

BIRMINGHAM INSTITUTE OF FOREST RESEARCH (BIFoR)



Annual Report: 2021 / 2022

Front page caption: Dr **Carolina Mayoral** using the canopy access system at the BIFoR FACE Facility

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Page 6: Robert Grzesik by Peter Miles

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Page 6: Catkins by Sophie Mills

Page 7: ARES by Sami Ullah

Page 7: QUINTUS plot by Robert Grzesik

Page 7: Soil moisture by Giulio Curioni

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Page 11: MEMBRA map by Adriane Esquivel Muelbert

Page 11: IPHC Scotland Plant Health Centre (Twitter)

Pages 12 & 13: by Adriane Esquivel Muelbert

Page 14: Anthology front page by Vahid Davar

Page 15: by Clare Hewitt and Dion Dobrzynski

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Introduction

Forests are increasingly making the headlines against the backdrop of the pledge made at COP26 of 140 countries to eliminate forest loss by 2030. This pledge also commits to support forest restoration, sustainable production and consumption. BIFoR, in just 8 years, has established strong roots and is now poised to deliver world-leading research that influences policy. Our ever-increasing number of academics are actively making contributions to the knowledge and evidence bank required to work towards a better [State of the World's Forests](#).

New appointments include; Honorary Prof. **Richard Norby**; Prof. **James McDonald** (Prof. of Microbial Ecology); Dr **Juliano Sarmiento Cabral** (Associate Prof. for Biodiversity Modelling and Environmental Change); Dr **Shoaib Amjad** (visiting Assistant Professor from Women University AJ&K Bagh, Pakistan); Dr **Johanna Pihlblad** (postdoctoral researcher joining the FACE underground project); Dr **Yafei Gao** (postdoctoral research joining the DiRTS project); Dr **Bruno Cintra**, Dr **Rodrigo Bergamin**, **Rachel Mailes** (Researchers joining the UKRI Treescapes/MEMBRA project); **Kapil Subramanian** and **Justine Philips** (research fellows in the [MaMoGH](#) project). Prof. **Sami Ullah** has been appointed academic lead for BIFoR FACE and a BIFoR Director and Dr **Emma Ferranti** has taken a new role as Senior Lecturer in Civil Engineering but remains a key part of the Institute.

In addition, the new members of the 'Forest Health' team that started in September 2020 (three postdoctoral researchers and 5 PhD students), have quickly helped increase the visibility and reputation of BIFoR in the plant pathology community ([page 10](#)). The recently funded **DiversiTree** project will further build the Institute's reputation within the UK by establishing a new collaboration with James Hutton Institute ([page 22](#)). Recent recruits also continue to impress, with Dr **Florian Busch** achieving a perfect 10 score for a new

research NERC standard grant project (£870,000) that will use cutting-edge technology and mathematical modelling to advance our understanding of plant carbon uptake.

Despite all the challenges brought by disturbances to carbon dioxide supplies internationally our fantastic team running the linchpin FACE experiment kept the experiment running with minimal disruptions to the CO2 fumigation (p5) through the growing season. BIFoR and Wykes Engineering were awarded a National Sustainability Award 2022 under the category of 'Partnership of the Year.' ([p5](#))

'BIFoR Global' research was put on the map thanks to the successful BIFoR annual meeting 'Transforming our Understanding of Global Forests' in June 2022, organised by Dr **Adriane Esquivel Muelbert** & Dr **Thomas Pugh** ([p 12](#)).

Our Interdisciplinary research is bolstered by the Forest Edge Doctoral Scholarship which will see the first cohort of students close to graduation ([page 14](#)).

In 2022 the announcement of a new Natural History GCSE brought about great excitement within Forest Education Networks, as there will be clear opportunities to bring in teaching about British forests. A new Education and Outreach officer starts soon and will continue to build on our exciting education resource ([page 16](#)).

