Observatree
monitoring tree health

Field Identification Guide

Asian and citrus longhorn beetles

Photograph: Melody Keena, USDA Forest Service, Bugwood.org

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Asian and citrus longhorn beetles

The Asian longhorn beetle (ALB, *Anoplophora glabripennis*) and the citrus longhorn beetle (CLB, *Anoplophora chinensis*) are native to eastern Asia, and pose a serious threat to a range of our native, naturalised and introduced broadleaved trees, including many species grown as ornamentals. The climate in much of the UK is conducive to establishment and spread of these pests whose main pathway of entry is in wood packaging materials (ALB) and via the live plant trade (CLB). The larvae of the beetles feed and tunnel under the bark in the wood of both healthy and stressed trees causing extensive damage and ultimately mortality to the infested hosts after several successive years of attack.

Species affected	The most significant tree hosts for ALB are: maple and sycamore (*Acer* spp.), horse chestnut (*Aesculus hippocastanum*), *Albizia* spp., alder (*Alnus* spp.), birch (*Betula* spp.), katsura tree (*Cercidiphyllum japonicum*), hazel (*Corylus* spp.), beech (*Fagus* spp.), plane (*Platanus* spp.), poplar (*Populus* spp.), apple and pear (*Malus* spp. and *Pyrus* spp.), false acacia/black locust (*Robinia pseudoacacia*), willow and sallow (*Salix* spp.), pagoda (*Sophora* spp.), mountain ash/ rowan and whitebeam (*Sorbus* spp.), North American oak such as the pin oak (*Quercus palustris*) and red oak (*Quercus rubra*) and elm (*Ulmus* spp.). Hornbeam (*Carpinus* spp.), ash (*Fraxinus* spp.), and cherry, plum (and other *Prunus* spp.) are only very occasional hosts for ALB. The most significant tree hosts for CLB are: maple, horse chestnut, alder, birch, hornbeam, *Citrus* spp., hazel, beech, crepe myrtle (*Lagerstroemia* spp.), apple, plane, poplar, cherry, apricot, peach (and other *Prunus* spp.), pear, willow and elm.
Signs and symptoms	Asian and citrus longhorn beetles spend most of their life, as larvae inside the trunk, branch or root of the tree, and hence there can be little or no external sign of their presence to anyone inspecting a host tree until the infestation becomes very heavy. This means that in most cases, the beetles have already become established by the time they are discovered and have probably spread to new hosts. Eggs (approximately 5.0 x 1.7 mm), which are initially a creamy white colour, but turn yellowish-brown prior to hatching, are smooth, elongate and taper at both ends. These are laid in cavities in the bark called egg pits, which are

	excavated by the female beetles. They are often close to the insertion points of branches into the stem. Sap may be visible emerging from the egg pits, which is produced by the tree in response to the attack on its bark. On hatching, larvae are 5 mm long, growing to a size of between 30 and 60 mm by the time they reach maturity. They are creamy white (sometimes with a brown pattern on the prothorax) and legless. The larvae tunnel and feed under the bark within the woody tissue of the tree. These tunnels, which can be up to 25–30 cm long and over 10 mm in diameter, disrupt the movement of water and nutrients around the tree. This results in the foliage of the infested trees becoming discoloured (yellow or red), wilting and falling prematurely and this is usually one of the first and most noticeable symptoms to occur. Branches also start to die back and eventually the trees can die as a result of ALB and/or CLB infestation. The symptoms in the crown typically start at the top of the tree and progress downwards as the infestation develops. The larval galleries cannot be seen unless the bark overlying them is removed or falls off. Larval activity can also leave trees susceptible to diseases and wind damage. As the larvae tunnel and feed, they generate frass (sawdust-like waste material) which may be ejected from the tunnels and collect in piles at the base of the trunk, or in the forks of branches; sometimes it may be seen actually extruding from exit holes left by the emerging adults. Bark fissures/vertical splits/cracks of 50–100 mm in length can occur in the bark that overlies larval galleries in branches and the main stem of infested trees. The splits are caused by the growth of callus (healing) tissue produced by the tree in response to larval activity. Once the larvae have fully matured, they create a pupal chamber in the wood quite near to the surface of the stem, branch or root, in which they pupate. The pupae are also creamy white, 27–38 mm long and have elytra (modified, hardened forewings) that cover the membranous hind wings that are used for flight. Following pupation, the adult beetles chew their way through the bark to the outside of the tree, leaving behind almost perfectly round exit holes of

