CHRISTMAS TREES UNDER FIRE

Christmas approaches and fir, spruce and pine trees will play a big part in the celebrations. But in 2011, the International Year of Forests, the UK's native trees and woodlands are threatened as never before by a range of exotic pests and diseases. **Dr John Morgan**, head of the Forestry Commission's Plant Health Service, reports.

You've bought your real Christmas tree, erected it in the living room and decorated it with tinsel and lights. It looks and smells wonderful, and the kids are suitably excited.

Perhaps you opted for a pine tree as lodgepole pine (*Pinus contorta*) and Scots pine (*P. sylvestris*) are among the species commonly used as Christmas trees. In fact, we have grown used to having plenty to choose from every December. But we should be wary of taking Christmas trees for granted.

The people who care for them are the frontline in a challenging struggle to manage a range of potentially damaging plant pests and diseases that have, in most cases, entered the country from abroad. Having originated where the ecosystem is in equilibrium with their existence, some of these organisms can be virulent, fast-spreading and unstable when presented with a novel environment devoid of the pressures that have kept them in check in their native lands.

The Forestry Commission, the Government forestry department, is so concerned about the future health of the UK's trees and woods that it plans to divert more funding into researching and combating tree pests and diseases over the next three years. The commission is also working closely with the Department for Environment, Food and Rural affairs (Defra), the Food and Environment Research Agency (Fera), environmental organisations and the forestry and horticultural industries to produce a Tree Health and Biosecurity Action Plan. It brings together all sectors concerned with the management of woods and forests, as well as other plant habitats. One output of the action plan will be an integrated, cross-sector strategy to protect these plants and habitats from pests and diseases.

Exotic menace

Our love of exotic plants and trees is partly responsible for the massive global trade in live plants, and "instant landscaping" for projects such as roadside and urban development also generates demand for semi-mature trees and shrubs, many from overseas suppliers.

Despite ever-tightening phyto-sanitary (plant health) controls and inspections at points of export and entry, some unwelcome guests are difficult to detect and still get in. Some pathogens enter the country in the soil of potted trees, plants and shrubs, while insect pests, such as moth and beetle species, enter in freight containers or vehicles, or as eggs. Oak processionary moth (*Thaumetopoea processionae* – see panel), for example, is believed to have entered London as eggs on semi-mature oak trees imported from continental Europe for a landscaping project.

Climate change might be playing a part in some cases, and oak processionary moth is thought to be an example. A native of southern and central Europe, the pest has become established as far north as the Netherlands in recent decades, possibly because late spring frosts that would have killed emerging larvae in the past have become rarer.

So what can we do about these biological assaults on our islands' ecosystems? Current Government strategy is founded on three basic principles:

1. Keep pests and diseases out.
2. If they do get in, eradicate them before they spread and become endemic.
3. If eradication proves impossible, control and manage them to keep them below epidemiologically significant levels.

There is broad agreement that the European Union's plant health regime should be strengthened to meet the challenges of the 21st century's global trading environment, so it is being reviewed. The UK is fully engaged in that review and the result is likely to be a more robust regime that will aim to make it more difficult for exotic pests and pathogens to enter the EU or individual Member States, while preserving the rights of EU citizens to engage in free trade and enjoy exotic plants.

Even without the review, much can and has been done by the UK and the international community to make it more difficult for pests and pathogens to cross borders. For example, the international plant health authorities moved quickly to counter the threat of Asian longhorn beetle (*Anaplophora glabripennis*) and pinewood nematode (*Bursaphelenchus xylophilus*) when the former began infesting trees in the USA and the latter in Portugal. The anecdotal evidence pointed to entry to both the USA and Portugal from Asia in packaging used by industries such as car manufacturing. By quickly agreeing the International Standard of Phytosanitary Measure No. 15 (ISPM15) in 2002, requiring all wood-based packaging materials to be either heat-treated or fumigated, these pests were prevented from entering many more countries.

