Observatree
monitoring tree health

Field Identification Guide

Great spruce bark beetle

Photograph: Forestry Commission

Forest Research
Llywodraeth Cynulliad Cymru Welsh Assembly Government
Scottish Forestry Coilltearachd na h-Alba
fera
Forestry Commission
National Trust
WOODLAND TRUST
Animal & Plant Health Agency
Department for Environment Food & Rural Affairs

Great spruce bark beetle

The great spruce bark beetle (GSBB, *Dendroctonus micans*) causes damage to spruce trees (*Picea* spp.) by tunnelling into the bark of living trees. On hatching, the developing larvae excavate feeding tunnels and galleries in the inner living bark layers. When beetle galleries completely girdle the stem, the part of the infested tree above the wound will ultimately die. This may take several years of sustained attack, with large breeding populations accumulating before individual trees are killed, creating a risk of spread to nearby trees.

Species affected	The GSBB is able to infest all of the spruce species that are grown in the UK including Sitka spruce (*Picea sitchensis*), Norway spruce (*Picea abies*) and Oriental spruce (*Picea orientalis*). Although GSBB is also known to attack several other tree species such as various pines (*Pinus* spp.), firs (*Abies* spp.), Douglas fir (*Pseudotsuga menziesii*) and European larch (*Larix decidua*), this is not currently the case in the UK.
Signs and symptoms	Trees that are infested with GSBB can eventually display browning and dying foliage over some, or all, of the crown. Dead or dying trees, or trees with top death, typically occur alone, or in small groups, although the scale of damage can be considerably higher when other stress factors are present. Adult female beetles will tend to attack trees where sap pressure is lowest, commonly at a fork in the main stem or just below a branch node or even in callus material around a healing wound. Adult beetles also attack trees around areas of damage such as that caused during a thinning operation. Resin tubes are characteristic of GSBB infestations. These are produced as the female beetle bores into the bark to lay her eggs, causing the tree to respond by producing a strong resin flow in an attempt to protect itself. The resin tubes range in colour from creamy white to purple and brown. The presence of resin tubes accompanied by resin bleeds are useful indicators of GSBB infestation. When these signs and symptoms occur near the base of the tree they may indicate stem or root attack. Feeding galleries often occur beneath the bark in areas close to resin tubes. These can be located by listening for a hollow sound when tapping on the bark surface.

	Loose bark and areas where bark has fallen away to expose beetle galleries may also be present on the stems of heavily infested trees. Attack by woodpeckers can be a useful indicator of the presence of bark beetles and may contribute to the severity of these particular signs and symptoms. A characteristic indicator of GSBB below the bark and within the galleries is the presence of a mixture of insect faeces (frass) and bark packed into 'islands' creating a distinctive quilted appearance. This can only be seen if the outer bark is removed or has come away. All beetle stages, from egg to adult, might be present within the galleries. Eggs are laid within a small egg chamber excavated in the cambium of the tree. They are usually laid on one side of the chamber in groups of 50–80. The larvae are a creamy white colour with a brown head and become progressively larger as they develop through their five larval stages (instars) to maturity. Mature larvae are 4–6 mm long. The larvae feed communally in a brood chamber which increases in size as the larvae feed, eventually reaching sizes of 50–100 cm long by 10–20 cm wide. The larval group feeds upwards and outwards from its origin, causing extensive damage to the tree. As the larvae feed, they pack frass and diseased and dead larvae behind them to keep the feeding front clear. On maturity, the larvae move back into the islands of tightly packed frass and each one constructs a chamber in which to pupate. The pupae are frequently found in close proximity to each other and therefore give rise to aggregations of adults under the bark where they can remain for long periods, until conditions for emergence are suitable. The newly emerged adults are light yellow-brown. As they mature the colour darkens to brown and black and characteristic orange hairs become visible. Adult beetles are 6–8 mm long and 2.5–3.0 mm wide. The relatively large size of the beetle enables the females to withstand the resin flow produced when they bore into the bark of trees. Male beetles are rare; to overcome this 'sibling mating' occurs before the beetles emerge from the brood area. The adults emerge through round exit holes. A single exit hole (approximately