	approximately 10 mm in diameter. The exit holes of ALB occur on the branches and mid to upper regions of the main stem, whereas those of CLB occur towards the base of the stem and on exposed parts of the main roots. After the discovery of exit holes, it is important to survey the surrounding areas to determine whether the beetles have spread to other host trees nearby. Although the beetles tend to stay close to the site of original infestation in the early stages of an outbreak, they can fly more than 2 km. Following emergence, the adult beetles feed on foliage and soft bark before mating. Adults of ALB and CLB are very similar in appearance; they are 21–37 mm long and glossy black with variable white/pale yellow markings. Their antennae are segmented, longer than their bodies and black with white/light blue bands. There are subtle differences between the adult ALB and CLB. For example, the front fifths of the CLB's elytra are granulated (so they appear slightly roughened and less shiny) while the ALB's elytra appear smooth and shiny throughout. Damage caused by the adults feeding on the foliage may also be visible on infested host trees. The beetles often de-vein the leaves, leaving the majority of the laminae in place. They also strip areas of young bark from shoots as they feed, leaving a distinctive pattern of damage. A number of other abiotic and biotic factors can cause canopy thinning, crown and branch dieback and discoloration of foliage such as drought, waterlogging, adverse cultural and environmental conditions and various diseases and other insect pests. Symptoms of root and butt rots such as late flushing, thinning foliage and decline leading to eventual death are also similar to those caused by ALB and CLB infestation. However, the presence of the round exit holes and larval galleries under the bark are two key indicators of ALB and CLB which can differentiate them from signs and symptoms of other factors. Larvae of native moths such as the goat moth (*Cossus cossus*) and the leopard moth (*Zeuzera pyrina*) can cause damage that could be mistaken for that of ALB and/or CLB. Like CLB, the goat moth tends to infest lower parts of the tree, whereas leopard moth infestations tend to occur in upper

	regions of the tree, in a similar way to ALB. But unlike ALB they preferentially attack small-diameter branches (<10 cm diameter). There are other differences that distinguish these two native moths from ALB/CLB. For example, the leopard moth larva has dark coloured spots, and the goat moth larva is a brown/red colour, whereas ALB and CLB larvae are a creamy colour with no spots. Also the larval/pupal cavities in the wood excavated by the native moth larvae tend to have a blackened or sooty appearance. The exit holes of the moths are also different in shape and size to those of ALB and CLB. Even the frass produced by the native moth larvae is different to that of ALB and CLB, in that it takes the form of pellets rather than sawdust-like material. Larvae of the native hornet moth (*Sesia apiformis*) and lunar hornet moth (*Sesia bembeciformis*) are a creamy white colour and tunnel in the roots and lower trunk of host trees and so could be mistaken for CLB. In addition, they share some host tree species with CLB such as poplar, sallows and willows. The large poplar beetle (*Saperda carcharias*) also causes similar damage to ALB/CLB and, in addition, its larvae look very similar to those of ALB/CLB. Furthermore, the exit holes produced by the large poplar beetles are round like those of ALB/CLB. However, the adults bear little resemblance to ALB/CLB. The goat and leopard moths and the large poplar beetle may be found in some of the same tree hosts as ALB and CLB, such as aspen (*Populus tremula*), other poplar, beech, maple, ash, elm, oak, alder, birch, willow and sallow, apple and other fruit trees.
Timing	The life cycle of ALB and CLB in the UK is thought to be two to three years with beetles emerging during the summer (between June and September) to mate and lay eggs, after which they die (they are likely to be most active in the UK between late July and early September). CLB adult beetles have most commonly been found emerging from imported plants in the UK in July and August, with occasional findings as early as May and as late as October. Foliage discoloration, wilting, shoot dieback and premature

