

What Issues May Affect UK Forest Management Within 50 Years?

Alison Field and **Eleanor Tew** summarise a recent exercise organised by Forestry England and the University of Cambridge that carried out a 50-year horizon scan of the developing issues that might affect forest management in the UK.

Forestry is a long-term business facing a multitude of challenges triggered not just by climate change but also by the desire to see an ever-wider range of social, economic, and environmental outcomes. To help address these challenges Forestry England joined up with the University of Cambridge to organise a 50-year horizon scan of the developing issues that might affect UK forest management.

Importantly, horizon scanning identifies *emerging* trends – threats and opportunities that we are less aware of now, but which might have major impacts on the sector in future. So, issues like climate change and herbivore grazing, although obviously significant now and in future, won't feature in a horizon scan because we already know about them and are responding. However, highlighting emerging trends gives us time to consider and react to them before they become critical.

The authors of the horizon scan “hope that this exercise stimulates wider recognition of these issues, a greater appreciation of their importance, and careful consideration, examination and debate, as we develop research, policy and practice to ensure that UK forests, and the sector that supports their management, are fit for the future.”

By presenting a summary of the horizon scan exercise

and the full scientific paper (Tew et al., 2023), RFS members are invited to reflect on how climate, technology, political and socio-economic drivers might impact on the forests and woods with which they are involved, and how the sector might collectively respond to these horizon scan issues.

Approach

The scope of the horizon scan was defined as:

“Emerging issues and opportunities affecting the use, development and management of woodland in the UK over the next 50 years. These include but are not limited to environmental, social, economic and political factors.”

More than 40 experts representing a diversity of perspectives, organisations, geographies and experiences, were invited to identify relatively unknown issues with potential for significant

impact. All the expert participants are authors of the scientific paper (Tew et al., 2023).

The experts used their extensive networks to collate ideas. We estimate 7,000 people were indirectly contacted through emails and newsletters – including through the RFS newsletter. The best ideas were put forward into a longlist of 180 issues. Following a tried-and-tested research framework involving anonymous scoring, analysis, and debate, the 180 issues were reduced to a final shortlist

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of 15. A full description of the method can be found in Tew et al. (2023). The study was a major piece of work and a novel departure for forestry.

Results of the horizon scan

The final shortlist is presented below and illustrated in Figure 1. The issues are grouped by the relationships between issues rather than their relative priority. For example, issues one, two and three are all heavily influenced by our changing climate and issues 10, 11 and 12 reflect the potential impact of new technologies on the forest sector. However, the Expert Panel did particularly highlight issue 1 'Catastrophic Forest Ecosystem Collapse', reflecting agreement that not only is such collapse likely but would have huge implications.

The 15 horizon scan issues are:

1. Catastrophic forest ecosystem collapse.
2. Increased drought and flooding change the social costs and benefits of trees.
3. Forest management becomes more challenging due to changing seasonal working windows.
4. Protecting and enhancing soil microbial ecology becomes a higher priority.
5. Viruses and viroids emerge as pathogens of increasing importance for trees.
6. eDNA revolutionises our understanding of forest ecosystems.
7. Trees are at the heart of future urban planning.
8. The Taskforce on Nature-related Financial Disclosures (TNFD) drives transparency and investment in nature-positive management.
9. Natural capital funding streams are greatly upscaled.
10. New technologies facilitate widespread adoption of smart silviculture.
11. New technologies improve worker health and safety.
12. New wood product markets stimulate more active forest management.
13. UK commercial forest resources may not match future value chains.
14. Unpredictable supply and demand dynamics in global wood product markets.
15. International commitments will spotlight ecosystem integrity and drive monitoring efforts.

