Category: Research Spotlight

Can you smell a sick tree?

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Picture walking through a forest with your eyes closed. You might imagine sunlight streaming through branches. You could feel leaves crunch under your feet, hear birdsong, and notice the wind rustling leaves. But what do you smell? Compared to many other organisms, humans rely little on scent. Yet, a whole chemical world is communicated among plants, animals, and microbes right under our noses. The smell of freshly cut grass, a pine forest, and flowers' aroma all come from volatile compounds made by plants. These volatile organic compounds change quickly with environmental conditions, stress, and seasons. This responsiveness means the air is full of information waiting to be used. For example, what if you could detect an unhealthy ecosystem or the presence of disease? I aim to answer this by studying *Phytophthora ramorum*, one of the most damaging tree diseases in the UK.

The genus Phytophthora means 'plant destroyer' in Greek. It is best known for causing potato losses in the Potato Famine, a result of *Phytophthora infestans*. Since 2006, *Phytophthora ramorum* has caused widespread tree mortality in the UK. Thousands of hectares of forest have been cut to limit the disease's spread. The main impact is in Larch forests, which were planted after WW1 for their fast growth, durable wood, and suitability to the UK climate. Losing these trees leads to less wildlife habitat, carbon storage, and timber, and changes the landscapes that communities value. Protecting these forests is of ecological, economic, and cultural importance.

Removing infected trees is relied upon as a post-infection management strategy. However, its effectiveness is limited by detection efficiency. Currently, infection diagnosis relies on visual inspection or DNA testing, which are expensive and time-consuming. Additionally, by the time visible symptoms appear, the pathogen may already have become established and spread through a woodland. Infected Larch trees emit *Phytophthora ramorum* spores at a rate much higher than other host species, behaving as beacons of disease emission. With more spores in the environment, there is an increased risk of *Phytophthora ramorum* becoming infectious to new hosts and causing disease across more of the landscape. This was the case with larch trees; *Phytophthora ramorum* was not known to be infectious to larch until it was introduced to the UK.

I am looking for changes in the scent of larch trees that could reveal infection before visible symptoms appear. By analysing these compounds, I aim to determine whether they can serve as reliable indicators of disease. If successful, this work could contribute to the development of new tools for forest health monitoring that are potentially capable of identifying infection before obvious symptoms appear and will provide a detailed picture of how a tree's chemical profile changes in response to infection. Technologies based on scent could one day become part of the toolkit used to monitor forests more efficiently and at larger scales. Instead of monitoring single trees, you could deploy sensors across a landscape.

This study system is also a proof of concept. If we can detect disease or ecosystem health before ecosystems are highly degraded using odour, we could intervene and adjust management practices sooner and improve ecosystem recovery outcomes. There is a further exciting future in volatile organic compound research to support ecosystem processes. Where scents are naturally used to attract pollinators, deter herbivores, communicate stress to neighbouring plants, and respond to environmental changes, we could enhance or breed for some of these traits to strengthen these characteristics. By measuring these compounds and understanding what triggers their production, we may be able to use them to improve our crops and ecosystems.

The next time you go out in a forest, take a breath, and try to pay attention to what you smell. Contrary to being passive components of the landscape, trees are constantly sending out information in a way that we are only just now coming to fully appreciate. The prospect of diagnosing disease through the scents that trees emit offers a fascinating glimpse into the future of forest health monitoring that could improve ecosystem conservation outcomes. The air around us contains valuable information waiting to be decoded. By learning how to interpret those messages, we may gain powerful new ways to protect the forests on which we all depend.