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Ash to ashes?

Ash dieback, which threatens to decimate Britain's second most common tree, is not the only threat to native species from invasive pests and diseases. David Roderick reports on how the Forestry Commission is fighting back with its Tree Alert web app

Although Ash dieback has hogged the headlines of late, a growing number of invasive pests and diseases threaten our trees. In response, the Forestry Commission needed processes with which to address the threats in a proactive and consistent way.

In July 2013, EU LIFE+ approved funding for Observatree, a four-year project lead by the Forestry Commission on behalf of a consortium of organisations interested in the preservation of British trees. Other members include, Forest Research, the Department for Environment, Food and Rural Affairs (Defra), Natural Resources Wales, Fera Science Limited (formerly the Food and Environment Research Agency), the Woodland Trust, and the National Trust.

As part of this project the opportunity was seized to take advantage of an engaged public as 'citizen scientists', as well as the 25,000 or so individuals who work in the wider arboreal industry to generate a volume of reports that would not be possible with Forestry Commission staff alone. The data collected would still need to be scientifically useful, so a structured approach was needed, including guidance for reporters and a process to assess and prioritise reports.

Solving the problem

To capture this information, the Forestry Commission specified a solution, known as Tree Alert, to capture reports of tree diseases. Any solution would need to be comprehensive enough to capture useful information, including the species, symptoms and, of course, location, but simple enough to minimise the loss of users through the process.

Users are guided through the process, being asked a series of

intelligent questions, which reflect previous answers, to help to identify the issue, including confirmation of the species as well as the key symptoms. Initially, specialist questions will identify the pests and diseases currently of most concern; not only Ash Dieback, but also Acute Oak Decline, Dothistroma Needle Blight, Phytophthora Lateralis and Asian Longhorn Beetle. In the future, and as new threats emerge, additional questions can be added to extend the usefulness of the system. Other pests and diseases, such as the Oak Processionary Moth, can be reported through a general reporting path.

A primary aim of the Observatree project is to engage the public in reporting tree diseases, with a view to encouraging wider interest in the issue of tree health. It will also create a volume of crowdsourced data that is large enough to detect tree health hotspots and temporal and spatial trends.

Enter the technology

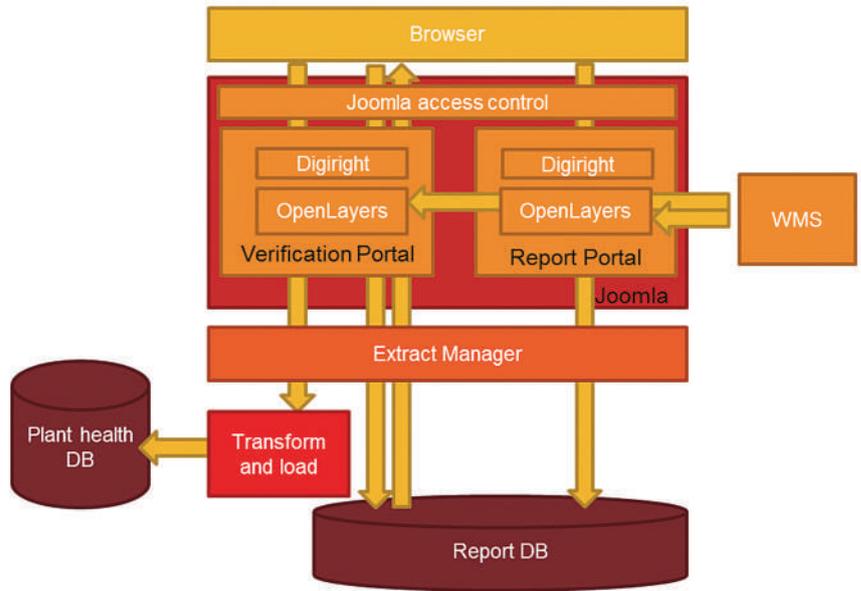
With limited time and budget available to the project team, an innovative and efficient approach was required. Any solution needed to be ready for deployment prior to the start of the next growing season, when most of the reports are made. Engaging with specialist software developer SCISYS, which has a long track record of integrating spatial components into business and operational systems, the Tree Alert system was commissioned.

