

| Indicator name   |  |   | Version  |
|--|--|---|----------|
| NF7 Proportion and area of 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  | N3: Sustain and enhance the benefits, goods and services that the natural environment provides | FO1a Forest extent affected by <i>Dothistroma</i> needle blight (DNB) |          |

### At a glance

- *Dothistroma* needle blight (DNB) has become the most significant disease affecting coniferous trees in the UK.
- Climatic changes may optimise conditions for spore dispersal and infection.
- The disease is most prevalent in the major pine growing regions in the north of Scotland, but only a small proportion of forest blocks across Scotland remain free of exposure.

| Latest Figure   | Trend      |
|---|------------|
| 60.7% (55402 ha) of total (high forest) pine woodland are within 1km of known outbreak of DNB<br>(Forestry Commission Scotland National Forest Estate only, 2013) | Increasing |

### Why is this indicator important?

Forest pests and pathogens can cause extensive and catastrophic damage to productive forestry stocks. Affected woodlands may experience severe outbreaks that reduce productivity, timber quality and/or require a change in forest management. The majority of insect pests that currently affect UK forestry are likely to benefit from climate change as a result of increased activity and reduced winter mortality. If climatic conditions influence the success of a pest or pathogen establishing, breeding and spreading, then such climatic changes are also likely to influence their prevalence and severity (Moffat *et al* 2012). Other effects may be more indirect and result from increased susceptibility to infection due to damage or stress to the trees as a result of storms, drought or temperature extremes.

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 this continues, year on year, gradually the tree will weaken, significantly reducing timber yields. 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 and has now been identified in Corsican, Lodgepole and Scots pine stands. Although primarily a disease of pines, five spruce species, European larch and Douglas fir are also known to host the disease (Forestry Commission, 2010).

Although it is not yet 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 pine woodland.

The indicator utilises the annual DNB surveys of the Forestry Commission Scotland's National Forest Estate (NFE) to calculate the proportion and area of key pine species which lies within 1km of a known outbreak of DNB. Although the data covers the FCS estate only, changes in the abundance of DNB in these areas is likely to be indicative of DNB abundance across forestry in Scotland as a whole.

**Related indicators:**

NB36 Proportion and area of Caledonian pine woodland exposed to *Dothistroma* needle blight (DNB)

NB38 Area of Caledonian pinewood containing *Dothistroma* needle blight

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

**What is happening now?**

Currently, 54,402 ha of pinewood in the NFE lies within 1km of known DNB infection. This represents over 60% of the FCS pinewood. Table 1 identifies the area at risk, broken down into the three main pine species in Scotland.

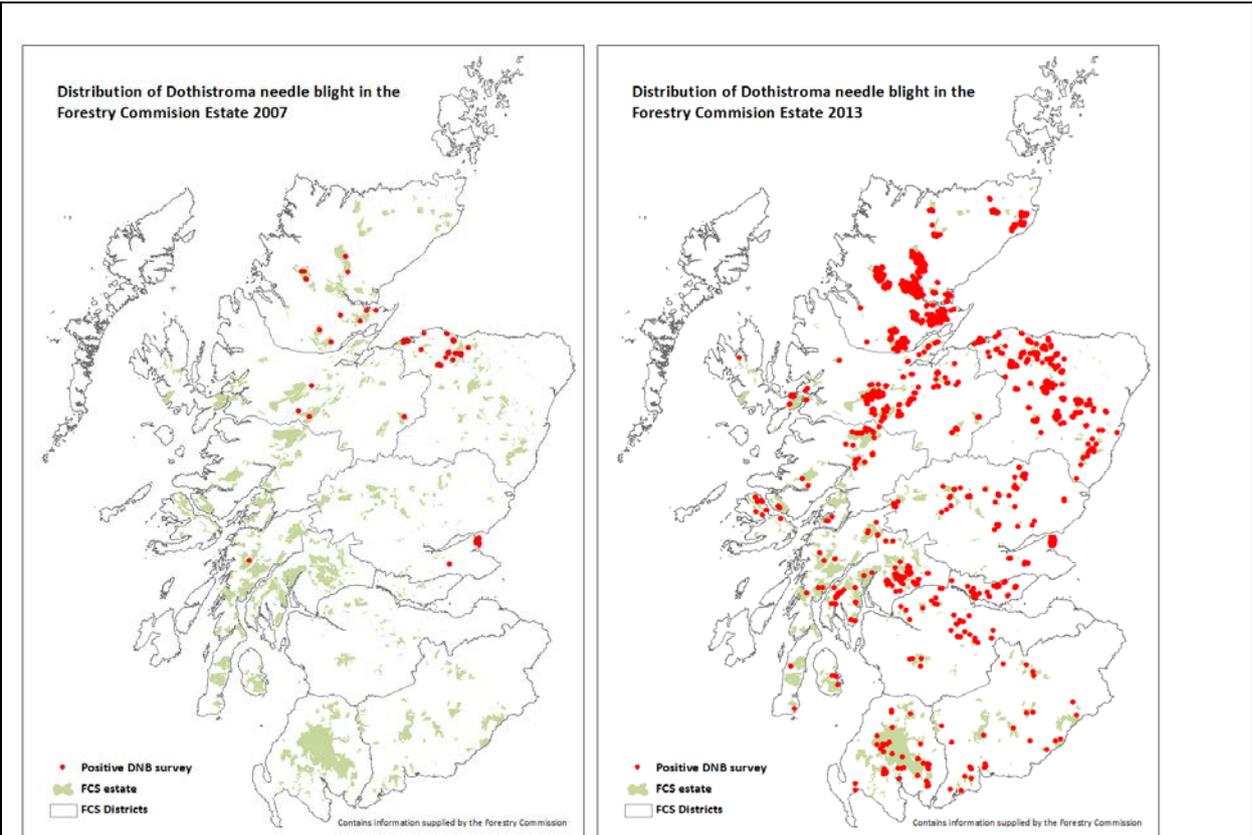
**Table 1** The area of major pine species in the Forestry Commission National Forest Estate within 1km of FC sub-compartments which have surveyed as positive for *Dothistroma* needle blight (2007-13).