	2.0–3.5 mm wide) can be used by a number of adults. Powdery frass is also ejected through the emergence holes and can collect at the base of a tree. At temperatures of between 12°C and 20°C adult beetles move within and between trees by crawling, but when temperatures reach 22.5°C or greater they are able to fly. Populations of GSBB are controlled in the natural environment by the predatory beetle *Rhizophagus grandis*. These beetles require GSBB to complete their life cycle, and populations of *R. grandis* can only be maintained in the presence of GSBB infestation. So, if you see *R. grandis*, then the GSBB is also likely to be present nearby. The signs and symptoms of GSBB infestations on spruce trees are distinctive and are not easily mistaken for other pests and diseases. However, a number of factors other than GSBB can cause browning and dying tops, thinning, crown and branch dieback and discoloration of foliage. These include drought, waterlogging, root compaction and adverse cultural and environmental conditions as well as mammal damage. Various root and butt diseases such as honey fungus (*Armillaria* spp.), *Heterobasidion annosum* and *Hypholoma fasciculaire* can also cause damage and death of spruce trees. The eight-toothed spruce bark beetle (*Ips typographus*), the adults of which have a similar appearance to GSBB, also infest spruce trees. While their exit holes are similar to those of GSBB, their feeding galleries are very different. Although some adults have been intercepted in the UK, to our knowledge there are no breeding populations currently present. A number of other bark beetles can also infest spruce trees; however, they usually occur in trees that are dying or are already dead. Discoloration and defoliation of the needles in spruce trees can result from infection by *Chrysomyxa abietis* and *C. rhododendri* (Chrysomyxa needle rusts). The green spruce aphid (*Elatobium abietinum*) may also damage foliage and shoots of spruce trees, causing discoloration and defoliation of needles. Other insects such as adelgids, mites, weevils, woolly aphids and sawflys can also cause needle and shoot damage in spruce trees.

	Bud blight caused by the fungal pathogen *Gemmamyces piceae* can cause the crowns of spruce trees to look 'moth eaten' and disfigured with dead, crooked twigs and branches, and unflushed buds. In addition, a pathology complex (a combination of pathogens) can also cause top death in spruce trees similar to that caused by GSBB. However, the presence of round exit holes and the distinctive larval galleries under the bark as well as resin tubes are three key indicators which can differentiate GSBB infestations from other pests, diseases and environmental factors.
Timing	The beetle has a long life cycle, ranging from 12 to 18 months under British conditions. This results in extensive overlap of generations so that it is possible to find any life-cycle stage at any time of year.
Biosecurity	Potential pathways of introduction include the movement of untreated wood from infested sites where eggs, larvae or pupae may be hidden from view. The larvae may live concealed inside infested wood and remain undetected until after transportation. Material from infested sites should not be moved into areas where GSBB has not been found. Sawmills should deal with bark material from infested sites appropriately. Sawn timber with bark removed is not a risk for spreading GSBB. Beetles for identification should be packaged in a secure, robust plastic container labelled with date, location and contact details and sent to the Tree Health Diagnostic and Advisory Service (THDAS), Forest Research, Alice Holt Lodge, Farnham, GU10 4LH.
Reporting requirements	If you find this pest, please report it through Tree Alert (https://treealert.forestresearch.gov.uk). In Northern Ireland please report via the TreeCheck website (www.treecheck.net) or phone app, or by emailing planthealth@daera-ni.gov.uk For traded plants and any non-tree hosts please email planthealth.info@apha.gov.uk (England & Wales), or hort.marketing@gov.scot (Scotland).

Based on information available in December 2017.

Photograph: Forestry Commission

Damage to Sitka spruce caused by great spruce bark beetle infestation.

