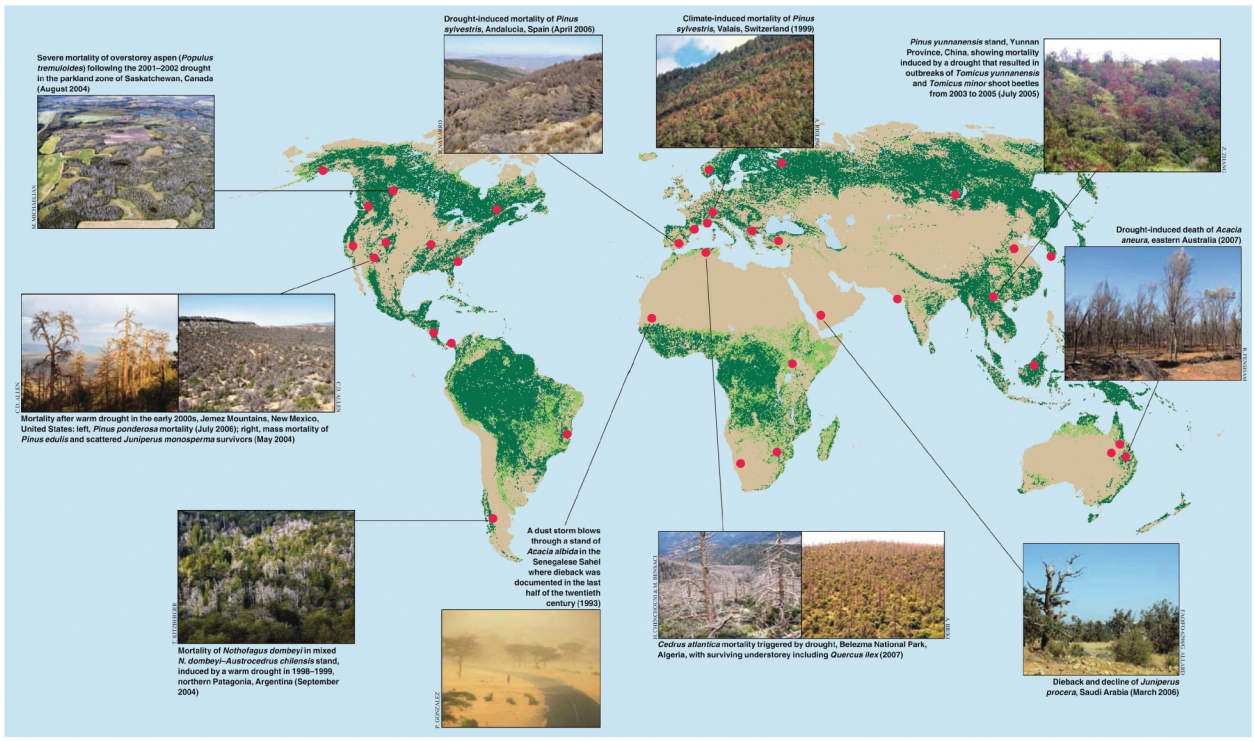
Are our forests running out of time?

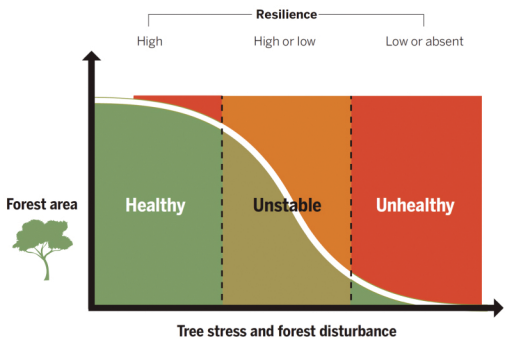


Forest areas currently undergoing dieback, attributed to climate change. Source: Allen (2009).

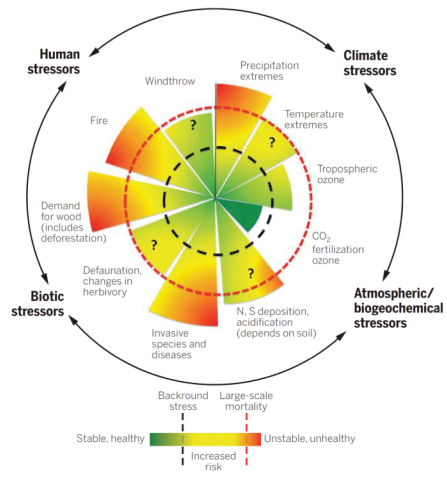
Example of drought-related mortality worldwide