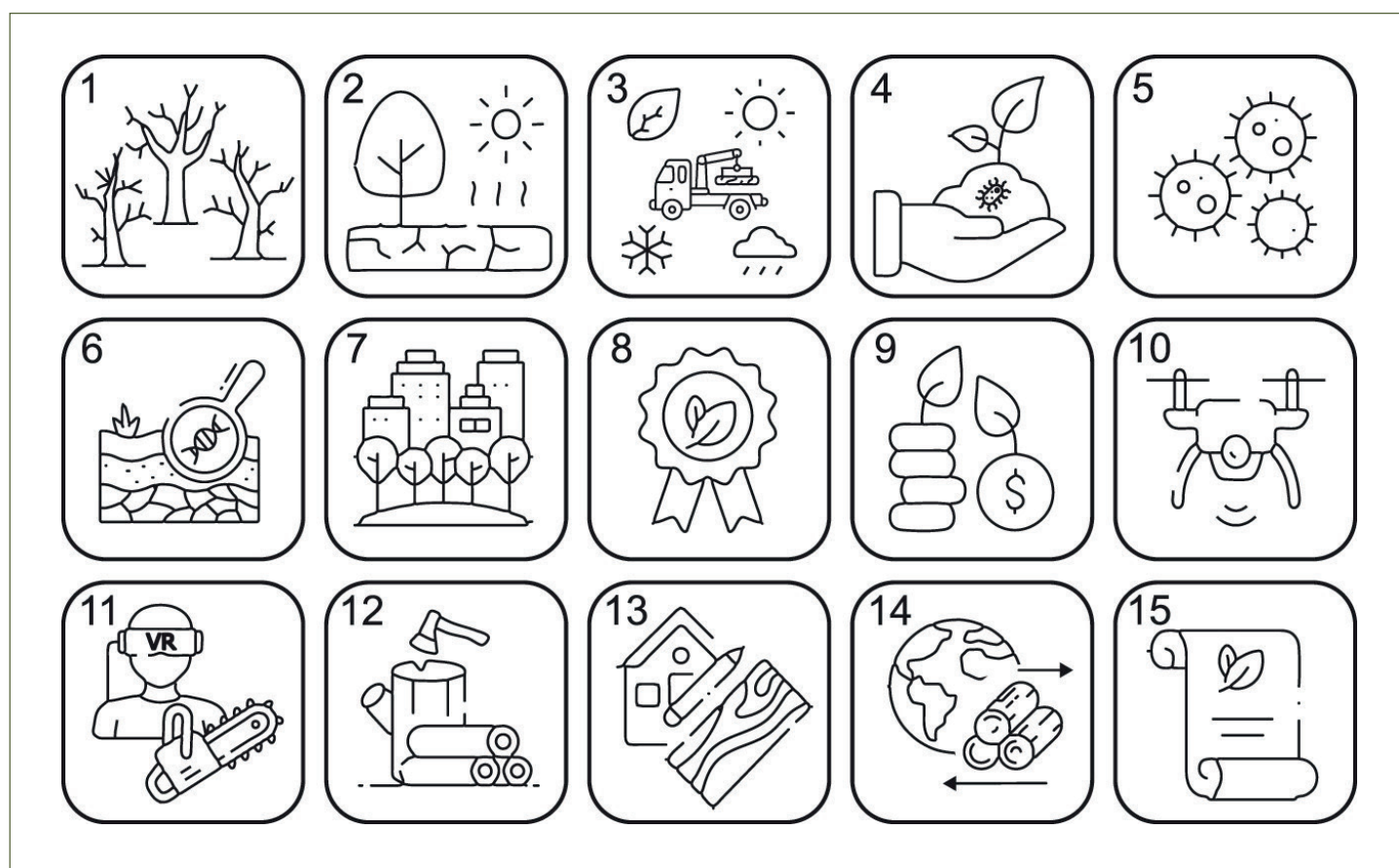


Figure 1. A graphical summary of the 15 top rated issues identified in the horizon scan; the icons have been adapted from images from Flaticon.com. From left to right and top to bottom the issues (1-15) are as described in the text above (Tew et al., 2023).



Figure 2. Fires, such as the after-effects of this one at Bramshill Forest on the Hampshire/Berkshire border, are one of the contributory factors that could result in forest ecosystem collapse.

Horizon scan issues explained

In this section each of the 15 horizon scan issues is briefly summarised, with a final few sentences in italics to suggest specific implications for the forest sector.

