

How drones can save the UK's forests

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Ash die-back disease causes 'holes' to appear in the woodland canopy

High-quality, affordable drones can revolutionise the way that landscape and vegetation data is collected. This short study shows how the impact of ash die-back disease can be assessed quickly in a small plot of woodland

The recent widespread decline of ash trees across Britain and Europe has been caused by the fungus *Hymenoscyphus fraxineus*, also known as Chalara or ash die-back disease. Although first described as *Chalara fraxinea* in 2006, the disease was later renamed. The fungal infection causes death of the sapwood and affects the ability of the tree to draw water and nutrients into its upper branches. The main symptoms are leaf loss and canopy dieback in infected trees, which is exacerbated under drought conditions. Young ash saplings are often killed in one year, but older trees may survive several seasons of attack until they die, leaving holes in the woodland canopy. As the fungus develops, it produces spores, which are dispersed on the wind causing further infections. Ash dieback disease has become a great concern for conservation and environmental organisations across Britain, however the ability to assess the extent of damage to woodlands quickly and cheaply is now within the reach of most organisations thanks to drone technology.

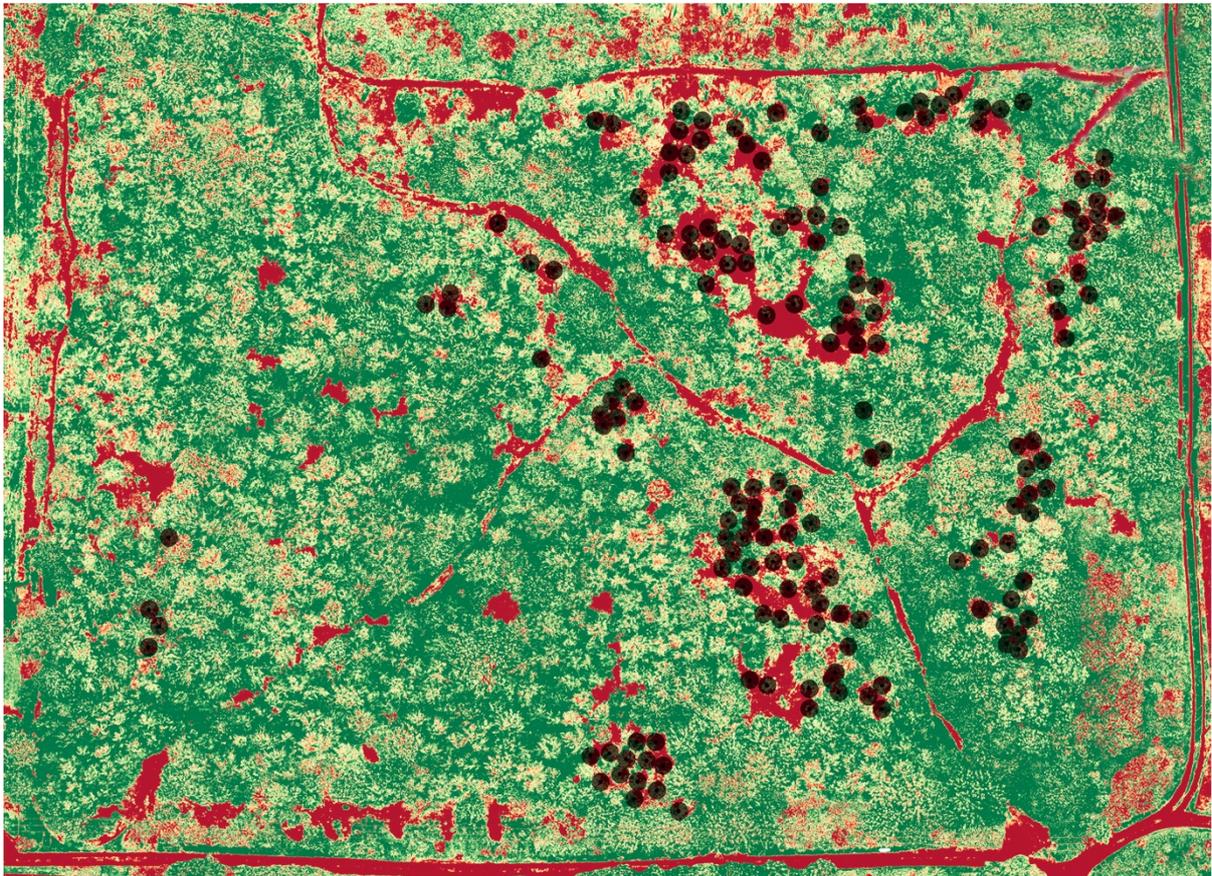
DRONE SURVEY

Modern affordable drones are reliable survey tools. The maps accompanying this article were produced using a DJI Phantom 4 Advanced drone costing less than £1,000. This Quadcopter has a 4k camera mounted on a gimbal, and uses photogrammetry to provide three-dimensional data. The flying height for this survey was 70m, which provides a photographic resolution of 2cm/pixel. The controller uses a handheld device, such as an iPad or Android tablet as the display. The DJI Go 4 app was used to provide basic drone control and the DroneDeploy app was used to fly the drone missions.

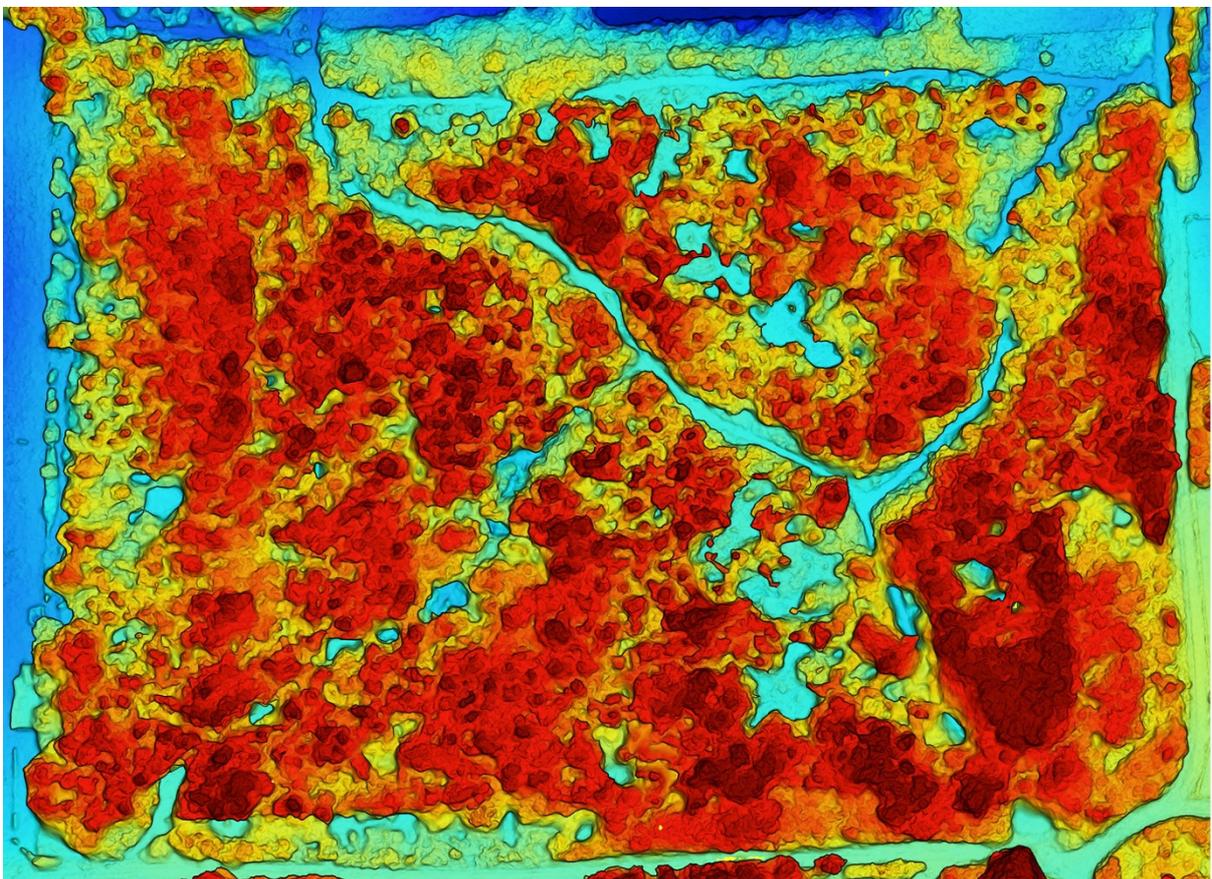


Aerial drone photograph of Reach Wood showing dying ash trees (June 2018)