Our Vision

BIFoR will be an internationally leading Institute that will address fundamental and interrelated challenges:

1. The impact of global change on forest ecosystems
2. The resilience of trees to invasive pests & diseases
3. The importance of trees and forests to humans and non-humans

Our research in four key themes:

1. **Climate** - The impact of climate and environmental change on woodlands
2. **Health** - The resilience of trees to invasive pests and diseases
3. **Global** - big data approaches across space and deep time
4. **Interdisciplinary** - Understanding the wider importance of trees and forests to human and non-human actors

Climate: BIFoR FACE - The impact of climate and environmental change on woodlands

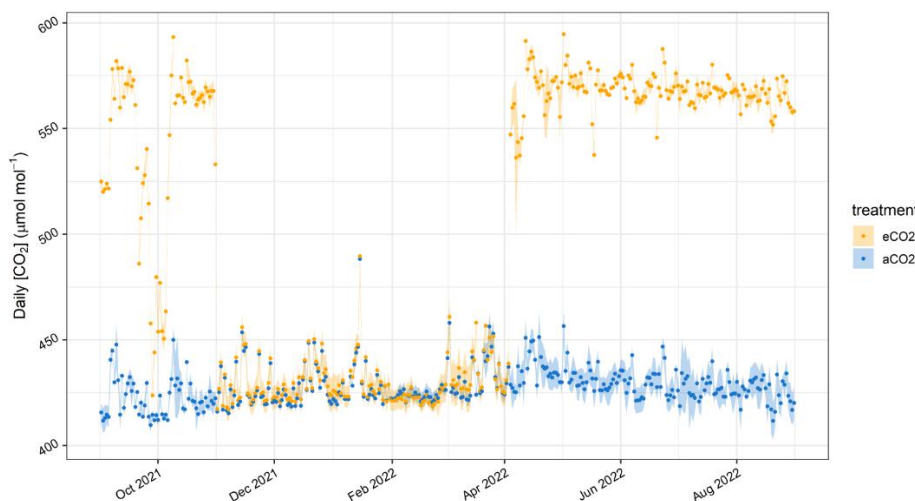
2022 marks the sixth year of fumigation of 30-meter diameter plots of mature oak forest with elevated CO₂ concentrations (+150 ppm above ambient), which represents the predicted CO₂ concentrations in our atmosphere in 2050. The growing season (March to October) has seen significant environmental changes through the season and in comparison to previous years. The Wood Brook river running alongside the woodland completely dried up completely for example.

The FACE fumigation with CO₂ has continued to out-perform expectations and delivered elevated CO₂ concentrations at or very near to the target of +150 ppm above the ambient (see figure below). The later part of the season has been impacted by the soaring costs and supply demands of carbon dioxide; however, the FACE team have been able to minimize the scientific risks.

This year the FACE team established an exemplary partnership with Wykes Engineering for the supply of CO₂ from 2023 through to the end of the planned experiment in 2027. This was done against the backdrop of sharply rising CO₂ costs, where the price of CO₂ tripled overnight threatening the continuation of the experiment. Wykes Engineering is the largest Anaerobic Digestion (AD) Facility in the UK, that utilises food and poultry wastes for bioenergy generation and bio-derived fertilizers. Wykes has committed to be a part of the circular economy. Wykes's AD process produces methane and as a bi-product also releases

CO₂. Wykes Engineering invested in CO₂ capturing technology and approached BIFoR FACE to gauge our interest in using this CO₂ for our long-term experiment. Given the volatile prices of CO₂ derived from fossil fuels as well as the benefits of using CO₂ that would otherwise be considered "waste" this partnership is a substantial step forward in sustainability for both BIFoR and Wykes Engineering. This excellent collaboration was recently recognized by the **UK National Sustainability Awards** - BIFoR and Wykes Engineering were awarded "Partnership of the Year."