Photograph: Robert Strouts, Forestry Commission

Typical ‘top death’ damage on spruce trees caused by infestation by the great spruce bark beetle.

Photograph: Suzanne Sancisi-Frey, Forest Research

Resin bleeding on the main stem of a mature spruce tree infested with the great spruce bark beetle.

Signs and symptoms

Photograph: Suzanne Sancisi-Frey, Forest Research

Resin bleeding on the main stem of a mature spruce tree infested with the great spruce bark beetle. Note the woodpecker damage on the bark. This can be a good indicator of the presence of bark beetles.

Photograph: Martin Jukes, Forest Research

Profuse resin bleeding on the stem and exposed roots of a spruce tree infested by the great spruce bark beetle.

Photograph: Suzanne Sancisi-Frey, Forest Research

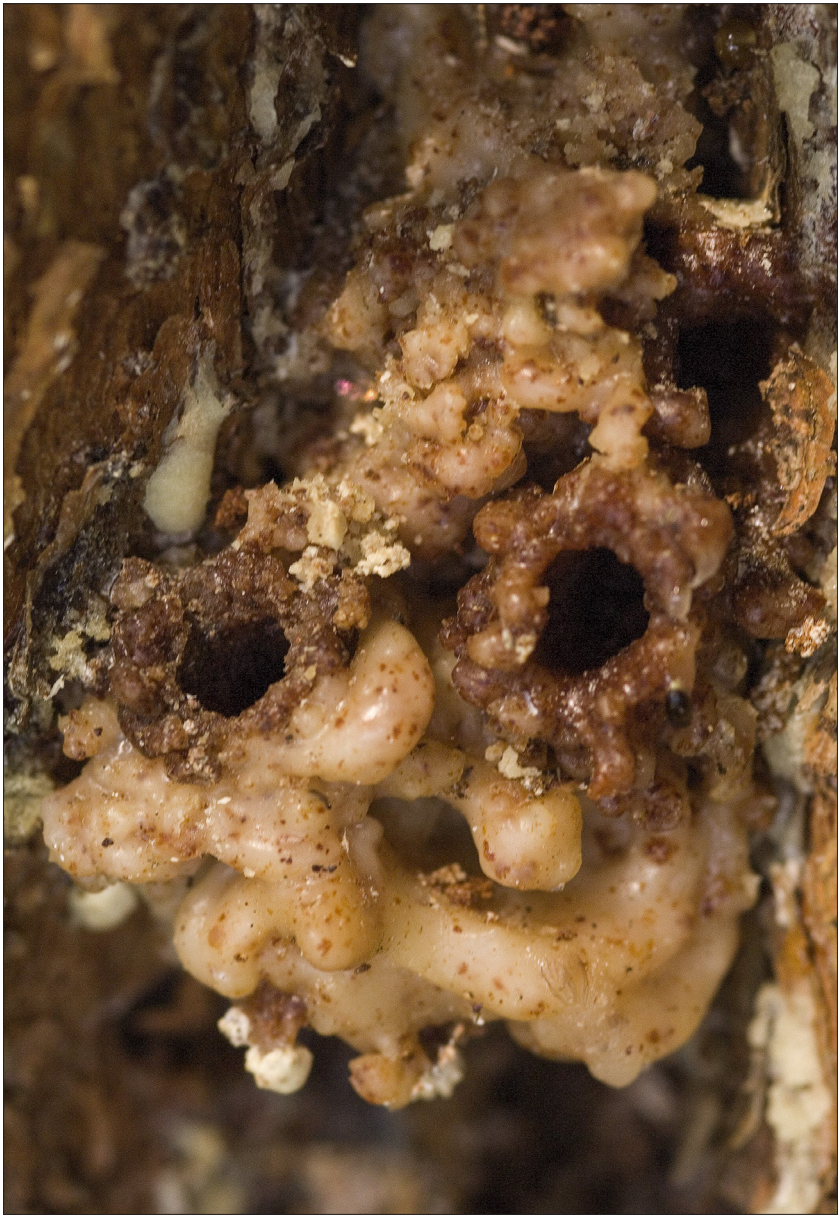
Resin bleeding and frass at the base of a tree infested with the great spruce bark beetle.