Each flight was generally around six minutes per mission and produced around 90 overlapping aerial photographs. DroneDeploy has the benefit of managing the entire mission from start to finish and uses cloud-based storage and processing so that demands on your PC are minimal. After processing, drone mission data is available as geo-referenced and orthorectified two-dimensional aerial photograph mosaics, plant health maps using VARI (Visible Atmospheric Resistant Index), elevation maps and as three-dimensional models.



VARI false colour image of Reach Wood showing holes in the woodland canopy (red)

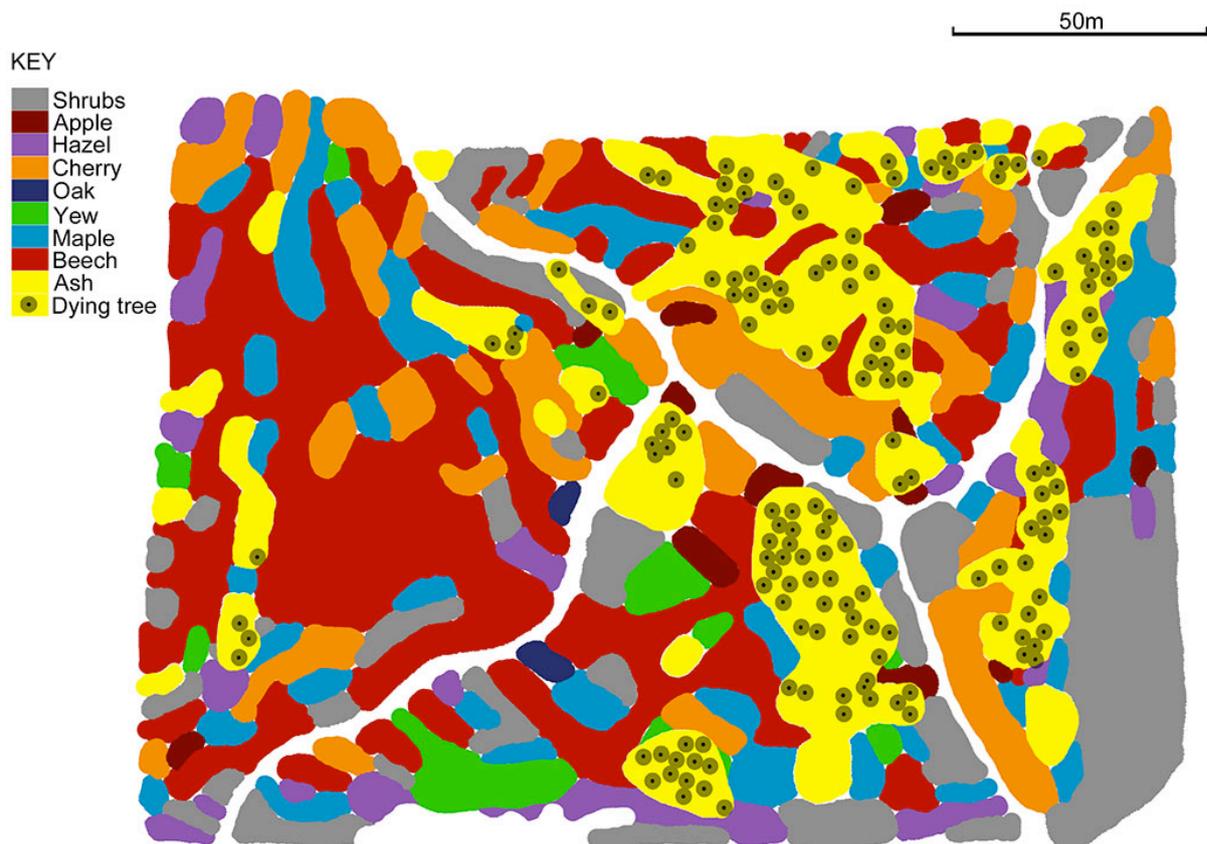


False colour elevation map of Reach Wood showing holes in the woodland canopy (blue)