Our NERC large grant, the [QUINTUS project](#) led by Prof. **Rob MacKenzie**, is piecing together the carbon and nutrient cycles under elevated CO₂. Emerging results were reported at the NDG James Memorial Lecture of the Royal Forestry Society. Three linked papers from doctoral researcher Anna Gardner show CO₂ uptake by the dominant oak trees through photosynthesis was increased by 23%, leaf nitrogen increased in-line with leaf carbon, and stomatal conductance decreased. Gardner et al, ([2021](#), [2022](#)). The tree growth data together with litter fall, fruiting bodies production, root production and root exudation of carbon into the rhizosphere (the later as part of the NERC Discovery grant ([FACE Underground](#) led by Prof. **Sami Ullah**) have now been put together for the estimation of an overall increase in net primary productivity of the wood.



Average measured CO₂ concentrations taken from the elevated (eCO₂) and control arrays (aCO₂) measured from September 2021 to September 2022



Growing our own talent – Robert Grzesik’s career has seen him move from BIFoR volunteer, to Field Technician to Senior Research Technician.



The FACE Operations team are happy to engage with visitors. **Gael Denny** (pictured) and the team will all take time to support and lead tours.

The following pages cover some of the measurements at BIFoR FACE. The expanding on site data collection supports the research of PhD students by giving them access to samples that would otherwise be beyond the financial scope of their PhD funding. The expanding PhD student community working directly at the FACE facility has been invaluable to advancing & expanding the cutting-edge research being undertaken. The data being generated are curated, recorded & stored at the BIFoR Data Archive portal & the physical samples (litter, green leaves, soil, and associated soil biodiversity samples) are archived in a dedicated dry storage area & freezers (-20 & -80 °C) facility on campus. This careful curation is overseen by Data Manager & Analyst, Dr **Giulio Curioni**.

Atmospheric processes research

Example core measurements and images of some project specific measurements

- Wind speed
- Air temperature and relative humidity profile
- Solar and net radiation
- CO₂, H₂O, CH₄, fluxes



Alexander Armstrong (NERC-CENTA PhD) used an advanced isotopic analyser (Picarro model G2201-I) from PICARO Pvt Ltd for 3 months. The analyser was installed to track down the source of the respired carbon by microbes and roots through ¹³CO₂ and ¹³CH₄ gas fluxes. The new data will help determine the proportion of respired carbon from different sources including the new carbon captured by the trees. A data note for [PICARRO](#) will follow.



BIFoR FACE was also approached in 2022 by the **Polish Academy of Science** (Dr **Zuzanna Filipiak**) for sharing pollen of dominant tree species for collaborative research on the evaluation of climate change on pollen stoichiometry and its implications for biodiversity (evaluated via a model honeybee species foraging on pollens). Collaborative work is now underway with the Polish Academy of Science and BIFoR look forward to the ever-expanding collaborative and research outputs from this unique climate change experiment.

Belowground research

Example core measurements and images of some project specific measurements

- Fine Root development
- Soil CO₂, N₂O and CH₄ fluxes
- N mineralization and N₂O source partitioning
- lab analysis for nutrients (cations, anions), particle size distribution at least three times a year



- Leaf litter
- pH, soil type, organic matter content, CEC, bulk density
- Soil Sampling and Lab analysis
- Hyphal growth and turnover



Data collection in 2022 covering core physico-chemical and biological characteristics of the FACE arrays and the associated nutrient fertilization automated root exudation systems (ARES) forest plots outside the FACE arrays continued.

Forest hydrology

Example core measurements and images of some project specific measurements

- Throughfall precipitation (ground level)
- Groundwater levels
- Field precipitation (ground level)



With the funding support of the QUINTUS project, the FACE facility has also seen extensive soil moisture sensor installation up to a meter depth in the summer of 2022.

- Soil moisture
- Soil pore water



Lysimeters (soil pore water sampling devices) are being installed at similar depths to the moisture sensors to explore the interactions between soil moisture dynamics and nutrient and carbon concentrations and their movement across the meter-deep soil profile.