	leaf fall are only obvious during the growing season when leaves are present on the trees. Feeding damage on the leaves will only be visible during the growing season following emergence of the adults. Areas of stripped bark will also be visible during the summer but along with other bark stem and branch damage such as branch dieback, exit holes, egg pits and cracked bark, these will still be obvious during the winter months. Frass is produced throughout the year, so may be seen at any time.
Biosecurity	Untreated wood packaging is a known pathway for ALB. Most of the CLB that have been intercepted in the UK have been associated with Japanese maple trees imported from China. The beetles are not harmful to humans, although they should be handled with caution because they can nip the skin. The nip is unlikely to penetrate the skin or draw blood. It is extremely important that no wood or foliage from host trees is removed from a potentially infested site. Vehicles should also be checked for live beetles. If any host tree material is intentionally removed from a site (e.g. for sampling), then it should first be triple-wrapped in strong and robust plastic bags, or double wrapped in bags which then must be secured within a plastic container. For beetles, please package in a secure, robust plastic container labelled with date, location and contact details and send to the Tree Health Diagnostic and Advisory Service (THDAS), Forest Research, Alice Holt Lodge, Farnham GU10 4LH.
Reporting requirements	If you find these pests, 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 March 2018.

Photograph: Dennis Haugen, USDA Forest Service, Bugwood.org

Dieback in the crown and discoloration of foliage in a Norway maple (*Acer platanoides*) tree infested with the Asian longhorn beetle (*Anoplophora glabripennis*).

Photograph: Dennis Haugen, USDA Forest Service, Bugwood.org

Branch dieback and damage in the crown of a Norway maple tree infested with the Asian longhorn beetle.

Photograph: Pennsylvania Department of Conservation and Natural Resources - Forestry, Bugwood.org

Damage to the stems of a tree infested with the Asian longhorn beetle. Note that the holes have been further attacked by birds trying to extract larvae from the bark.

Photograph: Dennis Haugen, USDA Forest Service, Bugwood.org

Circular exit holes (10 mm diameter) on the branch of a tree infested with the Asian longhorn beetle.

Photograph: Nigel Straw, Forest Research

Numerous exit holes in a felled tree heavily infested with the Asian longhorn beetle.

Photograph: Pennsylvania Department of Conservation and Natural Resources - Forestry, Bugwood.org

Circular exit hole on the stem of a tree infested with the Asian longhorn beetle.

Photograph: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

Circular exit holes on the stem of a tree infested with the Asian longhorn beetle.

Photograph: Art Wagner, USDA - APHIS, Bugwood.org

Circular exit hole (approximately 10 mm diameter) on the root flare of a tree infested with the citrus longhorn beetle (*Anoplophora chinensis*).

Photograph: Art Wagner, USDA - APHIS, Bugwood.org

Pupal chambers in the root collar of a tree infested with the citrus longhorn beetle.

Photograph: National Plant Protection Organization, the Netherlands, Bugwood.org

Citrus longhorn beetle exit hole on a bonsai tree.

Photograph: Kenneth R. Law, USDA APHIS PPQ, Bugwood.org

Frass material produced by the activity of Asian longhorn beetle larvae extruding from an exit hole.

Photograph: Pennsylvania Department of Conservation and Natural Resources - Forestry, Bugwood.org

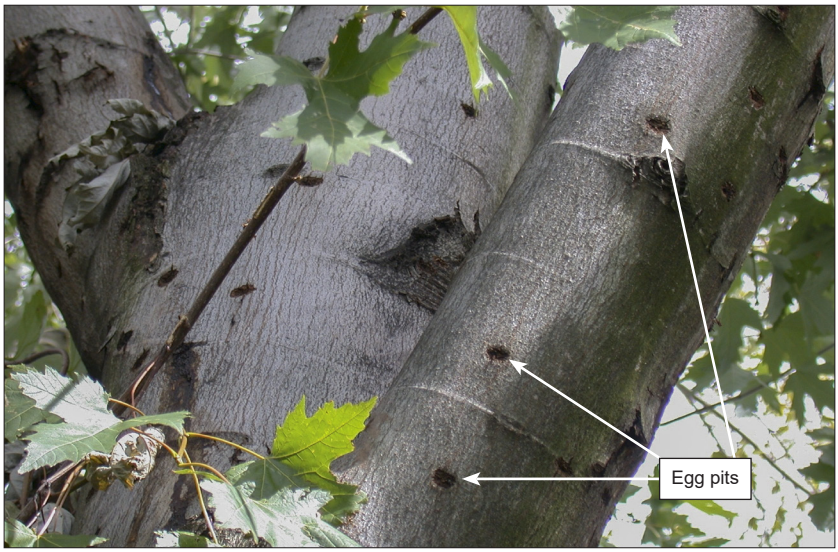
Frass material produced by the activity of Asian longhorn beetle larvae that has collected in the fork of an infested tree.

