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Beating the beetles

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Bark beetles have decimated spruce trees in parts of mainland Europe, but drones, sniffer dogs and nuclear waste models are (so far) winning the battle in southern England. **Liz Sheffield** explains

The UK government's plant health risk register lists more than 1400 pests and diseases. Public enemy number one is currently a tiny beetle, only half a centimetre in length, called *Ips typographus*. The word 'typography' is related to the art of engraving, and the specific name of this beetle refers to the engraved appearance of the galleries (tunnels) made by the larvae burrowing under the bark of trees.

Timber

Spruce is the main tree used for timber in the UK. There are currently more than 725 000 hectares under cultivation – worth at least £3 billion a year to the UK economy. The beetle has destroyed at least 100 million cubic metres of spruce in Norway since it took hold a decade ago. Checks for the beetle in imported timber have long been in place in the UK but, in 2018, a breeding population of the beetles was found in a woodland in Kent, southern England. The source is

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Galleries made by the eight-toothed spruce bark beetle (*Ips typographus*) when feeding on the phloem under the bark (larvae are white)

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suspected to have been winds blowing the insects across the English Channel.

The beetles are initially associated with damaged or recently felled spruce trees, but when their numbers build up, they can start to breed in adjacent, healthy trees. The males burrow through the bark to make mating chambers in the phloem beneath. Up to four females, lured by pheromones, will then join the male and mate. Each makes her own gallery, running up the tree through the phloem, and lays up to 80 eggs in separate chambers either side of the gallery. When the eggs hatch, each larva munches its own gallery off the chamber. Large numbers of larvae can destroy an entire ring of phloem – cutting off transport, girdling and killing the tree. Infested trees and timber must be removed, chipped and/or burnt to destroy the pests.

Fighting back

Spruces are conifers, all of which secrete resins. These compounds can flow into damaged areas, such as those made by burrowing insects, and harden to seal off the opening. In addition to the mechanical deterrent, resins contain terpenes, giving the distinctive 'pine fresh' smell. These aromatic compounds act as neurotoxins, respiratory irritants and antifeedants for invading insects. However, when trees are stressed – for example, by drought or overwhelming numbers of invaders – such defences can prove inadequate. The situation is made worse by the association of spruce bark beetles with pathogenic fungi, such as the blue-stain fungus, many of which can transform spruce terpenes into bark beetle pheromones.

This symbiosis does, however, provide one weapon with which we can combat the beetle threat. The scent of the pheromones can be detected by sniffer dogs. So although the beetles themselves, and the tiny holes they make to enter a tree, might be difficult to detect, sniffer dogs can identify an infested tree in seconds. Another weapon is traps containing pheromone. Beetles are attracted to these traps, so regular monitoring can reveal their arrival before numbers have a chance to build. And because growing parts of the trees cannot be supplied with photosynthate in infected trees, another weapon is using drones to detect areas of brown foliage.

The final weapon in the fight is predicting where beetles might appear. 'We have been doing modelling with colleagues at the University of Cambridge and the Met Office which have adapted a nuclear atmospheric dispersion model to *Ips*', explained Dr Max Blake, from the team at Forest Research. This model was developed to predict where winds take nuclear fallout and has been applied to cross-Channel wind patterns.

The application of all these weapons by forest workers, landowners and volunteers means that the UK has been confirmed as the first country to have eradicated spruce bark beetle in its controlled areas (those in the southeast and east considered at risk from infestation). But after a drought-full summer, and with climate change in full swing, those of us in the UK will certainly need to be on guard for new outbreaks in the future.

Weblinks

Forestry Commission and DEFRA, 'Beat *Ips typographus* beetle', **https://tinyurl.com/k8y5warc**

Forest Research, 'Help prevent establishment of spruce bark beetle by joining national monitoring project', **https://tinyurl.com/5bstjk9d**

Gov.uk: 'Report a tree pest or disease', **https://tinyurl.com/yup62j77**

Netherer, S. *et al*: 'Interactions among Norway spruce, the bark beetle *Ips typographus* and its fungal symbionts in times of drought', *Springer Nature Link*, **https://tinyurl.com/4bn9s25h**

Stallard, E. and Rowlatt, J: 'Drones join battle against eight-toothed beetle threatening forests', *BBC*, **https://tinyurl.com/4muwn3cv**