UNIVERSITY OF BIRMINGHAM

RESEARCH THAT MATTERS

BIRMINGHAM INSTITUTE OF FOREST RESEARCH (BIFoR)

The University of Birmingham has established a significant research effort to provide the fundamental science, social science, and cultural research on woodlands and forests necessary to enable 'one-planet' sustainable living.

Whilst pursuing this broader remit, the Birmingham Institute of Forest Research (BIFoR) will focus initially on the impact of environmental change on woodlands, and on the resilience of woodlands to pests and diseases.

The Institute's key research infrastructure is a 'next generation' Free-Air Carbon dioxide Enrichment (FACE) facility to study the ecosystem-level effects of increased carbon dioxide (CO_2) on mature oak woodland

BIFoR FACE directly addresses to what extent mature woodland ecosystems trap carbon – with profound consequences for future climate change.

BIFoR FACE was made possible by a generous gift of £15 million (plus access to a suitable site and refurbished field headquarters) by Birmingham alumnus Professor Jo Bradwell and his wife Barbara.

Image Credit Norbury Estate

The knowledge gap

- The atmospheric concentration of carbon dioxide has increased by more than 40 per cent since pre-industrial times, and will continue to increase at least over the coming decades, trapping more heat in the lower atmosphere.
- Approximately one in three CO_2 molecules produced by human use of fossil fuels have been captured by the land surface, mostly by trees. Whether this will be maintained in the future is not certain because we do not know how mature woodlands react to climate change.
- The higher temperatures, severe weather events, displacement of populations, and economic pressures caused by climate change will drive landscape change in ways we cannot yet forecast.
- It is not yet established what type of re-afforestation works best for each of the key sustainability drivers.
- It is not clear how society's needs for provisioning, regulating and cultural ecosystem services can be brought into balance, or how these can best deliver health and wellbeing benefits.
- The dynamic responses of woodlands and forests to combinations of climate change and pests and diseases are only partially understood, because there have been too few experiments on mature unmanaged (wild) forests of sufficient scientific depth and duration.

Background

- Woodlands and forests are home to more than half of all species.
- Forests are critical components of global carbon, nutrient and water cycles, influencing the thermal balance of the planet directly and indirectly.
- Forests deliver direct economic, environmental and social benefits, ranging from fuel and building materials to the sense of wellbeing associated with a walk in the woods.
- Forests also deliver services that underpin the production of food, clean water and the breakdown of waste products.
- As human populations have expanded, increasing pressures have been placed on forests, with the 20th century witnessing the steepest rise in rates of deforestation.
- All visions of sustainable UK growth recognise the need for increased forest coverage for energy security, food security, water quality and quantity, and biodiversity.

BIRMINGHAM INSTITUTE OF FOREST RESEARCH (BIFoR)

www.birmingham.ac.uk

BIFoR FACE

The BIFoR FACE facility is designed to study the impact of rising carbon dioxide levels in mature oak woodland. In addition to on-campus laboratories there are field facilities in a woodland area, enabling scientists to take measurements from deep within the soil to above the tree canopy. Autonomous sensors and instrumented trees allow scientists to take measurements continuously and remotely, over timescales ranging from seconds to decades.

Image Credit Andrew Priest Photography
www.pro-photographers.co.uk

The detail

CO_2 and FACE: The dynamic response of forests to environmental change, including climate change, is only partially understood. Rising CO_2 is unavoidable in the coming decades, and will have direct effects on every ecosystem, yet because of the technical challenges and costs involved, experimental data on mature trees, woodlands and forests are lacking. To increase understanding, BIFoR has built a full-scale free-air carbon dioxide enrichment (FACE) facility, set in a woodland of 150-year-old oak standards and unmanaged hazel coppice, and started experimental CO_2 delivery in April 2017. The basic construction of a woodland-FACE experiment is a cylindrical ring structure, as wide and as high as the tree canopy (approximately 25 metres), open to weather, pollen, spores, animals, etc. The rings support pipes that deliver CO_2 in such a way that the woodland inside the ring is immersed in elevated CO_2 but the rest of the woodland remains unaffected.