Photograph: Pennsylvania Department of Conservation and Natural Resources - Forestry, Bugwood.org

Excavation egg pits and exit holes on the stem and branches of a tree infested by the Asian longhorn beetle.

Photograph: Kenneth R. Law, USDA APHIS PPQ, Bugwood.org

Exit holes, excavation egg pits, stripped bark and frass on a tree infested by the Asian longhorn beetle.



Photograph: Pennsylvania Department of Conservation and Natural Resources - Forestry, Bugwood.org

Excavation egg pits and exit holes on the stem and branches of a tree infested by the Asian longhorn beetle.

Photograph: Joe Boggs, Ohio State University, Bugwood.org

Egg pits excavated on the stem by the female beetles to lay their eggs in. Note the mandible marks around the periphery of the pits.

Photograph: Kenneth R. Law, USDA APHIS PPQ, Bugwood.org

Egg pits excavated on the stem by the female beetles to lay their eggs in.

Photograph: Reproduced with permission from Natural Resources Canada, Canadian Forest Service, 2018

Cracks that have developed in the bark overlying Asian longhorn beetle larval feeding tunnels.

Photograph: Nigel Straw, Forest Research

Larval tunnels of the Asian longhorn beetle in the heartwood of a felled infested sycamore (*Acer pseudoplatanus*) tree. Note the frass within the chamber.

Photograph: Dean Morewood, Health Canada, Bugwood.org

Feeding damage – young bark that has been stripped by adult Asian longhorn beetles.

Photograph: Art Wagner, USDA - APHIS, Bugwood.org

Feeding damage – young bark of a maple tree that has been stripped by adult citrus longhorn beetles.

Photograph: Dean Morewood, Health Canada, Bugwood.org

Feeding damage – sugar maple (*Acer saccharum*) tree bark that has been stripped by Asian longhorn beetles.

Photograph: Joe Boggs, Ohio State University, Bugwood.org

Feeding damage to foliage caused by adult Asian longhorn beetles.

Photograph: Pennsylvania Department of Conservation and Natural Resources - Forestry, Bugwood.org

Feeding damage on a leaf caused by an adult Asian longhorn beetle. Note the central vein has been removed but the laminae remain intact.

Photograph: David Crossley FBIPP QEP, Fera Science

Citrus longhorn beetle and exit hole in branch.

Photograph: George Gate, Forest Research

Asian longhorn beetle.

Photograph: Donald Duerr, USDA Forest Service, Bugwood.org

Asian longhorn beetle.

Photograph: Karen Snover-Clift, Cornell University, Bugwood.org

Asian longhorn beetle.

Photograph: Kenneth R. Law, USDA APHIS PPQ, Bugwood.org

A mature larva of the Asian longhorn beetle.

Photograph: National Plant Protection Organization, the Netherlands, Bugwood.org

A mature larva of the citrus longhorn beetle.

Photograph: Steven Katovich, USDA Forest Service, Bugwood.org

Asian longhorn beetle larvae at varying stages of their development.

Photograph: Gyorgy Csoka, Hungary Forest Research Institute, Bugwood.org

The larvae of other species such as the goat moth (*Cossus cossus*), the leopard moth (*Zeuzera pyrina*) and the large poplar beetle (S*aperda carcharias*) produce frass material which can collect in branch forks and at the base of trees.

Photograph: Gyorgy Csoka, Hungary Forest Research Institute, Bugwood.org

Larva of the goat moth. These can reach approximately 100 mm in length when mature.