1. Catastrophic forest ecosystem collapse

Climate change projections (IPCC, 2023) predict more severe, frequent, and extreme weather with knock-on impacts from high winds, fire, pests, and disease outbreaks. Most recently Storm Arwen caused losses of 12,750ha of forest across Great Britain (Forestry Commission, 2022), *Phytophthora ramorum* has led to the extensive felling of larch, the southeast England outbreak of the great spruce bark beetle (*Ips typographus*) is cause for considerable concern and the visible impacts of ash dieback are clear throughout the UK. However, a catastrophic collapse would be caused when multiple threats take place simultaneously.

The definition of forest collapse used here followed Lindenmayer et al. (2016) as the “abrupt, long-lasting, and widespread change in ecosystem state and dynamics that has major negative impacts on biodiversity and key ecosystem services”.

This issue was very highly ranked by nearly 90% of panel members in recognition that large-scale disturbance

events are becoming more frequent in UK forests. Evidence also demonstrates that there is increasing, widespread natural disturbance to European forests through wind, fire (Figure 2) and bark beetles, which almost certainly have been exacerbated by the simplification of forest ecosystems through past management. Hundreds of thousands of hectares of forests have died in central Europe and North America.

We are already seeing that changes in forest ecosystems, whether abrupt or gradual, can have multiple knock-on impacts both on forest ecology (with potential for species extinction) and for salvage or phyto-sanitation fellings, generating unpredictable timber surpluses or deficits and uncertainty around the provision of other ecosystems services.

The likelihood of forest collapse is a fundamental issue with significant implications for the future of UK forestry.

2. Increased drought and flooding change the social costs and benefits of trees

More severe flood and drought events are expected. Whilst forest cover is recognised as limiting the impacts of flooding in wet areas, in drier regions water demand from trees is likely to exceed rainfall, depleting local water resources and raising conflicts with other demands for

water through abstraction for domestic use, industry and agriculture etc. (Tew 2019). The Environment Agency (2020) have estimated that in England an extra 3,435 million litres of water will be required by 2050 to meet future water demand.

Future forest policy will need to be alive to the impacts of forests on water in a warming climate and how the balance of social benefits and disbenefits may change.

3. Forest management becomes more challenging due to changing seasonal working windows

Climate change will bring wetter winters, which will reduce the working window for harvesting machinery to avoid long-term damage to forest soils. In contrast, hotter summers will bring extended heatwaves where extreme temperatures will restrict access to woods at the height of the day due to health and safety considerations.

Foresters and the supply chains that they support may need to find alternative employment for their workforce when weather prevents work in the woods. Like other

sectors the forest workforce may need to develop transferable skills to work elsewhere when forests are 'closed'.

Options for timber/wood product storage to maintain a continuity of raw material supply to markets may also be required.

4. Protecting and enhancing soil microbial ecology becomes a higher priority

Soils are increasingly recognised as the foundation for the health of the entire forest ecosystem. With the help of DNA barcoding and other technological advances, understanding the microbial ecology of forest soils has increased considerably over the last decade. However, there are still many gaps, not least appreciating the role of soil bacteria and fungi. Practitioners are only too aware of the impacts of soil compaction on tree growth which will be exacerbated by the greater risks to soils highlighted in issue three.

Changes in policy and practice may be required to safeguard soil health whilst also maintaining viable forest operations. Further thought to management that improves the functioning of soils, e.g. planting "improving" soil species, may also generate interest.

5. Viruses and viroids emerge as pathogens of increasing importance for trees

Few viruses and viroids are known to be pathogens of forest trees, yet they are the largest group of pathogens

listed on the Defra UK Plant Health Risk Register (around 14%). Whilst there are many examples of significant viral diseases in crop plants (e.g. *Citrus*, *Prunus*) fewer are known for forest trees. Virus or viroid infections may go undetected because symptoms are subtle, gradual, inconspicuous or easily confused with other conditions, so their impact may be over-looked.

The trees and forest sector may be significantly unprepared for the environmental and economic risks of viruses and viroids. We also understand little about their general role in ecosystem functioning, negative and positive.

