IDENTIFY SPRUCE BEETLE INFESTATIONS EARLIER USING SATELLITE DATA

AN EARLY WARNING TO FELL INFESTED TREES BEFORE THEY LOSE THEIR VALUE

Bark beetles have been a growing menace to the forestry industry around the world over recent decades. In this article we explore how beetle infestation affects timber quality over time, the challenges of identifying infected trees using traditional methods, and how multi-spectral satellite data can help to identify affected stands before they lose much of their commercial value.

SPRUCE BEETLE OUTBREAKS SPREADING

Bark beetles have been an important part of forest ecosystems for millennia. Infesting old or damaged trees, they lay eggs under the bark and then hatched larvae mine the area below, eventually cutting off the tree's supply of nutrients. Though this slowly kills the tree, it offers food, shelter and nutrients for other forest life – including woodpeckers, fungi and ants – and eventually clears a space for new, healthy trees.

However, when these rice-grain-sized beetles attack en masse during an outbreak, they turn their attention to healthy younger trees as well. Such outbreaks used to be episodic but have now expanded to epidemic levels in many parts of the world through a perfect storm of factors that include recurring drought, climate change, overly dense mature forests and changes in the beetle's biology.

The effects have been devastating, with the spruce beetle, for example, destroying 15 million trees in southeast Norway in the 1980s, and severe outbreaks of mountain pine beetle leaving a trail of destruction spanning almost 45 million acres in British Columbia, Canada, between the 1990s and 2012. More recently, the North American spruce beetle and its European counterpart have ravaged vast areas of forest, including in British Columbia once again, where the largest outbreak in history was recorded in 2017, and in Białowieza Forest straddling Poland and Belarus, an outbreak that threatens the survival of Europe's oldest forest.
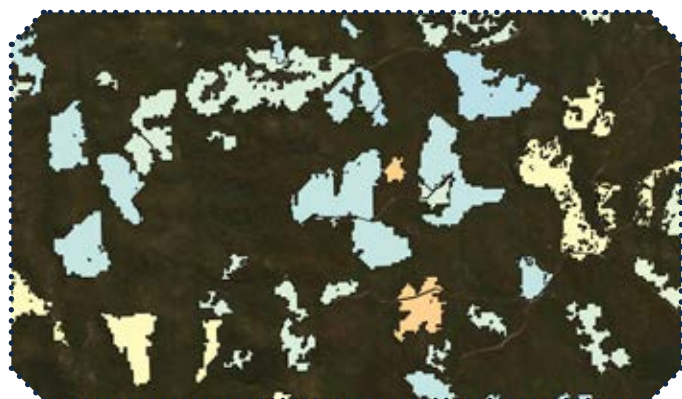
TIMBER DEPRECIATION AFTER BEETLE INFESTATION
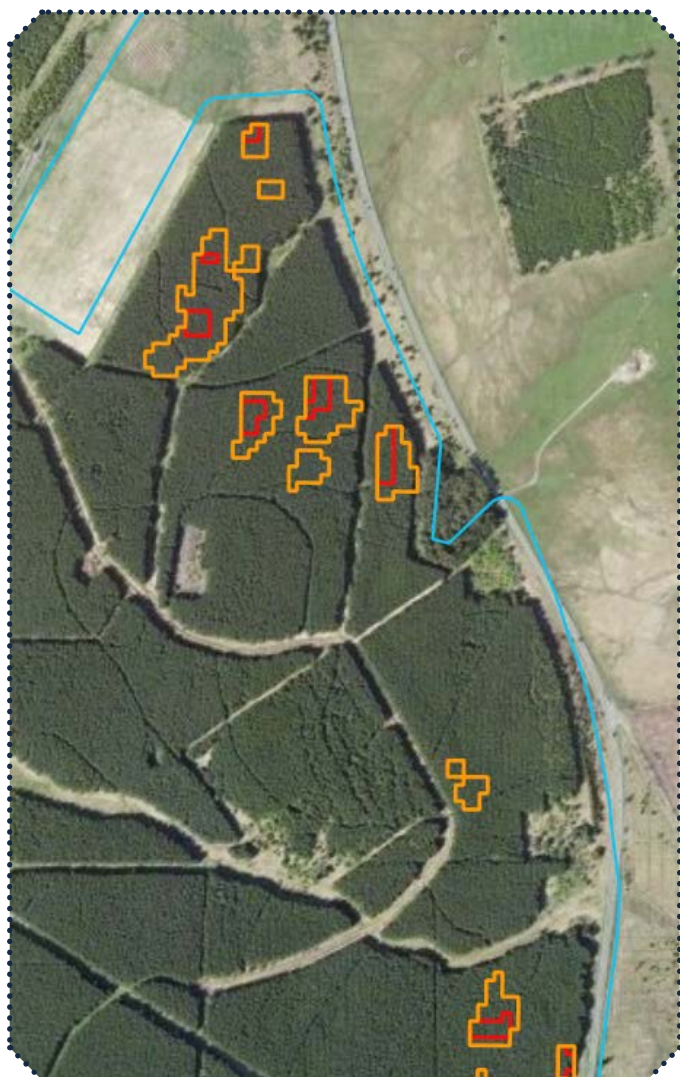
After a bark beetle attack, foresters are left with large areas full of dead trees. As a way of retrieving some value before complete wood decay – and encourage forest regeneration while avoiding hazards such as wildfires – many are salvaging the timber. But doing so is a race against time. Attacked trees remain commercially useful for just 3 years, and their value depreciates rapidly.