Photograph: Gyorgy Csoka, Hungary Forest Research Institute, Bugwood.org

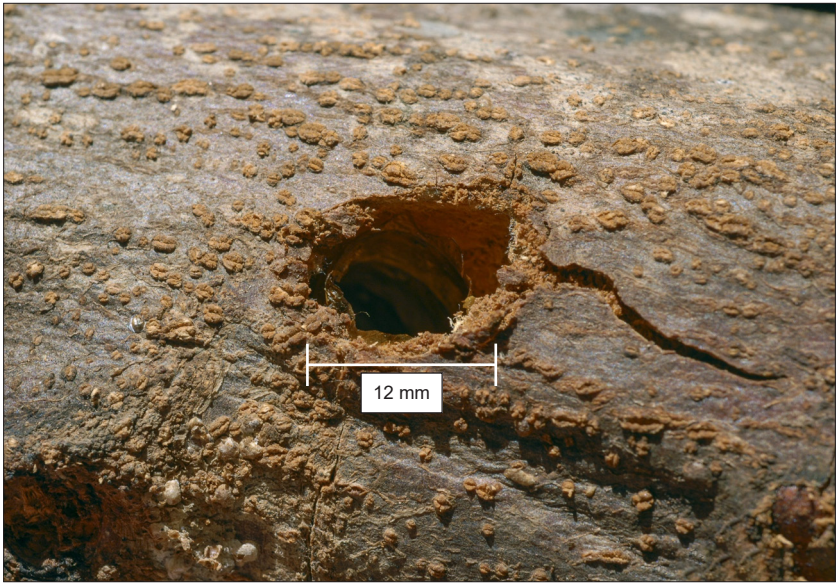
Goat moth damage to lower regions of the stem of an infested tree.

Photograph: George Gate, Forest Research

Leopard moth damage on sycamore.

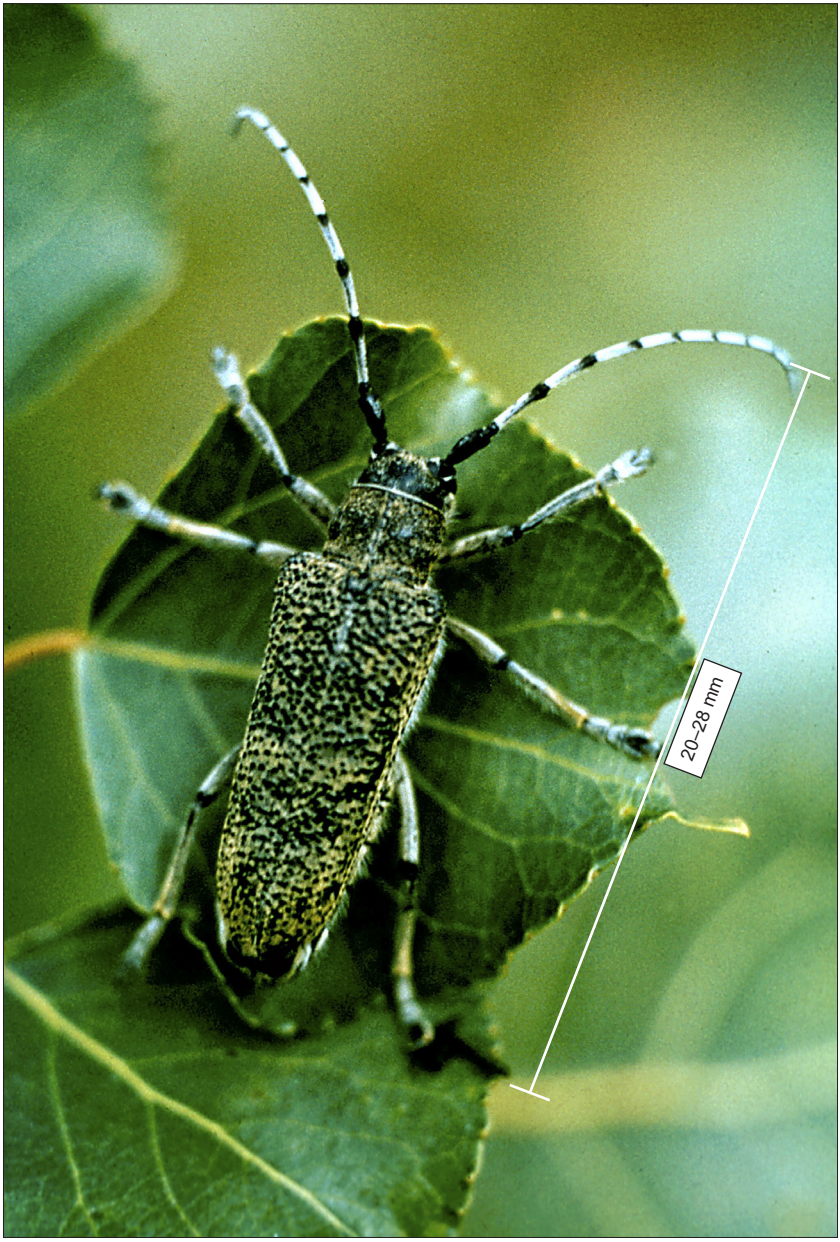
Photograph: Milan Zubrik, Forest Research Institute - Slovakia, Bugwood.org