6. eDNA revolutionises our understanding of forest ecosystems

Environmental DNA (eDNA, the matter which is released from organisms into the environment) sampling allows us to identify entire ecological communities from small samples such as soil or water. This transforms our ability

to monitor forest ecology over large areas,

cheaply, quickly and comprehensively. It has growing applications for monitoring tree and soil health, helping to track trends in pest and disease outbreaks and the impact of changes in forest management. Evidencing the biodiversity value of non-native species or the impacts of compaction from forest machinery on soil communities are just

two examples of how better data from eDNA

can help inform decision making for forest management.

eDNA metabarcoding will revolutionise our understanding of forest ecosystems and bring an ecological data explosion. We will need to consider how such data are presented, interpreted and used.

7. Trees are at the heart of future urban planning

The multiple benefits that trees and the urban forest bring to the built environment include improvements to public health and well-being, environmental cooling, air quality improvements, managing stormwater and promoting social ties. With continuing urbanisation and as cities prioritise climate change adaptation, it is likely that there will be a dramatic increase in tree planting to create 'forest lungs', a stronger network of street trees, trees in woods, parks and gardens and peripheral urban forests (Figure 3).

A demand for more liveable cities will raise the profile and value of street trees, the urban forest and 'forest lungs'.

“There is little doubt that the next 50 years could bring major changes to UK forests.”

8. The Taskforce on Nature-related Financial Disclosures drives transparency and investment in nature-positive management

The Taskforce on Nature-related Financial Disclosures (TNFD; <https://tnfd.global/>) is a global initiative led by the private sector. Companies and investors will be asked to report on both the direct and indirect impact that their activities and investments have on nature. This will also include full disclosure of the impacts generated by their supply chains and raw material usage. As the framework being set up will require forestry companies to publish their impacts on biodiversity, the value of using eDNA monitoring (see issue six) could become even more significant.

TNFD reporting may become mandatory for large companies and will promote a move to more economically viable biodiverse, nature-first forest management.

9. Natural capital funding streams are greatly upscaled

The concept of natural capital and ecosystem services – which recognises the wide range of benefits that nature provides that have value to society – is well developed. For example, Forestry England sets a value of around £2 billion/annum (2021/22) for their provision of ecosystem services to the nation which includes timber, carbon sequestration, health and wellbeing, and recreation (Forestry England, 2022). Following the precedent of the Woodland Carbon Code there are now other verification methodologies and trading arrangements being established to broker payments between growers and investors for both individual and bundles of ecosystem services (e.g. carbon and biodiversity). Standardisation of measures and certification of products are important to ensure quality, transparency, and foster investor confidence. Initiatives such as the British Standards Institute Code of Practice for Natural Capital Accounts, and a woodland creation natural capital ‘Canopy’ certification scheme developed by Grown in Britain and the Forest Canopy Foundation are helping to build the market.

As long as growers of new forests and managers of improved forests can demonstrate additionality (that ecosystem service payments are for new benefits that would not otherwise occur) then as new schemes win credibility, there is likely to be a significant uplift in the availability of funds from investors to the forest.*

**For a review of the Woodland Carbon Code and additionality see Hepburne Scott (2023).*



Figure 3. Hackney, London, a collaboration between JLL Gibbons and muf architecture. This 0.2ha garden is the flagship project of the Making Space in Dalston initiative. Under the protective canopy of birch and alder alongside an open-sided English oak framed barn a rich programme is delivered to over 150,000 visitors/annum. The success of the garden not only lies in the inspired stewardship of social enterprise ‘Grow Cook Eat’ that cares for it but also in the social, cultural and ecological benefits it provides. Ken Worpole says the garden has become, “one of the best-loved, and most joyful features of ‘the new Hackney’”. It provides a cool space in the city especially in times of extreme heat where the community can gather and interact, providing a green, tranquil and restorative environment, despite its inner city location.

