinewood*. Available online at:

<http://www.snh.gov.uk/about-scotlands-nature/habitats-and-ecosystems/woodland/pinewoods/>

Further information

Dothistroma needle blight:

<http://www.forestry.gov.uk/forestry/infd-74jfk>

<http://scotland.forestry.gov.uk/images/corporate/pdf/dothistroma-needle-blight-action-plan-scotland.pdf>

Caledonian pinewood:

[http://www.forestry.gov.uk/pdf/Pinewood.pdf/\\$FILE/Pinewood.pdf](http://www.forestry.gov.uk/pdf/Pinewood.pdf/$FILE/Pinewood.pdf)

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Appendix One: Indicator metadata and methodology

Table 1: Indicator metadata

	Metadata
Title of the indicator	Proportion and area of Caledonian pine woodland exposed to Dothistroma needle blight (DNB)
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.	Data supplied directly 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 Dec 2013. Data available from 2006. The Caledonian Pinewood Inventory was created in 1999 and to prepare the CPI, the extent of native pinewoods named by Steven and Carlisle were investigated. The total pinewood area included within the Inventory is nearly 18,000 hectares and comprises 84 separate pinewoods of various sizes
Frequency of updates: Planned or potential updates	Annual DNB surveys of FCS National Forest Estate
Spatial coverage: Maximum area for which data is available	DNB survey: FCS National Forest Estate Caledonian pinewood: The total pinewood area included within the Inventory is nearly 18,000 hectares and comprises 84 separate pinewoods of various sizes
Uncertainties: Uncertainty issues arising from e.g. data collection, aggregation of data, data gaps	DNB data covers FCS National Forest Estate only
Spatial resolution: Scale/unit for which data is collected	DNB infection collected by FC National Forest Estate sub-compartments.

Categorical resolution: Potential for disaggregation of data into categories	
Data accessibility: Restrictions on usage, relevant terms & conditions	<p>Any product derived from or incorporating the Data must include the following statement: <i>“Contains, or is based on, information supplied by the Forestry Commission.”</i> If the Data is derived from or includes third party data supplied by the Forestry Commission additional third party statements may also be required</p> <p>For Scottish datasets: <i>“Contains, or is derived from, information supplied by Ordnance Survey. © Crown copyright and database right [insert year of supply]. All rights reserved. Ordnance Survey Licence number 100021242.”</i></p>

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.
<p>Forestry Commission Scotland: DNB sub-compartment survey data Caledonian Pinewood</p>

Table 4 Indicator methodology

Indicator methodology
The methodology used to create the indicator data
<ul style="list-style-type: none"> • DNB data copied from district servers (Dec 2013) and supplied by FCS. • 1km buffer created around all sub-compartments with DNB positive results for the relevant period (files cleaned to remove duplicates but leave positives for which no later survey showed subsequent negative result). • An intersect was then applied to select areas of Caledonian Pinewood which were coincident with the buffered exposure area.