

HAVE YOU SAVED A TREE TODAY?

John A. Lucas, Editorial Board Member



John Lucas

There are mounting concerns about the negative impact of invasive species not only on agriculture, horticulture and forestry, but also natural plant communities. The accelerating pace of incursions of exotic pests and pathogens into the UK in recent years has advanced the issue up the political agenda, with a higher priority being placed on biosecurity. A particular issue is the fate of UK native trees. We have relatively few (around 30) major woodland species, and many of them are under threat from recently introduced invasive pests and pathogens, or others spreading in mainland Europe.

Increasing resilience

In response to this scenario a Tree Health and Plant Biosecurity Expert Taskforce, comprised of academic scientists, was established by the Department of the Environment, Food and Rural Affairs (Defra) in 2011. Its remit was to provide advice on the current threats to tree health and plant biosecurity in the UK and to make recommendations about how they might be mitigated. An interim report was published in 2012 and the final report in May 2013. (<https://www.gov.uk/government/publications/tree-health-and-plant-biosecurity-expert-taskforce-final-report>). This concluded that existing arrangements were not satisfactory, so action needed to be taken on several fronts. A series of key recommendations were made, including development of a prioritized national plant health risk register, improved planning, surveillance and preparedness, and strengthening legislation. There was also a need to increase scientific capability in the area and develop more effective means of communication. A Chief Plant Health Officer was appointed to provide strategic and tactical leadership for managing biosecurity risks. Subsequently, a joint initiative between three UK research councils, Defra, the Forestry Commission, and Scottish Government was launched to support new research on tree health and biosecurity. Five years on from this initiative, a further UK report has emerged aimed at strengthening the resilience of trees, woods and forests to pests and diseases (See Tree Health Resilience

Strategy: <https://www.gov.uk/government/publications/tree-health-resilience-strategy-2018>), from here on referred to as THRS.

These reports are valuable additions to the wider polemic about the fate of the natural environment and should serve to raise the profile of biosecurity in both political and public arenas further. Importantly, the THRS was conceived in partnership with diverse organizations and key stakeholders with an interest in trees. It sets out a series of well-considered and worthy goals, both ecological and behavioural, to protect trees from pest and disease threats better. However, achieving them will not be straightforward. The discussions informing these reports coincided with further losses of important tree species due to invasive pathogens, most notably ash dieback caused by the fungus *Hymenoscyphus fraxineus*, which was first observed in the UK in 2012 and has since spread widely in the country. The epidemic has further highlighted lapses in biosecurity and detection, as many of the widely dispersed foci of the disease are almost certainly due to spread from imported nursery stock, and recent research suggests the disease was present for almost 10 years before first reported. Useful lessons have, however, been learned, including better coordination between the diverse organizations and stakeholders with an interest in trees, and the value of citizen science in monitoring the epidemic. There have also been important inputs from the scientific community, ranging from using molecular biology and genetics to analyse variation in both the tree host (Sollars *et al.* 2017) and pathogen populations (Orton *et al.*, 2017; McMullan *et al.*, 2018), to modelling optimum sampling strategies to aid detection (Alonso-Chavez *et al.*, 2016). New tools to combat the epidemic are emerging from this research, including genetic markers for reduced susceptibility in ash trees, and detailed information on the origin and current diversity of the European pathogen population. The latter has shown that any further introductions from the native range of the fungus in Asia would most likely exacerbate the current situation by increasing the genetic variation present in the European pathogen population and hence its adaptive potential. Coordinated action and strict biosecurity measures on a continental scale are needed to prevent this from happening.

The long-term consequences of incursions by new invasive pests and pathogens are hard to predict. What is certain, however, is that this is not just about trees. Woodlands and hedgerows support a wealth of species and are therefore critical in maintaining biodiversity and ecosystem services (Boyd *et al.* 2013; Freer-Smith & Webber, 2017). The life cycles of trees are measured in centuries rather than months and years, so losses cannot be restored quickly. The arrival of the more aggressive strain of Dutch Elm disease (*Ophiostoma novo-ulmi*) in the 1970s serves as an example. The epidemic devastated almost all the mature hedgerow and woodland

elms, once immortalized in the paintings of John Constable, and transformed the English rural landscape. There were wider impacts on the ecosystem with the loss of nesting sites for birds and habitats for insects and other creatures. In the short term some species actually benefitted, such as woodpeckers, with the new abundance of dead timber, and woodland flowers, as the tree canopy thinned out. Now, fifty years later, elms are still common in the UK, but almost exclusively as naturally coppiced trees regenerating from surviving root systems. Once they reach adolescence they become attractive to the bark beetle vector of the disease and become infected again (Figure 1). To date there is little evidence for the natural selection of more resistant genotypes in the elm population. Perhaps the long-term consequences of ash dieback will be different as some variation in resistance to the disease has been reported and ash trees are prolific producers of wind-dispersed seeds. When oak sudden death (*Phytophthora ramorum*) invaded the UK it was initially considered a threat to broad-leaved trees and some forest shrubs, but subsequently the pathogen jumped to larch, a new and taxonomically unrelated host, with unexpected and serious impacts on forestry plantations. So, any strategy for biosecurity somehow has to factor in unseen consequences arising from the dynamic nature of pest and pathogen evolution.