Photograph: Forestry Commission

Heavy resin bleeding on the stem of a tree infested with the great spruce bark beetle.

Photograph: Suzanne Sancisi-Frey, Forest Research

Fresh resin dripping from a branch infested with the great spruce bark beetle.



Photograph: Isobel Cameron, Forestry Commission

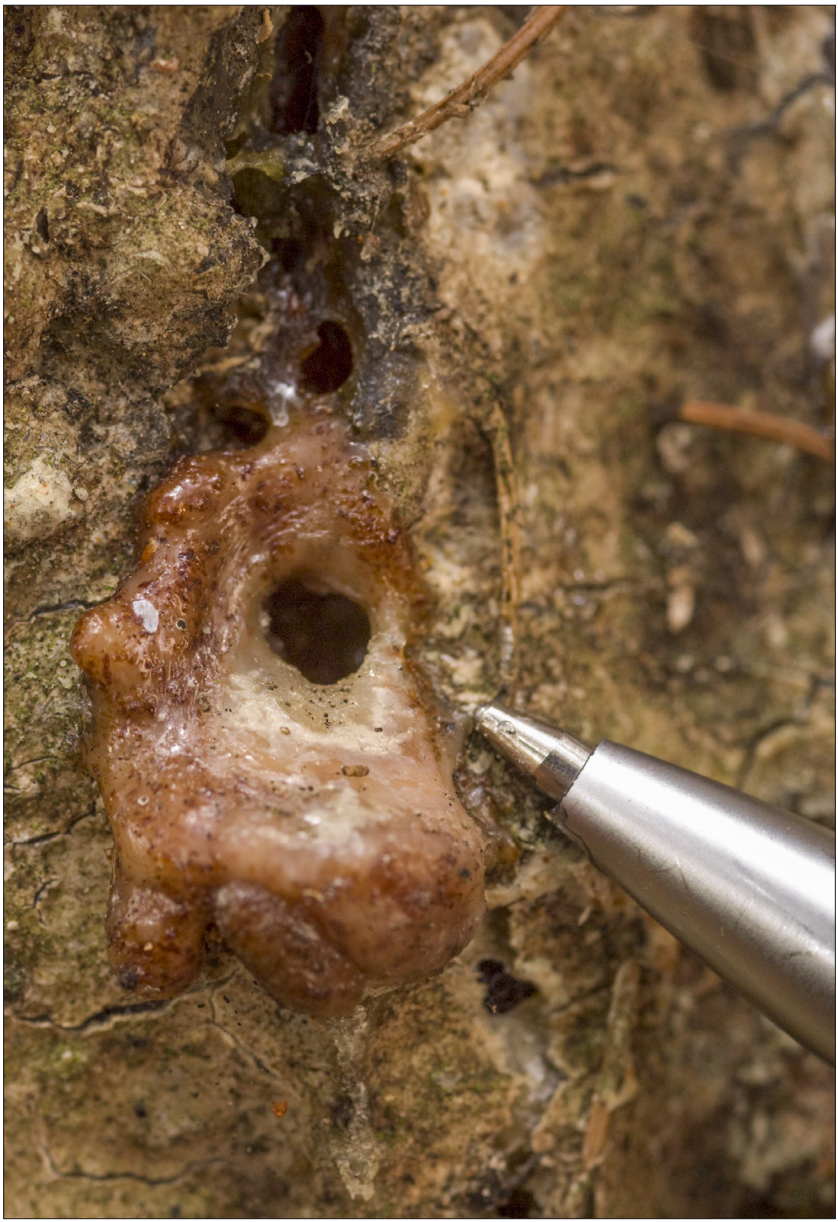
Resin tubes are characteristic of infestations by the great spruce bark beetle and are produced when a female GSBB attempts to enter a tree.