Aboveground measurements

Example core measurements and images of some project specific measurements

- Vegetation indices – Phenocam
- Tree stem growth
- Tissue samples of leaves buds & catkins bio banked for future research
- Leaf Area measurements of green leaves
- Soil moisture (gravimetric and volumetric) & soil temperature
- Each tree is identified and given a number
- Leaf Area Index – both hemispherical and direct methods
- Phenology and biodiversity observations, including bryophyte, deadwood surveys
- Leaf litter traps – matter is separated into different categories including a 'woody material' archive and 'reproductive output' archive



Inside the recently refurbished Terraced huts

The ever-increasing demands of sample (soil, tissues, air, biota) sorting, processing and characterization in the laboratories was met by the University of Birmingham via investment of £50,000 for the refurbishment of the Terraced Huts laboratories to meet the needs for processing of soil, water and tissue samples. The refurbishment of the Terraced Huts laboratory was followed by a substantial discount deal for BIFoR with SciQuip Ltd where laboratory equipment (Orbitor shaker to fridge and water baths) worth of £26,000 was offered at half price. The Terraced Huts lab is now occupied by researchers using it to its full capacity for sample processing.

Microbial processes

- Soil fungal metagenomics
- Macrofungi surveys

New review by doctoral researcher Aileen Baird on the importance of fungi in the context of tree planting [Baird, A. and Pope, F. \(2022\)](#).

Animals

- Camera traps are installed through the woodland

BIFoR FACE have entered a partnership with [BIOSCAN](#) - an international project focused on DNA barcoding for species discovery, interactions and dynamics as influenced by many ecological and climate change factors. Entomological traps set up at BIFoR FACE will provide the specimens to BIOSCAN for DNA barcoding and identification. This will complement the on-going entomology research led by Dr **Scott Hayward** at BIFoR FACE in addition to helping the international community in understanding the response of species to future climates with associated implications for biodiversity conservation.



Research Collaborators at BIFoR FACE

BIFoR engages with more than 55 stakeholders. Throughout 2021/22 we have continued to work closely with national and international research collaborators, strengthening collaborations with:

- **Research institutions** - Amazon FACE, Centre for Ecology and Hydrology, CSIRO, Earthwatch Institute, EucFACE, Forest Research, Laboratoire des Sciences du Climat et de l'Environnement (LSSCE), Met Office, Max Planck Institute for Biogeochemistry, National Centre for Atmospheric Research (NCAR), NIAB, and the Met Office.
- **Education stakeholders** – Universities of Bangor, Birmingham City, Bolgna, Bristol, California Davis, Exeter, Harper Adams, Helsinki, Imperial College London, Keele, Leicester, Lancaster, Lund, Manchester, Munich, New South Wales (Australia) Plymouth, Reading, Southampton, Stafford, Swansea, Tennessee, Tianjin Normal University (China), Warwick, Western Sydney, Unicamp (Brazil) and the Open University.
- **Others** – the [Ecological Continuity Trust](#), the [Small Woods Association](#), the **STEAMHouse** art project ([Clare Hewitt](#)), the **British Bryological Society** and [ArtDocs](#)

New 2022 funding into BIFoR FACE

- The role of mesophyll CO₂ diffusion in modulating the response of photosynthetic carbon uptake to CO₂ enrichment of a mature temperate forest (2022 – 2025) a £870,000 NERC funded standard grant, led by Dr **Florian Busch** (University of Birmingham)
- [CLEANFOREST](#) EU Cost Action on Joint effects of Climate Extremes and Atmospheric deposition on European FORESTs (2022 to 2026) looking at how different global change drivers affect forest responses and how experimental manipulation experiments (e.g. BIFoR FACE among others) can help in quantifying the response of forests to global change. Prof. **Sami Ullah** is Co-I on the Cost Action and member of the CLEANFOREST Management Committee.
- Royal Society International Exchange (2022-24) Effects of simulated increase in nitrogen deposition on mature deciduous forests in the UK and Italy: above and belowground responses (£12,000). Work now underway at BIFoR and an oak woodland in Italy, led by Prof. **Sami Ullah**.