(Photo: Lorraine Worpole)

10. New technologies facilitate widespread adoption of ‘smart silviculture’

Building more resilient forests (multi-aged, multi-species forests) and being asked to provide ever-more diverse ecosystem services from forests (such as carbon sequestration, flood alleviation, access for health and wellbeing), increases the complexity of decision-making for their management. Forestry is already the most heavily regulated land-based sector in the UK. It is recognised that ‘adaptive forest management’ (continually changing practice based on testing and experience) is essential to forest resilience (D’Amato et al., 2023; Lawrence, 2017). Emerging technologies such as machine learning, artificial intelligence, remote sensing, use of drones and eDNA will permit more cost effective and evidence-based design, management and monitoring of forests. Such ‘smart silviculture’ could, for example, enable more rapid and targeted responses to pathogen outbreaks, more reliable predictions of volume, carbon capture and timber value from multi-aged, multi-species forests, precision

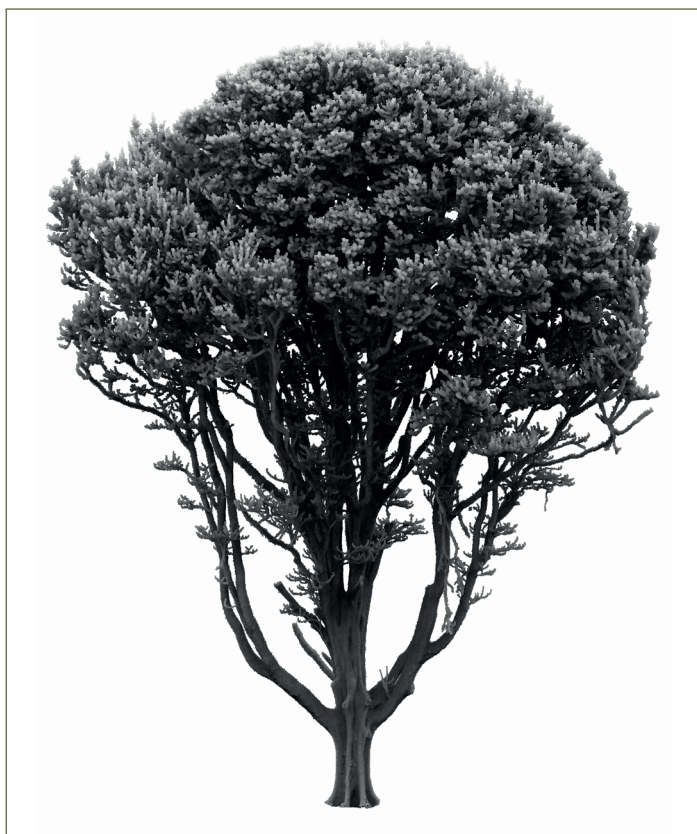


Figure 4. Wytham Woods sycamore terrestrial laser scanning (TLS) point cloud shows the potential of TLS technology to capture detailed 3D structure of trees. Data were captured in 2015 in leaf-off conditions with a RIEGL VZ-400. This tree is estimated to have a DBH of 1.46m, a height of 30.5m, a vertical crown projected area of 465m² and a volume of 65m³ (Calders et al., 2023).

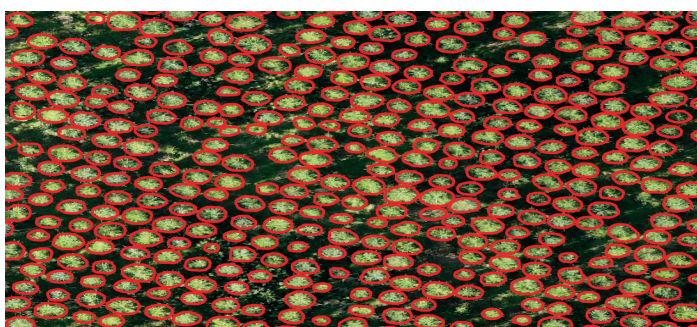


Figure 5. Machine learning algorithms coupled with high resolution drone imagery identify, count and measure individual trees in an afforestation project. The technology company CSX carbon has developed skills for the accurate measurement of carbon sequestration. Set up by Andy Howard and Edward Milbank in 2020, CSX carbon uses the latest in earth observation technologies (ground, airborne, satellite) and data analytics to improve the measurement, monitoring and verification of above ground biomass (AGB). This approach provides accurate verification of carbon sequestration for purchasers of offsets from nature-based solutions. CSX also support and work alongside Ghent and Oxford Universities applying the TLS ground-based imaging methodology described by Kim Calderys in Figure 4 to UK forests. See <https://csxcarbon.com/csx-natural-capital-management/>. (Photo: Andy Howard)