Clearly though, a number of the pests and pathogens that have already entered the UK are here to stay, so we are necessarily in "control and manage" mode. *Phytophthora ramorum*, for example, is a very damaging pathogen whose permanent presence in the UK we now accept as inevitable (Brasier & Jung 2006).

Phytophthora ramorum is a fungus-like pathogen that is particularly damaging to the economically important Japanese larch (*Larix kaempferi*) and other species associated with woodland, particularly *Rhododendron* and the ecologically important bilberry (*Vaccinium myrtillus*). Japanese larch succumbs very quickly, producing huge quantities of infective spores that spread widely from tall trees in wind currents. Infected trees must be felled, preferably before sporulation,

BIOGRAPHY

Dr John Morgan is head of the Forestry Commission's Plant Health Service, leading the commission's work to protect Britain's trees, woods and forests from pests and diseases. He holds a PhD in forestry and a BSc in ecological science from the University of Edinburgh, and has worked in a variety of research, advisory, management, policy and technical support roles during his 20-year career with the commission.

International plant health authorities moved quickly to tackle the Asian longhorn beetle menace.

The *Phytophthora ramorum* pathogen is particularly damaging to the Japanese larch.

and more than 2 million larch trees have now been prematurely felled in the UK since 2009.

The Forestry Commission is also urging vigilance for symptoms on larch, *Vaccinium* and *Rhododendron ponticum*. Ramorum disease is also known, confusingly, as "sudden oak death", because a different type of *P. ramorum* has killed millions of native oak and tanoak trees in the USA. Fortunately, Britain's native oaks, sessile and pedunculate oak (*Quercus petraea* and *Q. robur*), are much more resistant than their American cousins, and only a few have become infected.

Management of *Phytophthora* pathogens is tailored to our understanding of the patterns of infection on each host, and is required to keep their incidence below epidemiologically significant levels. Infected plants are destroyed, and surrounding areas monitored for recurrence. The application of biosecurity measures is also vital to prevent or minimise spread.

In the case of Japanese larch, which was not known as a *Phytophthora* host until 2009, the need to cut down infected trees is significantly changing landscapes and has serious economic consequences for landowners. It is a drastic step that can be heart-breaking for owners and disappointing for local communities and woodland visitors. However, sacrificing a comparatively small number of trees will save a much greater number in the long-term, and the Forestry Commission greatly appreciates public-spirited co-operation from woodland owners. Without it, *P. ramorum* would almost certainly be causing more damage than it is currently.

The success of the strategy, when it comes, will be marked by small numbers of isolated outbreaks of ramorum disease that can be quickly and easily cleared up without serious economic losses or major landscape and ecological damage.

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Investigate to eradicate

If we are to protect our native ecosystems from invasive pest species, a rigorous and rapid response from the scientific research community is essential. We are fortunate that Fera and several British academic and scientific institutions employ some of the world's leading plant pathologists and entomologists to work on these problems. Through their work, our understanding of the organisms and mechanisms involved are improving all the time, which can only improve our ability to manage plant pests and diseases.

There are several success stories that suggest we should not fear catastrophe. For example, when the great spruce bark beetle (*Dendroctonus micans*) was accidentally imported from continental Europe in the 1980s, it was feared the softwood timber industry in northern and western regions, dominated by Sitka spruce (*Picea sitchensis*), would be seriously affected (Fielding & Evans 1997).

The initial response was to declare quarantine zones where the pest first became established and prohibit the movement of bark-covered logs to prevent the spread of the beetle. This was followed by intensive research into potential longer-term control measures, which eventually resulted in the deployment of a biological control agent – *Rhizophagus grandis*, a tiny predator beetle which feeds exclusively on great spruce bark beetle, and therefore poses little risk to native insect species. It also has an impressive ability to "sniff out" the tiniest beetle populations and finish them off. Now, when an outbreak of great spruce bark beetle is detected, *R. grandis* is released in the affected woodland and quickly decimates beetle populations.