Photograph: Suzanne Sancisi-Frey, Forest Research

An old resin tube on the stem of a tree infested with the great spruce bark beetle.

Photograph: Helen Carter, Forestry Commission England Tree Health Team

Fresh purple, brown and cream resin tubes produced by female great spruce bark beetles.



Photograph: Isobel Cameron, Forestry Commission

A resin tube produced by a female great spruce bark beetle on the stem of an infested tree.

Photograph: Isobel Cameron, Forestry Commission

Resin tubes and granular resin at the base of a tree infested with great spruce bark beetles.

Photograph: Martin Jukes, Forest Research

Adult great spruce bark beetle with eggs in a brood chamber.

Photograph: Isobel Cameron, Forestry Commission

Mature great spruce bark beetle larvae (4–6 mm long).

Photograph: Martin Jukes, Forest Research

Larvae of the great spruce bark beetle feeding communally within a brood chamber in an infested spruce tree.

Photograph: Martin Jukes, Forest Research

The larvae of the great spruce bark beetle feeding within the bark of an infested tree.

Photograph: Forestry Commission

Frass is packed by feeding larvae into ‘islands’ which collectively have a quilted appearance.

Photograph: Martin Jukes, Forest Research

Young adult great spruce bark beetle.

Photograph: Jacques Regad, Département de la Santé des Forêts, Bugwood.org

A group of mature adult great spruce bark beetles and an exit hole.

Photograph: Forestry Commission

The specific predator (biological control agent) *Rhizophagus grandis* controls populations of the great spruce bark beetle in the natural environment.

Photograph: Forestry Commission

Larvae of the specific predator *Rhizophagus grandis* feeding on a great spruce bark beetle larva.

Photograph: Forestry Commission

Damage to young Sitka spruce caused by the green spruce aphid (*Elatobium abietinum*).

Photograph: Forestry Commission

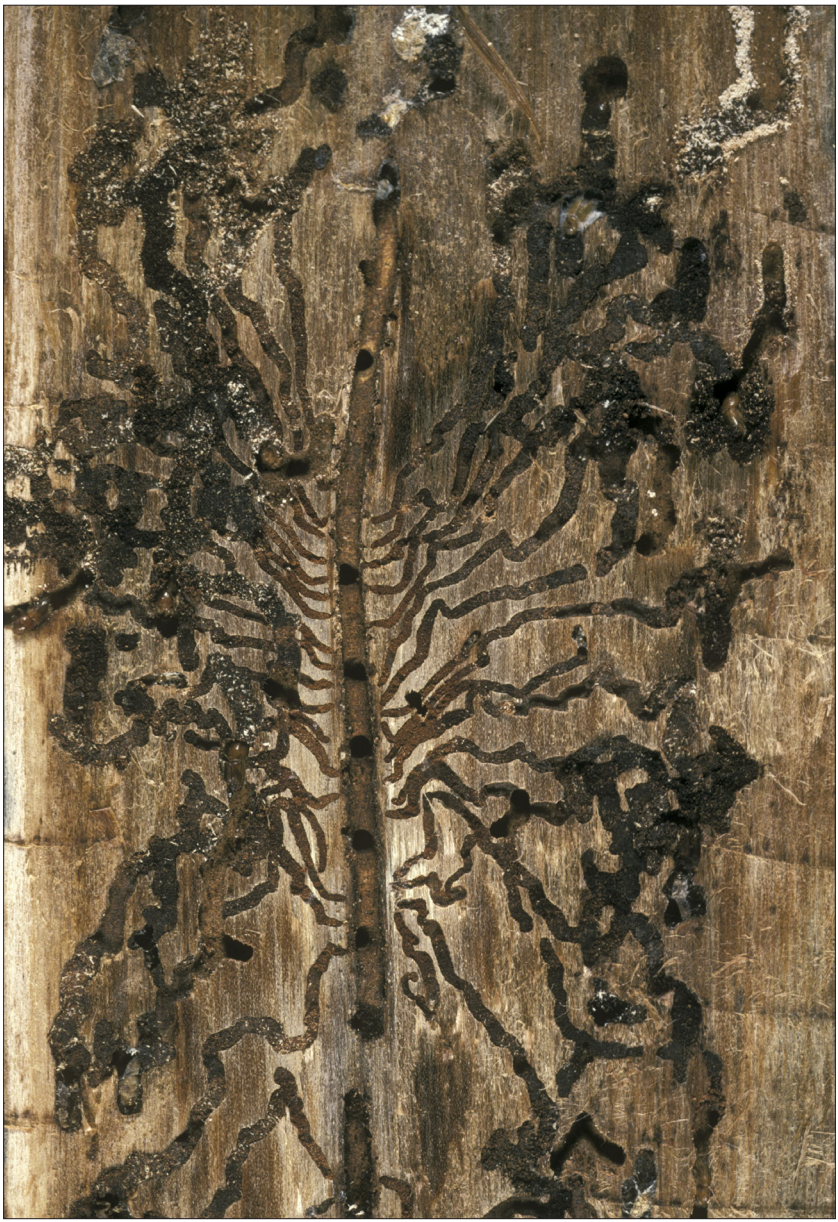
Damage to young Sitka spruce shoots caused by the green spruce aphid.