tree breeding and better matching of timber properties to available market opportunities (Figure 4 & 5).

‘Smart silviculture’ – a ‘tech savvy’ approach to silviculture – that provides regularly updated, reliable data with accurate interpretation could enable more confident and adaptive decision-making. Building the skills and developing the scale of activity that justifies such an investment will bring new entrants into forestry and demand business-to-business collaboration.

11. New technologies improve worker health and safety

There is increasing investment in remote-controlled devices and automation, such as remotely operated machinery and using drones to carry harvesting tools. These approaches eliminate exposure to health hazards like machine vibration and lessen the need for manually demanding work. Simulators and virtual reality can be used in training, such as how to operate harvesting machines and chainsaws. Improved digital connectivity to remote areas will improve the response to safety or accident alerts.

Emerging technologies will revolutionise working practices and deliver significant improvements for health and safety across the forest sector, if rigorously applied.

12. New wood product markets stimulate more active forest management

Timber and wood products are replacing more carbon-intensive material such as steel, concrete, and plastic. Engineered wood, use of wood fibre for clothing and other technical innovations that offer substitutes for products such as plastics widen the market for low quality timber, a diversity of wood products, and trees of minor species (Figure 6). This could provide an economic incentive to bring less commercially viable woodlands into management. Given that lack of woodland management is a risk for long-term resilience and a cause of biodiversity decline, this could have significant wider positive benefits.

Technical innovation could generate new markets with greater potential revenues from managing smaller diameter trees and trees of minor species. This could stimulate forest management in smaller and (currently) less commercially viable woodlands.

13. UK commercial forest resources may not match future value chains

UK forests currently sell most of their output into construction, fencing, pallet, and board markets. New markets are likely to emerge that more efficiently use the whole harvested biomass (see issue 12). Many foresters

will be reminded of the salient lessons learnt from the Napoleonic oak plantings and planting poplars for the matchstick industry. Our challenge today arises from the need to plant and manage multi-species and multi-aged forests for climate change resilience, where the timber output may not match future market requirements.

The forest sector will need to invest in research and development to ensure that the wood properties and yield from future forests can serve a range of future markets that can sustain viable silviculture and financial returns.

14. Unpredictable supply and demand dynamics in global wood product markets

With 80% of its timber being imported, the UK is heavily dependent on a few other countries for sustainable supplies of wood and wood products. Although the UK's dependency on imports may be an appropriate strategy for such a densely populated nation, it comes with risks of potentially sudden shifts in global markets (price and availability). There are also concerns about the social and

environmental impacts of 'offshoring' timber supplies from countries whose sustainability standards may be less stringent than the UK.

The UK forestry sector needs greater flexibility to respond to fluctuations in future supply or market prices.

15. International commitments will spotlight ecosystem integrity and drive monitoring efforts

The UK government has signed up to the goals and targets of the Global Biodiversity Framework (GBF) at the Kunming-Montreal COP15 (Horwood, 2023). Proposed indicators to demonstrate how these targets are being met include a requirement to assess ecosystem structure, composition and function through a newly defined Ecosystem Integrity Index. Whilst currently vague, assessing and monitoring these aspects of a forest and its management will probably guide the development of future forest standards, policy and practice. If applied well, this offers a great opportunity to increase the sector's understanding of ecosystem integrity and incorporate it into



Figure 6. Home grown and manufactured ash glulam beams, Buckland Timber, CREDITON, Devon.