Research Council funded collaborations ongoing:

- [MEMBRA](#) (2021 - 2024) Understanding Memory of UK Treescapes for Better Resilience and Adaptation, funded the UKRI Treescapes Program (£1.9 million). Research now underway both at BIFoR-FACE and the Wolfson Advanced Glasshouses among a country-wide sites. Led by Dr **Estrella Luna Diez** (University of Birmingham) with Dr **Marco Catoni**, Dr **Adriane Esquivel Muelbert**, Dr **Scott Hayward**, and Prof. **Rob MacKenzie**.
- [QUINTUS](#) (2018 - 2024) - a £3.7m NERC funded large grant project, Quinquennial (half-decadal) carbon and nutrient dynamics in temperate forests: Implications for carbon sequestration in a high carbon dioxide world, led by Prof. **Rob MacKenzie** (University of Birmingham)
- [FACE Underground](#) (2020 - 2023) - a standard NERC funded project. This project will use the FACE experiment to determine whether mature temperate forests will be able to access more soil nutrients under elevated carbon dioxide (eCO₂), led by Prof. **Sami Ullah** (University of Birmingham)
- Distributed Real Time Soil (DiRTS) Monitoring project (£1.5 million with £0.4 million to BIFoR, 2021-2024) funded by joint NERC-NSF call under the Signals in the Soil program is underway currently developing ion-selective electrode sensors for in situ nutrient sensing in soils and evaluating how in situ sensing of mineral nitrogen relates to greenhouse gas-N₂O fluxes, led by Prof. **Sami Ullah**.
- [Disentangling mechanisms of co-adaptation between trees and soil food webs in response to environmental perturbations](#) (2019 - 2022) - a NERC funded project, led by Prof. **David Johnson** (University of Manchester) in collaboration with Prof. **Rob MacKenzie** (University of Birmingham).

Health – The resilience of trees to invasive pests and diseases

Tree health research at BIFoR continues to grow from strength to strength. We welcome the arrival of Professor **James McDonald** to the University of Birmingham and BIFoR. **James** brings a wealth of knowledge of microbial ecology and microbiomes. He is currently carrying out the UK's largest analysis of oak-associated microbes to identify those that might cause disease as well as identify beneficial microbes, with a view to developing ways of using beneficial microbes to support oak health.

There has been further success in the latest Treescapes funding round, with **Rob Jackson** and **Olivia Mosley** being awarded funds as part of a project, called DiversiTree, led by **Ruth Mitchell** at the James Hutton Institute ([page 22](#)). This will focus on whether planting mixtures of tree species leads to increased microbial diversity on leaves and improved resilience to pathogens.

Two of our [Action Oak](#) -affiliated students are making great progress with their projects: **Emily Grace** has, for the first time, identified bacteriophage (a type of virus) that target two of the acute oak decline pathogens, *Brenneria goodwinni* and *Gibbsiella quercinecans*. These are being studied to see whether they can be used as a therapeutic to treat diseased trees. **Vanja Milenkovic** is examining whether mulching of trees leads to improvements in tree health, and after much scoping of sites, she is focussed on oak trees in Wyre Forest. In two months' time, **Rob Jackson** becomes President of the British Society for Plant Pathology representing plant pathology members from around the world.

The [MEMBRA](#) investigators and research team have been very busy this year kicking off the project and performing all the necessary fieldwork. They have surveyed trees across the UK and have sampled about 70% of the material for DNA methylation.

The year has been marked by extreme drought and high temperatures and one thing that they have observed is the increased incidence of ash dieback disease. This disease, caused by a fungal pathogen, seems to have sped up and the team has only been able to find a handful of fully healthy trees. The team has done all the necessary samplings to assess memory of the disease in different age trees as well as in their progenies this last summer and have prioritised this work in case the trees do not make it through to next summer. This work has been supported by **Jo Clark** from the [Future Trees Trust](#) and **Paul Hill** from the [Earth Trust](#) as they provided access to the ash trials in Little Wittenham (Oxfordshire).

