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How the very small can fell the very tall: the oomycete threat

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What are oomycetes?

Oomycetes are probably one of the most economically and socially important taxonomic groups you have never heard of. Oomycetes can best be described as fungus or algae-like; they reproduce by spores, which means that the spread is difficult to control as spores can be carried on wind, water, equipment and people. Oomycetes are classified as protists, which are eukaryotic organisms that are not plant, fungus or animal. Included in the group is the genus *Phytophthora* (from Greek, meaning plant destroyer); a prominent example is *Phytophthora infestans* which causes the potato blight that resulted in the Irish potato famine in the 1840s and to this day causes large yield loss in agriculture and horticulture.

Which tree species are affected?

There are several species of *Phytophthora* which are highly destructive to UK tree species. Once infected, trees develop lesions on the stem, lose leaves or needles, and eventually die. To date the most economically important attack has been that of *Phytophthora ramorum*, which in the UK attacks larch that is frequently planted for commercial forestry. To prevent the spread of *P ramorum*, infected trees must be cut down, and the movement and procession of timber is strictly controlled by licensing. *P ramorum* also infects several other species, including *Rhododendron* which can serve as a reservoir for spores, causing continuous reinfection.

Juniper is one of only three UK native conifer species, primarily found growing as part of rare upland ecosystems, where it supports a range of specialised invertebrates, fungi and lichens. Juniper is under threat from *Phytophthora austrocedri* which have left large parts of the population in unfavourable condition.

Effect of international trade and climate change. What can we do to prevent the spread of *Phytophthora*?

Phytophthora are true globetrotters. *Phytophthora pluvialis* was originally discovered in the USA in 2013 on a variety of trees, and was also found to cause red needle cast in Monterey pine in New Zealand. By 2021 it was detected in the UK on Douglas fir and western hemlock, as far apart as Cornwall and Cumbria, reflecting how our interconnected modern world makes it possible for not only us but also pathogens to travel far and wide. A key factor in preventing the spread of spores is maintaining good biosecurity measures, such as cleaning footwear and wheels between visits to forests. Potential sighting of infections, or more generally of unhealthy-looking trees, should be reported via Forest Research's Tree Alert online tool at **www.forestresearch.gov.uk/tools-and-resources/fthr/tree-alert**.

The effect of climate change on the battle between *Phytophthora* and trees is likely to favour *Phytophthora*, as drier warmer summers will stress the trees, and wetter, milder winters will advantage the survival of the *Phytophthora* spores.

What can we do about *Phytophthora* in future?

Biosecurity measures can help, but increasing resilience is the key to reducing the impacts of all kinds of pests, diseases and abiotic threats (such as drought, wind and fire). Unfortunately, all these threats are increasing in association with climate change. The level of damage they cause is often interconnected: abiotic factors can lead to stressed trees, which then become more susceptible to pests and diseases. However, only some pests and diseases may be present within, or near to, a woodland or forest. The effect of a pest or disease on an individual host tree species and its closely associated biodiversity can be devastating, but if only one or two tree species, among a diverse range, act as hosts, the lost trees have less impact on the woodland or forest as a whole. The continuity of canopy protects habitat and/or timber production and climate mitigation.

> *"Increasing resilience is the key to reducing the impacts of all kinds of pests, diseases and abiotic threats."*

Oomycetes may be small, and little known, but their impacts have big lessons to teach us. Avoiding large contiguous single species blocks in commercial forest plantations by using a matrix of smaller blocks and/or species mixtures is a rational response to our experience of *Phytophthora ramorum* on larch (and our awareness of the establishment of the European spruce bark beetle *Ips typographus* in south-east England). The effects of *Phytophthora austrocedri* on juniper suggests that increasing the abundance of rarer tree species in our native woodlands would be a sensible measure.