Depreciation depends on the products being made from the timber, but essentially boils down to two defects that spread over time...

Discoloration - from blue stain fungus, an organism intimately connected with the beetle

Moisture loss - causing timber shrinkage and checking.

LIMITATIONS OF CURRENT FOREST MONITORING METHODS

In order to salvage timber while it is still valuable, foresters currently rely on obvious visual cues from ground surveys and/or government aerial and satellite imagery.

However, both methods have significant drawbacks...

Ground observations: though boots on the ground can identify individual trees in the first year (green-attack) after infection, ground surveys are restricted to a small area within forests that often span thousands of hectares, severely restricting their utility.

Aerial and satellite imagery: these methods are adept at covering large areas of forest and picking up how the stand's foliage fades to yellow and red over the spring and summer following attack (red-attack), and the ultimate complete loss of needles (grey-attack) three years after initial infestation. However, during green-attack – when the tree still retains most of its commercial value – there are no visibly apparent signs of deterioration from above.

MULTI-SPECTRAL SATELLITE DATA BENEFITS

A more sophisticated analysis of earth observing satellite data has the potential to transform forest monitoring and provide a global picture of beetle outbreaks for foresters. By assessing multi-spectral bands such as intra-red to measure more subtle indicators of plant health, infestation can be detected as early as June or July the following year – around three months earlier than when using purely visual methods. This short but crucial time window allows foresters to validate, plan and fell diseased trees in the same year, and thereby sell the timber as much as a year earlier than traditional methods allow to obtain a better market price.

In future, multi-spectral satellite data could also be combined with other forest health monitoring methods to better understand the location, extent and impacts of infestation, and predict where future outbreaks are likely to occur – providing a tool for foresters to identify bark beetle infestations early and helping stop outbreaks in their tracks.

AN EARLY WARNING INDICATOR

Multi-spectral data from earth observing satellites can be gathered for large areas of forest on a monthly or even weekly basis. Through the interpretation of this data using powerful geospatial analytics and data science to identify subtle indicators of plant health, earth observation is a powerful method to identify spruce beetle infestation early so that timber can felled and sold at a higher price – effectively providing a beetle infestation early warning system not possible with aerial or ground-based data gathering methods.

FIND OUT MORE

For more information, please contact us on **+44 (0)1865 817 500** or email **info@rezatec.com**

CASE STUDY: BRITISH COLUMBIA

Contributing $12.9 billion to GDP and supporting 140,000 jobs, the forestry sector is a vital part of British Columbia's economy. However, the Canadian province has been one of the worst-hit areas for bark beetle outbreaks.

Since the early 1990s it is estimated that Pine Beetle killed more than half of all merchantable pine, representing a staggering 723 million m^3 of timber and by 2054 will result in an estimated cumulative $57.37 billion (or 1.34%) loss in GDP.

With Pine Beetle infestations falling, the Spruce Beetle represents the latest challenge to the forestry industry with their numbers now reaching epidemic levels. If left unchecked, Spruce Beetle has the potential to pose similar levels of damage to British Columbia's forestry industry.