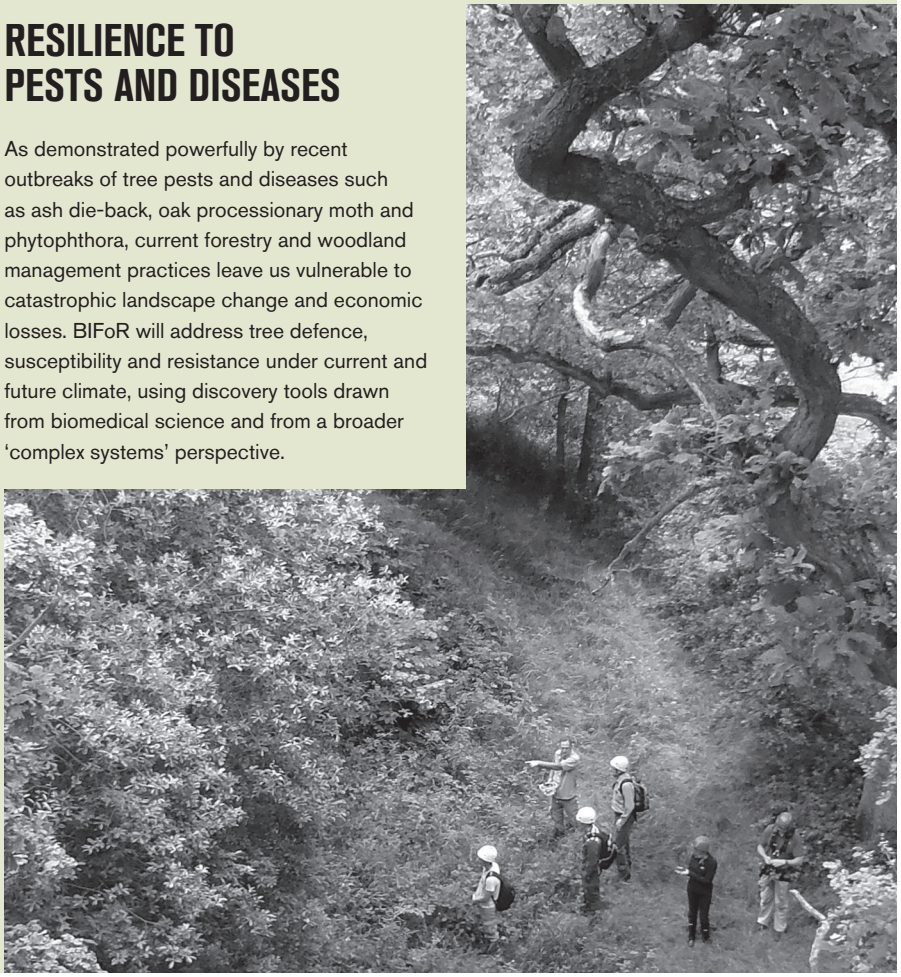
To maintain the naturalness of the system, winds continuously disperse the CO_2, so it must be replenished, using an average of 15 tonnes per day. Substantial gas handling facilities are required. The carbon 'sacrificed' in the experiment for scientific purposes is a tiny fraction of carbon released into the atmosphere each day as a result of UK scientific activities and a miniscule part of the UK's overall carbon footprint. Forest FACE experiments in mature forests — of which BIFoR FACE is one of only three globally — are 'big science', terrestrial ecology's version of the space programme. Like large physics experiments or advanced manufacturing centres, BIFoR FACE requires sustained investment and stringent quality assurance and quality control. Only in this way can the project follow the carbon from leaf to stem to root and beyond, to establish the true contribution of mature forests to the removal of CO_2 from the air.

RESILIENCE TO PESTS AND DISEASES

As demonstrated powerfully by recent outbreaks of tree pests and diseases such as ash die-back, oak processionary moth and phytophthora, current forestry and woodland management practices leave us vulnerable to catastrophic landscape change and economic losses. BIFoR will address tree defence, susceptibility and resistance under current and future climate, using discovery tools drawn from biomedical science and from a broader 'complex systems' perspective.

NATURE-BASED SOLUTIONS

Much of the remainder of the work undertaken through BIFoR relates to the costs and benefits of societal goods extracted from wooded landscapes in urban and rural settings. This research is framed in terms of ecosystem services, green infrastructure, and nature-based solutions. BIFoR chemists, physicists, and engineers are quantifying the effects of vegetation on air pollution. Investigators across the life, environmental and public health sciences are extending the evidence base on how the quality of physical activity and the quality of the surrounding environment deliver physical and mental health benefits. Social science and cultural researchers critique and contextualise past, current and future approaches to land use and forest governance.



Designed and printed by

UNIVERSITY OF BIRMINGHAM | creativemedia

15014