Climate change and insect pests of trees

Will the impact of damaging forest insects increase?

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Insects provide many critical ecosystem services, such as pollination, decomposition and pest control. Many beneficial insects appear to be in decline, due to habitat loss, pesticide use and climate change. Only a small number of insect species have become damaging pests of trees, but their occurrence and impact may unfortunately be increased by climate change. Warmer temperatures are likely to benefit many pest insects, whilst severe weather events may reduce host-tree resistance.

Background

Major groups of forest pests include **defoliators** which feed upon leaves or needles, **sap-feeders** which suck plant juices through piercing mouthparts, and **bark beetles** which feed and develop within a tree's inner bark. Healthy trees have a range of anti-insect defences and can usually withstand moderate feeding damage. Growth may be impacted by repeated years of heavy defoliation, for example, but trees will typically recover after the insect attack. Most bark beetles can only colonise a tree after it has been weakened or damaged, by disease, drought or wind-throw for instance, but a few species can attack and kill live trees if populations are large enough to overwhelm the trees' defences.

The changing climate is altering the impact of forest pests, acting directly upon the insects and indirectly through changes to the health and resistance of their host trees. Warmer temperatures enable some insects with a flexible life cycle to produce more generations each year, boosting population growth. Trees and forests are being subjected to more frequent drought events, associated with changing rainfall patterns and higher temperatures. Severe drought leads to water-stress and poor growth, weakening tree defences and increasing the risk of attack by pests.

Defoliators

There is a wide variety of defoliating insects, of which the larvae of moths and sawflies tend to be the most damaging. Many are adapted to feed on new leaves in the spring and cannot adjust their generation time, but some species, such as the **horse chestnut leaf miner**, respond to warmer summers by producing more generations. This small moth mainly causes aesthetic damage but has spread rapidly throughout Europe over the last 30 years. Other defoliators have also expanded their range northwards, including **pine processionary moth** (PPM) which has benefited from an increased survival of larvae during milder

The defoliating alder leaf beetle appears to be increasing in abundance in recent years.

winters. Spread of PPM to Britain is of concern as its caterpillars (like those of **oak processionary moth** – OPM) bear irritating hairs. Defoliation and defoliator outbreaks are likely to intensify with climate change, which may predispose trees to further attack by other pests and diseases. However, the abundance of predators may also increase, whilst the foliage of drought-stressed trees can become tougher and less palatable to defoliators, so uncertainties remain due to the complexity of such interactions.

Sap-feeders

The nutritional quality of host trees is influenced by the severity of stress upon them, so populations of aphids, such as **green spruce aphid**, tend to increase when water stress is intermittent, but are adversely affected by continuous drought conditions. Rising temperatures tend to drive an increase in abundance and damage of sap-feeders, such as **oak lace bug**, a North American pest now spreading widely across continental Europe.

Photo: Joseph Berger, Bugwood.org

The recent rapid spread of oak lace bug through Europe appears to be aided by a warming climate.

Bark and wood-boring beetles

Destructive outbreaks of bark beetles often occur when storms create large quantities of wind-thrown trees, allowing massive population growth of species such as the **European spruce bark beetle** *Ips typographus*, and subsequent 'mass attack' of live hosts. Recent outbreaks of *I. typographus* across Europe have been driven by multiple years of drought, causing large areas of weakened Norway spruce forest to be attacked and killed by extensive larval feeding within the inner bark (see top photo on the first page). Small populations of *I. typographus* have been recently detected in southern England for the first time, thought to have dispersed naturally across the Channel. This poses a new threat to UK spruce forests, particularly when affected by storms and drought events.

Adult **large pine weevils** feed on the bark of conifer seedlings and can cause major damage to new plantings. The influence of a changing climate on the beetle's development and life cycle is complex, with warmer temperatures expected to increase activity and damage but reduce generation time, particularly in the North and West of Britain. Here the management option of waiting until the adults disperse from a felled site before replanting is likely to become more favourable, rather than having to protect seedlings with insecticides.

The larvae of most wood-boring beetles feed in dead wood and are harmless, though some species, such as **oak pinhole borer**, can stain potentially valuable timber. A few invasive species attack live trees, including **Asian longhorn beetle** which was accidentally introduced to southern Britain through international trade. The relatively cool maritime climate of Britain proved suboptimal for this species, limiting population growth and dispersal opportunities, and allowing it to be successfully eradicated.

In summary, many forest pests are expected to benefit from warmer temperatures through shorter generation times and increased survival, with some species expanding their distribution to new areas. Conditions may become more suitable for a wider range of non-native forest pests, many of which are regularly moved through the global trade in forest products. Additionally, more severe weather events will reduce host-tree resistance and help drive pest outbreaks. However, predictions of overall pest damage remain difficult. Careful selection and planting of diverse species mixtures and good management to optimise the growth and resistance of trees should promote resilience against pest and disease attacks. Regular monitoring of tree health will help identify emerging problems, and these can be reported through Forest Research's online **TreeAlert** resource.

More information:

You can find further details of key pests and diseases of trees and woodlands online at FR's pest and disease resources:
www.forestresearch.gov.uk/tools-and-resources/fthr/pest-and-disease-resources/

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Version 01: 23 May 2023

FR(GB-DI)PDF/MAY23/0014