Buckland Timber was founded in 2013 by Devon forester Bill Blight and his farmer neighbour Ralph Nicholson who wanted to make better use of local timber as an alternative to biomass markets. Joined by Robin Nicholson who has an engineering background, the business started with an ambition to produce locally grown laminated timber. Buckland Timber grew by focusing on bespoke products, creating tight or elaborate curves, long-span beams and working with species other than spruce and became the largest glulam manufacturer in the UK. Ten years on Buckland Timber employs 20 staff with a design team of seven and, through partnership with UK Hardwoods, locally grown timber is used for 50% of in-house manufacturing, with the main species being larch, Douglas fir and ash. (Photo: Rhys Warren)

decision-making. New technologies (including eDNA, issue six) may become key monitoring tools for forests and their environmental health.

The Global Biodiversity Framework and its monitoring requirements may become a crucial measure to inform and guide future management decisions.

Discussion

Press coverage following publication of the horizon scan scientific paper focused heavily on the risk of catastrophic forest ecosystem collapse in UK forests over the next 50 years. Given that the Expert Panel highlighted this particular issue, and its fundamental implications for the sector and wider society if it did indeed come to pass, this does seem appropriate. There is evidence that realistic ‘fear-based’ messaging combined with concrete action is necessary to sustain and stimulate urgent and effective action (Hornsey and Fielding, 2020). However, we must take this as a call to action, and respond appropriately as a sector with meaningful and sustained change.

There is little doubt that the next 50 years could bring major changes to UK forests, to how they are managed and to the outputs they deliver. Horizon scanning is a tool to highlight some of the issues that deserve increased attention for the development of research, policy, and practice. Although this horizon scan identified certain issues that threaten all aspects of forestry, others are more focused, yet together they demonstrate how forest management is influenced by a complex suite of interrelated drivers.

The Royal Forestry Society is among the 30 forest sector signatories to the Forestry and Climate Change Adaptation Accord published by the Forestry and Climate Change Partnership (2022). Signatories agreed to “take urgent action, recognize the need to work together, and commit to promote the importance of the adaptation of our trees, woods, and forests to climate change”. The 2022 Accord also updates a set of Principles of Adaptation, which are to:

- Ensure diversity of species, genetics, age, and stand structure (Figure 7).
- Build connectivity in the landscape.
- Understand and anticipate climate change.
- Be risk aware (environmental, social, and economic).

As such the Accord demonstrates that the UK forest sector does broadly understand what needs to be done to



Figure 7. Improving stand resilience can be achieved by adopting multi-aged, multi-species silviculture, as here at the Stourhead (Western) Estate, Wiltshire.

“We must take this as a call to action.”

increase forest resilience. However, there are challenges, not least around capacity and resources that limit the ability of the sector to overcome or dramatically upscale action to safeguard our forests. Achieving the scale of change required may also require a major cultural shift across the sector to help forest managers to embrace adaptive forest management: continually innovating, monitoring, adapting and sharing their learning (Lawrence, 2017).

The degree of uncertainty and unpredictability of issues that have been highlighted means that a wide diversity of forests and forest management will be needed to spread risk and deliver the many benefits that society is seeking from UK forests. Many will need to collaborate (multi-agency, multi-sector and throughout supply chains) to build both a landscape-scale response as well as the confidence that leads to rapid investment, in what will be complex changes in forest management when outcomes are uncertain.

Although many of the issues identified in the horizon scan are significant challenges, many are also opportunities. The purpose of a horizon scan is looking to the future, so we do now have time to act: to embrace the opportunities and tackle the challenges. The next steps are ours to take.

Our thanks to Forestry England and the University of Cambridge for such a thought-provoking initiative, well-executed and now disseminated. The full scientific paper is freely available in the journal *Forestry* – see the References for full details.

We are delighted that the Forestry Commission and the Institute of Chartered Foresters will be leading a response to this horizon scan in 2024, starting with a series of webinars to explore all the issues in more detail. We hope that the RFS and individual members will engage in the debate and give careful consideration to these issues. May this exercise unite the effort and investment needed to safeguard our forests and the businesses that depend on them for future generations.

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