| Species           | Exposed area (ha)* |              |
|-------------------|--------------------|--------------|
|                   | 2007               | 2013         |
| Lodgepole pine    | 3207               | 28357        |
| Scots pine        | 4023               | 24894        |
| Corsican pine     | 834                | 1089         |
| <b>Total pine</b> | <b>8066</b>        | <b>54402</b> |

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

**What has happened in the past?**

There has been a dramatic increase in identified infection since first detected in 2002, with the earliest available survey figures being from 2006 (see Figure 1 for comparison between 2007 and 2013). The proportion of pinewood at risk of infection has seen a corresponding rapid increase over this period (from 9% to 60% exposure- see Table 1), particularly in response to the appearance of infection in areas that were previously disease free.



**Figure 1** Known distribution of *Dothistroma* needle blight in Forestry Commission National Forest Estate forest blocks, 2007 and 2013

### 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%<sup>1</sup> of pine forest area in the UK may be affected by DNB, with this figure rising to between 49% to 98%<sup>2</sup> in the 2050s and 100%<sup>3</sup> 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.

Limiting the spread and potential impact of DNB on Scottish forestry is being addressed by the FCS *Dothistroma* Needle Blight Action Plan, which is reviewed annually. As well as increasing awareness, research and detection effort, the action plan also covers preventative measures (e.g. destruction of infected plants in nurseries, buffer zones around Caledonian pinewoods), and the prioritisation of felling infected stock (Forestry Commission Scotland, 2013a). Further planting of Corsican and Lodgepole pine is not recommended and has been suspended in many areas of the National Forest Estate, though in some areas, where it is necessary to avoid fertiliser or herbicide treatment, planting of Lodgepole pine of Alaskan origin in mixture with Sitka Spruce has continued (Griffin, 2014). In addition, it is recommended that no pine species be planted within 600m of core native pinewood areas (Forestry Commission, 2013b).

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

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

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

The main management option to minimise infection is to implement measures to prevent the planting of infected plants. If infection does occur then it is recommended that all plants from the same batch are destroyed. Management strategies to minimise the risk of infection of established plants includes ensuring that all stands are kept well thinned to facilitate air movement and to lower humidity in the canopy, and to maintain regular monitoring to ensure early detection of infection and prevent it spreading further.

### Patterns of change

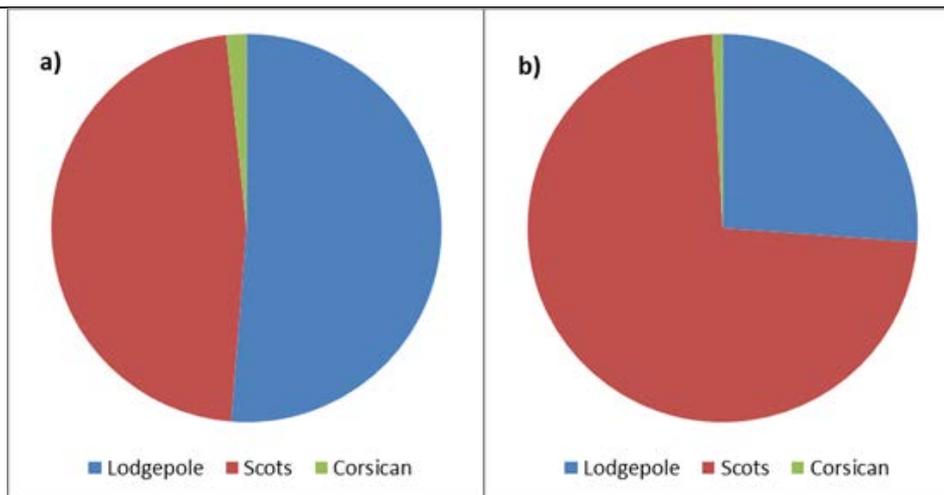
Whilst still most prevalent in the major pine growing regions in the north of Scotland, DNB has now been detected in all forest districts, with a very small proportion of forest blocks remaining free of any infection at all (see Figure 1).

### Interpretation of indicator trends

The current extent of 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 'Forest area and proportion of stands infected 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.