Another ongoing challenge is the tension between tighter controls at national borders, and the economic drivers for unrestricted trade. This was first highlighted ten years ago (Brasier 2008) but the debate continues. The THRS aims to partner in the implementation of the new EU Plant Health and Official Controls regulations which will provide significant improvements in biosecurity. Just this week the government has issued guidance on importing and exporting plants and plant products and potential arrangements in the event of a no deal Brexit (<https://www.gov.uk/government/publications/importing-and-exporting-plants-if-theres-no-brexite-deal/importing-and-exporting-plants-and-plant-products-if-theres-no-brexite-deal>). Needless to say, this would complicate matters as the UK would be treated as a third country and lose access to the EU plant passport regime. The main impact is likely to be on exports to the EU rather than imports, as currently most commodities coming from the EU are regarded as “low risk”, with the exception of plants and plant products managed under the EU passport scheme, which would then be subject to UK import controls to maintain biosecurity. The THRS also recognizes the need for behavioural change, from onsite activities to purchasing, with key goals such as working together more closely to protect and value trees, and putting biosecurity at the heart of best practice. Time will tell if this more joined up approach through the whole supply chain will yield dividends.

A new green agenda?

In January this year the UK government published its 25-year plan to improve the environment (<https://www.gov.uk/government/publications/25-year-environment-plan>). There is a convergence of goals with the THRS in terms of increasing the area of woodland and forests in the UK, placing more emphasis on natural capital and “green infrastructure”, as well as strengthening biosecurity. The ecological aims of the



Figure 1. Young hedgerow elms infected with Dutch Elm Disease showing chlorosis and desiccation of leaves. The disease now cycles within populations of regenerating saplings. (Photograph: John Lucas.)

THRS include connecting-up currently dispersed fragments of woodland to create “linear forests” as well as increasing genetic diversity to build greater resilience (Spencer, 2018). These plans are welcome and ambitious, but again there are conflicting pressures and priorities to consider. The government is committed to a major programme of house-building to address the current shortage of affordable homes, with at least some of this development on previously protected green-belt land. Meeting their targets without inflicting further environmental damage will depend on how well the intended green infrastructure is factored into such development. The THRS report is also overly optimistic in its assertion that everyone loves trees. The citizens of Sheffield, where over-zealous felling of urban trees has caused a public outcry, might disagree. In my experience the first step with in-fill development is too often to remove most of the existing vegetation, including hedges and trees, even where there is no apparent threat to public safety or the foundations or drains of the new properties. There is an ongoing need for much greater awareness of the many benefits of trees in terms of carbon capture, reducing noise and air pollution, and enhancing biodiversity. The evidence for positive effects of trees and green spaces on personal health and well-being is now well documented. Changing old habits is mainly a question of better education,

to make everyone aware that taking care of nature is not just an issue for conservationists, but instead an essential part of responsible citizenship. There should also be increased consultation between developers, ecologists and other stakeholders to ensure that future townscapes are designed with nature in general, and trees in particular, in mind.

Grounds for optimism?

The recent history of pest and pathogen incursions into the UK has largely been a case of reaction to a crisis rather than proactive steps to pre-empt it. The proverbial horse has bolted before counter measures are deployed. This is not a criticism of the phytosanitary agencies as resources were often insufficient to cope with the sheer scale of plant products entering the country. With the increased emphasis on biosecurity this situation is now changing. There is some cause for optimism with better offshore intelligence about impending threats, and novel technologies for pest and pathogen detection and diagnosis to intercept alien species at the border. Remote sensing based on drones and improved sampling strategies should improve our ability to monitor outbreaks if they occur. Recent experience with the ash dieback epidemic shows that genetics and genomics can quickly help to characterize the enemy, as well as informing efforts to reduce the vulnerability of the host population. Genetic and structural diversification of forests and woodlands is not a new concept, but there is now an increased interest in applying it in practice. Improved communication via different media platforms will help to raise awareness of biosecurity and encourage public participa-

tion in combating the threats actively. The holy grail of saving our trees for future generations may now be a little closer.

References

- Alonso-Chavez V, Parnell S, & Van den Bosch F (2016) Monitoring invasive pathogens in plant nurseries for early-detection and to minimise the probability of escape. *Journal of Theoretical Biology* 407, 290–302. doi: 10.1016/j.jtbi.2016.07.041
- Boyd IL, Freer-Smith PH, Gilligan CA & Godfray HCJ (2013) The consequence of tree pests and diseases for ecosystem services. *Science* 342: 823 + doi: 1126/science.1235733
- Brasier CM (2008) The biosecurity threat to the UK and global environment from international trade in plants. *Plant Pathology* 57: 792–808.
- Freer-Smith, PH & Webber, JF (2017) Tree pests and diseases: the threat to biodiversity and the delivery of ecosystem services. *Biodiversity and Conservation* 26: 3167–3181 doi: 10.1007/s10531-015-1019-0
- McMullan M, Rafiqi M, Kaithakottil, G & 28 others (2018) The ash dieback invasion of Europe was founded by two genetically divergent individuals. *Nature Ecology and Evolution* 2: 1000–1008. doi: 10.1038/s41559-018-0548-9
- Orton ES, Brasier CM, Bilham LJ, Bansal A, Webber JF & Brown JKM (2018) Population structure of the ash dieback pathogen, *Hymenoscyphus fraxineus*, in relation to its mode of arrival in the UK. *Plant Pathology* 67:255–264. doi: 10.1111/ppa.12762
- Sollars ESA, Harper AL, Kelly LJ & 28 others (2017) Genome sequence and genetic diversity of European ash trees. *Nature* 541: 212–216 doi:10.1038/nature20786
- Spencer J (2018) Forest resilience in British forests, woods and plantations – the ecological components. *Quarterly Journal of Forestry* 112:59–66.