Region/country	Forest type
Africa	
Algeria	*Cedrus atlantica*
Namibia	*Aloe dichotoma*
Senegal	*Acacia*, *Cordyla*, *Nauclea* and *Sterculia* species
South Africa	*Dichrostachys*, *Pterocarpus* and *Strychnos* species in the northeast
Uganda	*Uvariopsis* and *Celtis* species in tropical moist forest
Asia and the Pacific	
Australia	*Eucalyptus* and *Corymbia* species in the northeast
China	*Pinus tabulaeformia* in east and central regions, *Pinus yunnanensis* in the southwest
India	*Acacia*, *Terminalia* and *Emblica* species in the northwest
Malaysia	Dipterocarpaceae in tropical moist forests in Borneo
Republic of Korea	*Abies koreana*
Russian Federation	*Picea* and *Pinus* species in temperate and boreal forests of Siberia
Europe	
France	*Abies*, *Fagus*, *Picea*, *Pinus* and *Quercus* species
Greece	*Abies alba* in the north
Norway	*Picea abies* in the southeast
Russian Federation	*Picea obovata* in the northwest
Spain	*Fagus*, *Pinus* and *Quercus* species
Switzerland	*Pinus sylvestris*
Latin America and the Caribbean	
Argentina	*Austrocedrus* and *Nothofagus* species in Patagonia
Brazil	Atlantic tropical semi-deciduous forest in the southeast
Costa Rica	Tropical moist forest
Panama	Tropical moist forest
Near East	
Turkey	*Pinus* and *Quercus* species in the central region
Saudia Arabia	*Juniperus procera*
North America	
Canada	*Acer*, *Picea*, *Pinus* and *Populus* species
United States	*Abies*, *Fraxinus*, *Juniperus*, *Picea*, *Pinus*, *Populus*, *Pseudotsuga* and *Quercus* species

Forest areas currently undergoing dieback. Source: Allen (2009).



Resilience is indicated by the tendency of a system to stay in its current state (high resilience) or to switch to another state (low resilience). The green area indicates forests experiencing background levels of stress and disturbance that are relatively limited, affect mostly small areas, and cause no fundamental changes in forest functioning. Such forests tend to be resilient at a broad range of spatial scales. As unprecedented levels of tree stress and disturbances are reached, the area experiencing complete breakdown of basic functions and resilience is expected to substantially increase, creating positive feedbacks with climate that could cross a threshold and lead to a novel (non-forest) ecosystem. Source: Trumbore *et al.* (2015).



Examples of different stresses and disturbances affecting forests and how they are expected to change in the future, compared with preindustrial levels. Stressors can be broadly placed in categories such as "climate," "biotic," and "human," but there are many connections among them. For example, a tree stressed by drought may succumb more easily to insect or disease outbreak. Many global changes that can negatively affect forests have increased in severity and frequency in recent decades, and are predicted to increase further in the future. Question marks signify processes for which uncertainties are large, highlighting the need for further research. Source: Trumbore *et al.* (2015).

Our research has shown how our native woodlands, specifically the ancient woodlands of the New Forest, are changing.

Many beech trees are currently dying because of the combined effects of climate change and the spread of pathogens. Many other native tree species, including oak, ash and alder, are also at risk. This problem likely to worsen in future, with the intensification of climate change and the spread of new pests and diseases.

Loss of trees has major impacts on wildlife and on the functioning of ecosystems. The decline of woodlands also affects their value to people. Our research has also shown that people appreciate native trees and woodlands, both in terms of their aesthetic value and for recreation. In addition, woodlands are valuable for production of timber and fuelwood, for storage of carbon, and for their role in regulating flood risk, climate and water quality. These services provided to people are all at risk if woodland dieback occurs.

The problem of beech dieback is not limited to the New Forest. Many other beech woods in southern England are showing similar symptoms. In fact, beech is suffering dieback throughout its natural range in northern and central Europe, a process that has widely been attributed to the impact of climate change, and its interaction with pathogenic fungi. The fact that beech is relatively shallow-rooted means that it is particularly susceptible to drought. As climate change intensifies, many other tree species could also become affected.

Recent surveys indicate that large-scale forest dieback is becoming increasingly widespread in many different parts of the world. Evidence suggests that climate change is a major contributory factor to this increase in tree mortality. Recent research indicates that warmer temperatures alone can increase forest water stress independent of changes in precipitation. In addition, warmer temperatures can directly accelerate drought-induced mortality of trees. Greater chronic forest stress and increased tree mortality risk is expected in many areas in coming decades, owing to increases in temperature and the frequency of extreme events such as severe droughts and heat waves.

Although native forests are adapted to some level of disturbance, all forests now face novel stresses in the form of climate change, invasive pests and air pollution. Detecting how intensification of these stresses will affect forests represents a major scientific challenge. It is particularly important to identify thresholds for rapid forest decline, as in our own research, because it can take many decades for forests to recover.

What can be done about this problem? We need to strengthen the resilience of forests to environmental change, so that they can recover more rapidly from disturbance. In the New Forest, this could mean protecting trees from herbivory, to help woodlands recover from dieback. Reducing other forms of disturbance, such as the cutting or damaging of trees and the amount of air pollution, would also help.

Many tree pests and diseases are being spread by the horticulture trade. These risks can be reduced by purchasing disease-free planting stock from reputable suppliers, and by purchasing plant material that has been grown in the UK. Practising good plant hygiene and biosecurity in gardens and woodlands can also help prevent accidental spread of plant diseases.

- You can report your sightings of diseased or dying trees to Tree Alert, hosted by the Forestry Commission: http://www.forestry.gov.uk/treealert
- You can help map and monitor the health of ancient trees by participating in the Ancient Tree Hunt, organised by the Woodland Trust http://www.ancient-tree-hunt.org.uk/
- You can support organisations that campaign to save forests, such as WWF UK and Greenpeace. In the New Forest, local conservation organisations include the New Forest Association and the Hampshire & Isle of Wight Wildlife Trust.
- You can help address climate change by reducing your use of fossil fuels, and using energy more wisely. Planting trees can also help – a single tree will absorb approximately one tonne of carbon dioxide during its lifetime.

bess biodiversity & ecosystem service sustainability

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