Inexpensive biological control agents such as *R. grandis* might seem an ideal tool for pest control, but they do not always represent a "magic bullet". As any Australian land manager plagued by cane toads can testify, introducing the wrong species can prove even more damaging than the pest it was intended to control.

Thorough research to ensure that the introduction will not in itself be damaging is therefore vital, and biological control agents must be approved by Defra's Advisory Committee on Releases to the Environment (ACRE) before they are used.

Resin tubes of *Dendroctonus micans* on spruce bark.

Christmas trees attacked

Going back to our Christmas pines, one disease is infecting millions across Britain, inhibiting their growth and timber yield, and in some cases killing them. This infection is red band needle blight (Brown & Webber 2008), also known as *Dothistroma* needle blight. Named for the distinctive red bands it causes on pine needles, the fungus responsible for this disease in the UK is *Dothistroma septosporum*, although a related pathogen, *Dothistroma pini*, causes the same condition in continental Europe.

Dothistroma septosporum was first observed in the UK in 1954,

KNOW YOUR ENEMY

A HANDY GUIDE TO TREE PESTS AND BLIGHTS

Phytophthora kernoviae mostly infects shrub and ground-cover species. As well as beech trees (*Fagus* spp.), its hosts include bilberry, an important woodland under-storey species, and *Rhododendron ponticum*, an invasive species in many woods, if they are exposed to sufficient inoculum pressure. It is of concern to the environmental, forestry and arboricultural sectors. See Brasier & Jung (2006) for more information.

Phytophthora alni, which has killed thousands of alder trees (*Alnus* spp.), is a new species resulting from the hybridisation of *P. cambivora* and another *Phytophthora* probably related to *P. fragariae*, a pathogen of strawberry. It is spreading across Europe as a "hybrid swarm" of variants, some of which pose a serious threat to alder and the stability of riparian ecosystems, of which alder trees are an important feature. See Brasier & Jung (2006) for more information.

Phytophthora lateralis is particularly serious in Lawson cypress trees, and confirmed in Scotland in 2010 and in Northern Ireland in 2011. Varieties of Lawson cypress (*Chamaecyparis lawsoniana*) are popular as ornamental garden plants, so the impact on the horticultural industry could be significant. *P. lateralis* has devastated Lawson cypress in its native USA, virtually destroying the trade in that species. See Robin *et al.* (2011) for more information.

Phytophthora pseudosyringae is increasingly being identified in the UK. Southern beech (*Nothofagus*) species are highly susceptible, and infection is typically aerial. Small plantations of *Nothofagus obliqua* and *N. procera* are grown in the UK for timber, but a consequence of this disease is that their future use in climate change adaptation strategies could be limited. In Europe, *P. pseudosyringae* causes a root and collar rot of beech, alder, hornbeam, sweet chestnut and oak species, and a foliar blight of bilberry. See Sansford (2009) and Brasier & Jung (2006) for more information.

Acute oak decline (AOD) This condition is killing thousands of oak trees in East Anglia and the Midlands. Infected trees die within five years of the onset of symptoms, characterised by trunk lesions oozing dark fluid. About 75 percent of symptomatic trees harbour a newly described bacterium, *Gibbsiella quercinecans*, and the buprestid beetle (*Agrilus biguttatus*). Researchers are investigating whether some interaction between these two, and between *G. quercinecans* and other bacteria, is contributing to the condition and its spread. See Denman and Webber (2009) for more information.

Horse chestnut bleeding canker This condition of horse chestnut (*Aesculus hippocastanum*) is caused by the bacterium *Pseudomonas syringae*, which until the 21st century had only been observed on Indian horse chestnut trees (*A. indica*) in their native range. A 2007 survey found that 49 percent of horse chestnut trees in the UK showed symptoms or possible symptoms of bleeding canker. Research investigating the potential susceptibility of other tree species is ongoing. See Steele *et al.* (2010) for more information.