Photograph: Thelma Wood, Forest Research

Adelgid galls caused by *Adelgis* spp. on spruce.

Photograph: George Gate, Forest Research

Adult eight-toothed spruce bark beetle (*Ips typographus*).



Photograph: George Gate, Forest Research

Ips typographus. Larger eight-toothed spruce bark beetle galleries in Norway spruce bark.

Photograph: Barry Lambsdown, Forestry Commission

Needle rust (*Chrysomyxa abietis*) showing on underside of Norway spruce needles.

Photograph: Thelma Wood, Forest Research

Chrysomyxa rhododendri. Fungus on current needles of Norway spruce. Yellowing of attacked needles and production of spermogonia and aecidia.

Photograph: Barry Lambsdown, Forestry Commission

Resin bleeding at the butt of an attacked Serbian spruce (*Picea omorika*) tree with a section of the bark removed to show typical mycelium of *Armillaria*. Indications are of severe root infection.

Photograph: J S Murray, Forestry Commission

Pathology complex – top dying of Serbian spruce.

Photograph: George Gate, Forest Research

Gilpinia hercyniae 6th instar larva and cocoon of spruce sawfly.

Published by Forest Research as part of the Observatree project.

Observatree aims to create a tree-health early-warning system using citizen science.

Observatree is a partnership project led by Forest Research, the research agency of the Forestry Commission. Project partners are the Animal & Plant Health Agency (APHA), Department for Environment, Food & Rural Affairs (Defra), Fera Science Ltd, the Forestry Commission, the National Trust, Scottish Forestry, the Welsh Government and the Woodland Trust. Supporting the project is Natural Resources Wales. The first four years of this project was 50% funded by the EU's LIFE programme.

Acknowledgements:

Dr Suzanne Sancisi-Frey, Forest Research, for compiling this guide based on a review of current literature and with technical contributions from experts across the Observatree partnership.

All those who have given permission for images to be used within the guide.

The Communications Team, Forest Research, for the original design and creation of the guide.

This booklet forms part of a set that supports Observatree volunteers when out looking for priority pests and diseases. It supplements face-to-face training and is not intended as a full or detailed description. It will also be useful for others who have some knowledge of the particular pest or disease and understand how to look for these. Further information is available online from the websites listed below:

www.observatree.org.uk

www.forestresearch.gov.uk/tools_and_resources/fthr/pest-and-disease-resources/

www.gov.uk/guidance/prevent-the-introduction-and-spread-of-tree-pests-and-diseases

https://planthealthportal.defra.gov.uk

FR(GB-SSF)/FG760/FEB18-17/0042