Using an Open Architecture combining a number of Open Source and existing SCISYS technologies, the project team was able to take advantage of functionality already available. The basis of the site uses the Joomla! content management system as an application

framework ... software with which the Forestry Commission IT department already had some familiarity.

This application uses OpenLayers as the mapping platform, using OS On-Demand WMS for map delivery. OpenLayers was selected for its maturity as a product, and as it supports a wide range of map sources. On this basis, the Forestry Commission could be confident that future changes in source maps can be accommodated. Looking further ahead, OpenLayers provides the ability to scale cloud-based operations without the limitation of CPU-based licensing models.

The functionality of OpenLayers is enhanced by SCISYS' Digiright ... a component that allows user to efficiently capture location information including the position of a tree. This also aligns with the UK Government strategy to encourage the use of Open Source technologies in place of commercial proprietary products wherever possible.



Schematic architecture

Reporting process

As tree disease identification can be a tricky process, reporters are asked a series of questions to ensure that they have correctly identified the species of tree, and to capture the relevant symptoms they have observed.

As part of this process the location of the tree is captured. Contact information is also captured to allow the team of volunteers and scientists to confirm or expand on information submitted. Any solution would need to capture a location for a reported issue to within a few metres, to allow investigating scientists to quickly locate the problem trees.

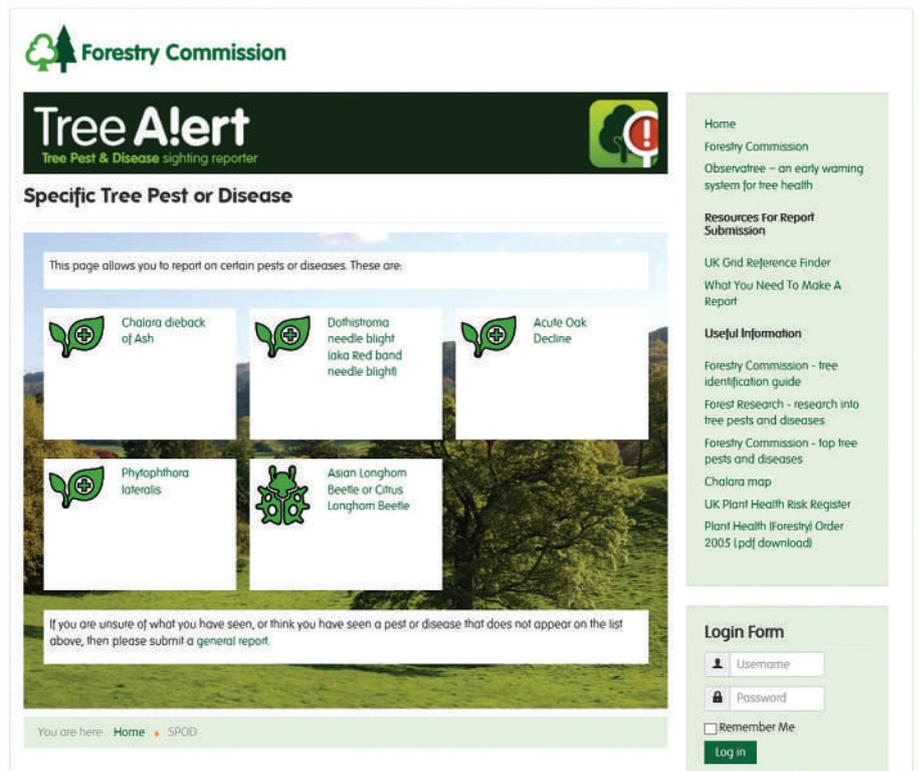
An initial examination of the submitted report is made by a Forest Research scientist, who first decides whether the report is credible and assigns it a priority depending on the symptoms reported and the location *vis-a-vis* existing knowledge of the disease and its distribution.