Currently figures are only available for the NFE, which accounts for approximately 40% of the total area of the three main pine species in Scotland (Forestry Commission, 2014). Although we might infer an equivalent level of risk to the private sector pinewood, it is interesting to note a proportionate difference in the dominance of Scots pine in comparison to the other two main pine species, in private ownership compared to the NFE (see Figure 2). However, this may change in future years in response to the moratorium on planting Corsican pine and some origins of Lodgepole pine (Forestry Commission Scotland, 2013a).



**Figure 2** Proportion of total pinewood area (Lodgepole, Scots and Corsican pine only), 2012 a) Forestry Commission Scotland National Forest Estate, b) Private ownership. (Forestry Commission, 2014)

### Limitations

- The buffer distance of 1 km is a fairly arbitrary distance and may need to be revised (NB buffer distance for the planting of Scot's 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.
- Positive survey results are applied to the whole sub-compartment, though detection may only have been at the edge of a sub-compartment.
- Data covers NFE only, however, figures are likely to be indicative of DNB abundance across Scotland.
- Positive status is assumed to remain for a compartment.

### References

- Brown, A. & Webber, J. (2008). *Red band needle blight of conifers in Great Britain*. Research Note FCRN002. Forestry Commission, Edinburgh
- Forestry Commission (2010). *Red band needle blight in Scottish tree nurseries*. Available online at: <http://www.forestry.gov.uk/>
- Forestry Commission (2014). *NFI Statistical Analysis Report: 50-year forecast of softwood timber availability*. Available online at: <http://www.forestry.gov.uk/>
- Forestry Commission Scotland (2013a). *Dothistroma needle blight action plan– Scotland (2013/14)*. Available online at: <http://www.forestry.gov.uk/>
- Forestry Commission (2013b) *Planting in native pinewoods: reducing risks from Dothistroma Needle Blight*. Available online at: <http://www.forestry.gov.uk/>
- Griffin, B. (2014) Personal correspondence

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/>

### Further information

*Dothistroma* needle blight:

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

*Dothistroma* needle blight Action

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

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Forestry Commission Scotland- Ben Griffin, Glenn Wilson and Colin Edwards for provision of FCS data and indicator review

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## Appendix One: Indicator metadata and methodology

**Table 1: Indicator metadata**

|  | Metadata   |
|--|--|
| <b>Title of the indicator</b>  | Proportion and area of pine woodland exposed to <i>Dothistroma</i> needle blight (DNB) |
| <b>Indicator contact:</b> Organisation or individual/s responsible for the indicator | Anna Moss (CXC, University of Dundee)  |
| <b>Indicator data source</b>   | Forestry Commission Scotland   |
| <b>Data link:</b> URL for retrieving the indicator primary indicator data.           | Data supplied directly by FCS  |

**Table 2: Indicator data**

|  | Indicator data   |
|--|--|
| <b>Temporal coverage:</b> Start and end dates, identifying any significant data gaps.                      | DNB sub-compartment data copied from FCS district servers Dec 2013. Data available from 2006.<br>FCS component visualisation data provided by FCS June 2013.   |
| <b>Frequency of updates:</b> Planned or potential updates  | Annual surveys   |
| <b>Spatial coverage:</b> Maximum area for which data is available  | FCS National Forest Estate   |
| <b>Uncertainties:</b> Uncertainty issues arising from e.g. data collection, aggregation of data, data gaps | Data covers FCS National Forest Estate only<br><br>FC Metadata: The SCDB is constantly being edited. This caused problems when the spreadsheet data from 2006 and 2012 was 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. |

|   |  |
|---|--|
| <b>Spatial resolution:</b> Scale/unit for which data is collected                   | DNB infection data collected by FC National Forest Estate sub-compartments. Species data collected by FC National Forest Estate sub-compartment component level.   |
| <b>Categorical resolution:</b> Potential for disaggregation of data into categories | Disaggregation by species.   |
| <b>Data accessibility:</b> Restrictions on usage, relevant terms & conditions       | 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. 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><br><a href="http://www.forestry.gov.uk/forestry/INFD-8G5BMY">http://www.forestry.gov.uk/forestry/INFD-8G5BMY</a> |

**Table 3 Contributing data sources**

|   |
|---|
| <b>Contributing data sources</b>  |
| Data sets used to create the indicator data, the organisation responsible for them and any URLs which provide access to the data. |
| <b>Forestry Commission Scotland:</b><br>DNB sub-compartment survey data<br>Component visualisation data                           |

**Table 4 Indicator methodology**

|  |
|--|
| <b>Indicator methodology</b>   |
| The methodology used to create the indicator data  |
| <ul style="list-style-type: none"> <li>• DNB data copied from district servers (Dec 2013) and supplied by FCS.</li> <li>• 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).</li> <li>• Polygons from high forest areas of Forestry Commission component visualisation database 2013 identified which overlapped this buffered area.</li> <li>• Statistics calculated for each species based on AREAA field</li> </ul> |

- Total pine area (high forest) data, for calculation of proportion, provided by Forest Research Scotland (July 2014).