REACH WOOD

In November 1994, local volunteers planted 3,200 young trees and shrubs to create Reach Wood on a former arable field located on the floor of an old chalk quarry. The woodland is owned by the Woodland Trust and comprises a mixture of beech, ash, cherry, field maple, crab apple and yew with a variety of shrub species including hazel, dog rose, wayfaring tree and spindle on the path edges. This young woodland is managed as a minimum intervention 'high forest', where natural regeneration of trees and shrubs is encouraged.

Although small (c. 3.8Ha), Reach Wood is important because it is located in one of the least-wooded districts in Cambridgeshire, which in turn is one of the least-wooded counties in England. In 2015 before the arrival of ash die-back disease, ash trees made up approximately 20 per cent of the canopy of Reach Wood. In the summer of 2018, 163 ash trees could be identified as dead or dying from drone aerial photography, accounting for approximately five per cent of the canopy and a quarter of all the ash trees. High-resolution drone aerial photography of dead and dying ash trees from the centre of the wood shows the extent of the damage.



Woodland types recorded in Reach Wood

The Visible Atmospherically Resistant Index (VARI) is a measure of 'greenness' in a Red-Green-Blue (RGB) colour image. It is not intended as a substitute for near infrared spectrometry (Normalised Difference Vegetation Index – NDVI), but it can be useful when detecting areas of plant stress in a woodland canopy. In this case, the VARI plant health map of Reach Wood shows the woodland floor in red through gaps in the canopy in many areas where ash die-back has affected trees. Similarly, the elevation map of Reach Wood shows 'holes' in the woodland canopy in some, but not all locations affected by ash die-back.

OUTCOMES

For Reach Wood, at the present time ash die-back disease has affected only a small proportion of the woodland canopy. However, in these areas the additional light and moisture reaching the ground has quickly created species-rich woodland glades full of tall herbs and grasses. These areas seem to be favoured by insects (butterflies in particular), birds and deer. Even rarer plants such as the bee orchid (*Ophrys apifera*) have taken advantage of the extra resources available, and numerous young ash and other tree seedlings can often be seen within the grass sward. In Reach Wood even if all the mature ash trees were eventually killed, the maximum loss would be c.20 per cent of the canopy. Natural regeneration will quickly fill these 'holes' and within a few decades the woodland will have recovered, albeit without ash trees.



THE FUTURE

Compared to Reach Wood, the picture is not so rosy for many ash-dominated woodlands across Britain. From the West Country to East Anglia, from the South Coast to Scotland, the survival of our third most common tree species is threatened. Almost every landscape will be profoundly changed by the impending loss of mature ash trees, and almost a thousand species of animals, birds, invertebrates and plants will be profoundly affected by its loss. Ash die-back disease is truly a ticking ecological time-bomb: a national disaster waiting to happen. Affordable and rapidly evolving drone technology offers the chance for conservation and environmental organisations to monitor the extent of damage to their woodlands so that they can plan management and mitigation strategies. From the air or from the ground, this genuinely might be a 'last chance to see' mature ash woodland in Britain.



The DJI Phantom 4 drone is affordable and provides high-quality data imaging

I hope that by writing this article I can enthuse teachers of geography and their students to say ‘we could do that too’, and to also embolden managers in key conservation roles to see the utility of affordable drones as a vital tool in their management toolkit. I feel passionately that not only should every college, sixth form and high school have a drone and be using it to teach geography and related disciplines, but that equally every conservation and ecological organisation should also have a drone and be using it as a tool to underpin decision-making and management work. So many organisations seem to be teetering on the brink of adopting this technology, but not yet making the leap.