Larvae nest

Oak processionary moth (*Thaumetopoea processionae*) was discovered in west London in 2006 and in Pangbourne, Berkshire in 2010. Its larvae severely defoliate oak trees, and shed tiny hairs that contain a toxin called thaumetopoein which causes skin and throat irritation. It is therefore a public health issue as well as a plant health one. Work to eradicate both the Pangbourne and London outbreaks is ongoing. See EFSA (2009) for more information.

Moth Larva

Pine-tree lappet moth (*Dendrolimus pini*) A breeding population of this continental European insect pest of Scots pine has been discovered in woods around Inverness. Pine-tree lappet can be a serious defoliator in its native range and outbreaks can cover thousands of hectares, resulting in seriously reduced tree growth and increased mortality, especially because defoliated trees become susceptible to other biotic risks. Management action is currently focused on containment while options for future management, including population control or eradication, are being investigated. See Sierpinska (1998) for more information.

Lappet Moth Larva

but outbreaks remained rare until the late 1990s. Since then it has affected the UK's Corsican pines (*P. nigra*) so badly that we have suspended planting them. Now, researching ways of managing the disease and, if necessary, finding substitute pine species are priorities.

Worryingly, *D. septosporum* is now infecting increasing numbers of lodgepole pine, and infection is becoming increasingly common in Scots pine. Scots pine is the UK's only native pine species, and is regionally and culturally important as a landscape feature.

It is hoped that Scots pine will prove more resistant than its relatives because it is growing within its natural range, but plant pathogens can evolve, mutate and hybridise to become more virulent and infect new species, so we must not be complacent about the potential threat.

As with all fungal agents, *D. septosporum* thrives in humid conditions, so forest managers are advised to thin their trees to facilitate air movement and reduce humidity in the forest canopy. Copper fungicides can be used to suppress symptoms in some situations, such as Christmas tree plantations. Forestry Commission woodlands are surveyed regularly, improving our knowledge of its extent. Continuing research will help in developing long-term management strategies, and in determining the distribution and ratio of the two mating types of this fungus known to be present in the UK. The presence of the two mating types is of particular concern because, together with genotypic variation, this could lead to the appearance of new, even more-virulent forms.

Be vigilant and diligent

Meanwhile, it is becoming clear that we are entering a new era in woodland management – one in which we will no longer be able to stroll in and out of woodlands without thinking about the potential consequences. In some cases we will have to take precautions to prevent the spread of pests and pathogens. Everyone can play a part, so our key message to people who own, visit or work in woodland is: "You can help us by being vigilant and diligent".

Be vigilant – regularly inspect the trees that you are responsible for, be alert for plant health problems, and report unexplained symptoms to us.

Be diligent – adopt "biosecurity" and hygiene measures in daily routines to minimise accidental spread of pests and disease. This means, for example, cleaning and disinfecting items such as tools, equipment and boots before leaving infected woodland sites.

In other words – don't take an unwelcome guest into the woodland with you, and don't bring one out.

Red band needle blight infects millions of Christmas pines across the UK, inhibiting their growth and timber yield and, in some cases, killing them.

Information and contacts

Brief details of some other significant tree pests and diseases in the UK are given in the accompanying panel, "Know your enemy". More detailed information about these and other pests is available from www.forestry.gov.uk/pestsanddiseases and the "Protecting Trees" area of www.forestry.gov.uk/forestresearch.

Reports of suspected sightings of the "quarantine" or notifiable species mentioned here (*P. ramorum*, *P. kernoviae*, *P. lateralis* and oak processionary moth) can be made to the Forestry Commission's Tree Health Diagnostic & Advisory Service as follows:

- ddas.nrs@forestry.gsi.gov.uk to report sites north of the Humber-Mersey line.
- ddas.ah@forestry.gsi.gov.uk to report sites south of the Humber-Mersey line. See also www.forestry.gsi.gov.uk/fr/ddas.

Readers can follow key tree pest and disease news and developments from the Forestry Commission at www.twitter.com/treepestnews.

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