Reports that call for further information are passed to a team of trained volunteers who use the contact details supplied to get back in touch with the reporter. Armed with any additional information, the completed reports are then passed to a scientist for assessment and possible further investigation on the ground.

The captured information is also recorded in Forestry Commission's existing plant health geospatial database. This allows further statistical analysis and the opportunity to track the spread of particular pests and diseases across the country over time.

Conclusion

The TreeAlert website allows the general public to report sightings of pests and diseases including an accurate location and observed symptoms so that investigations can be prioritised and conducted efficiently.



Answers to questions posed in the on-screen dialogue are determined by answers to previous questions to narrow down possible outcomes

The validation built into the reporting process helps reporters accurately identify target tree species and capture relevant information about symptoms. In particular, the capture and processing of spatial information will enhance the strategic reporting, decision-making and operational response. To date, more than 500 reports have been submitted, providing a valuable resource in the fight against invasive pests and diseases.

Roger Coppock, Head of Corporate and Forestry Support at the Forestry Commission is in no doubt as to the efficacy of this new

resource. "The information gathered on the TreeAlert site doesn't just allow us to investigate individual cases reported by the general public, as we can now set priorities based on risk and track the incidence of new and invasive pests and diseases. This information will prove invaluable in our understanding of their spread and help us protect our woodlands for generations to come,"

David Roderick is an IT Consultant with SCISYS UK based in Chippenham, Wiltshire (www.scisys.co.uk)



The tell-tale signs of *Xylella fastidiosa* – a pathogen that poses a threat to the whole EU region and beyond
Image: Emanuele Mazzoni Photo / Shutterstock

Spatial information in the fight against new plant diseases

New and exotic plant diseases are on the rise, with grave consequences for agriculture and the natural environment. Stephen Parnell from UNIGIS UK looks at how spatial data, technologies and modelling are improving our ability to fight back.

The British landscape was once full of elm trees. The introduction of a microscopic fungus in the 20th century changed all of that. Over the course of two epidemics, 60 million elm trees were lost, landscapes were irreversibly changed, and ecosystems altered forever.

Since then, our forests and woodlands have faced an onslaught of new invasions. From *Phytophthora ramorum*, a 'fungus-like' organism that infects a number of trees including larch and some species of oak, to ash dieback, a disease first discovered in the UK in 2012 and causing such alarm that the government convened Cobra, the UK government emergency response committee usually reserved for terrorist threats and other such national emergencies.

Global issue

It's not just the UK that's affected; this is a global issue and agricultural crops and natural environments around the world are facing similarly grave threats. Most commentators point to changing trends in world trade and travel and the consequent movement of plant material. In the US and Brazil, citrus industries have suffered from a spate of exotic diseases originating from South East Asia which have devastated production; in Florida citrus canker arrived in 1995 and \$1 billion was spent trying to eradicate it. In 2005 the towel was thrown in on the eradication program and, that same year, a far more devastating disease - citrus greening

- arrived and subsequently spread throughout the State. Global banana production is currently facing a severe threat from a strain of 'Panama disease' called Tropical Race 4. Global wheat production is being challenged by a new virulent strain, Ug99 of stem rust disease, so named because it was first discovered in Uganda in 1999, and has since spread across Africa and the Middle East. The list goes on...

The latest threat to Europe - *Xylella fastidiosa* - is particularly concerning however. This bacterial pathogen has spread through Italy and poses a potential threat to the whole EU region. The pathogen has a long history in some parts of the world but it has never been found in Europe before. That is until 2013, when the disease - thought to have arrived accidentally on coffee plant's from Costa Rica - was found on olive trees in Apulia. It's spread by sap-feeding insects such as spittlebugs and invades a plant's water distribution system, preventing essential water and nutrients from being transported around the plant.

But here's the really worrying part: whereas many plant diseases are capable of infecting only a small number of host species, *Xylella* has a vast list of potential host plants. Different sub-species of the pathogen can infect a range of species, from Britain's native pedunculate oak, to citrus trees, and olive.

Emergency measures

In an attempt to prevent the further spread of *Xylella*, the European



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