Emerging leopard moth larva. On reaching maturity they can be 50–60 mm in length.



Photograph: Esmat M. Hegazi, University of Alexandria, Bugwood.org

Leopard moth exit hole.



Photograph: Jean Pinon, Institut National de la Recherche Agronomique, Bugwood.org

Large poplar beetle.

Photograph: Louis-Michel Nageleisen, Département de la Santé des Forêts, Bugwood.org

Large poplar beetle larva and tunnel packed with sawdust-like waste. The exit holes produced by the adult beetle are similar in shape and size to those of the ALB.

Photograph: Suzanne Sancisi-Frey, Forest Research

Damage caused by native moth species. Callus material has formed around exit holes.

Photograph: Suzanne Sancisi-Frey, Forest Research

An exit hole produced by native moth species.

Photograph: Suzanne Sancisi-Frey, Forest Research

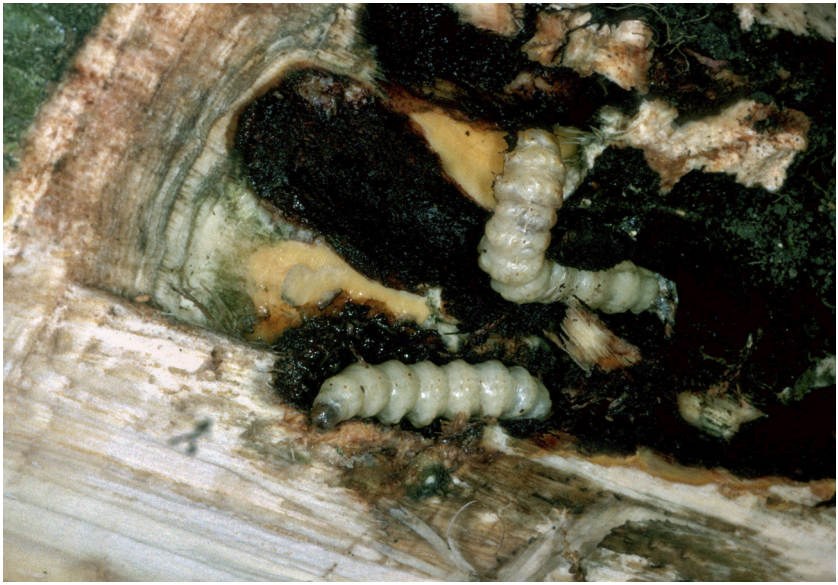
An exit hole produced by native moth species. Note the blackened colour/ sootiness of the exit hole.

Photograph: Nigel Straw, Forest Research

Exit holes produced by the hornet moth (*Sesia apiformis*) at the base of an infested tree. The holes here are approximately 8 mm wide.

Photograph: Gyorgy Csoka, Hungary Forest Research Institute, Bugwood.org

Frass produced by the hornet moth which has collected at the base of an infested tree.



Photograph: Louis-Michel Nageleisen, Département de la Santé des Forêts, Bugwood.org

Larvae of the hornet moth. Mature larvae are approximately 30 mm long.

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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.

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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

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