Academics and researchers from BIFoR attended the [Action Oak](#) Partners' event hosted at the Royal Botanical Gardens Kew on the 7 June 2022. Dr **Estrella Luna Diez** presented the latest results on the effect of elevated CO₂ in seedlings and mature oak trees as well as introducing the work that [MEMBRA](#) will be doing with oak trees, aiming to understand the memory of different stresses, including drought and Acute Oak Decline (AOD).

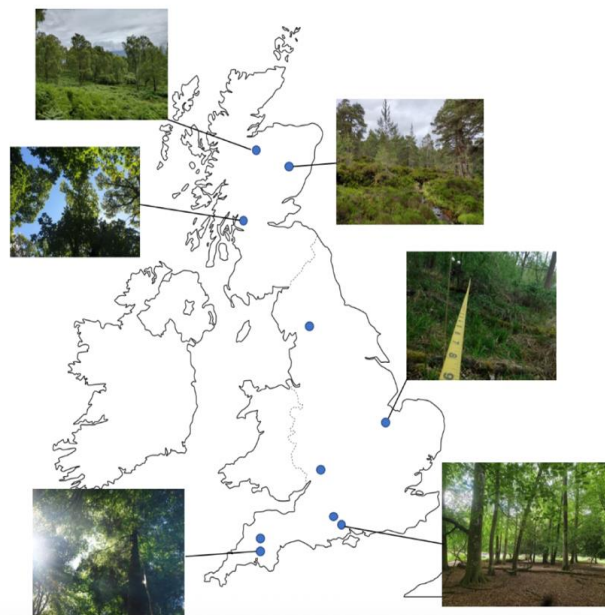
Drs **Graeme Kettles** and **Thomas Welch** have developed methodology for performing disease phenotyping of oak seedlings against AOD and the Oak powdery mildew fungus. This has revealed that there is a wide spectrum of responses in UK oak populations against these two pathogens, with many oak seedlings highly resistant. The team are now using association transcriptomics to understand how particular oak gene variants, or gene expression patterns, allow some trees to be resistant to these pathogens whereas others are highly susceptible. This work aims to identify genetic markers that would allow prediction of which trees will be vulnerable to disease in the future.



MEMBRA fieldwork sampling leaves and seeds from ash trees showing different levels of ash dieback disease in Paradise Woods, The Earth Trust, and Little Wittenham. Dr **Estrella Luna Diez**, **Peter Miles** and **Iwan Evans**.



Rob Jackson and **Amy Webster** with St Helena research and conservation team in the cloud forest peaks on the island. Several indigenous tree species, such as Black Cabbage tree, are at severe risk of extinction from an unknown disease – **Rob** and **Amy** are trying to uncover the cause.



The [MEMBRA ecology team](#) (**Bruno Ladvoat Cintra**, **Rodrigo Bergamin** and **Rachel Mailes**) coordinated by **Adriane Esquivel Muelbert** had a very successful fieldwork season. MEMBRA is a UKRI Future of Treescapes funded project. The team has measured over 7,000 [tree] stems in 11 sites across the UK – from Devon to Avimore. These sites have rare records or forest dynamics dating back to the 60s. These new data will allow us to understand the impact of recent environmental changes on UK woodlands.



The inaugural International Plant Health Conference (IPHC) was opened by Prof. **Nicola Spence** and saw BIFoR academics lead a side session, 'Forest Health in a Changing Climate – risks, mitigations and tools' alongside the **FAO**, **Defra**, **UK Met Office** and **EucFACE**, **Western Sydney University**.

Global – Big data approaches across space and deep time

The BIFoR annual meeting took place 21 – 23 June 2022 and this year we took the opportunity to highlight our global research. The annual meeting was called [‘Transforming our Understanding of Global Forests’](#) and was organised by Dr **Adriane Esquivel Muelbert** and Dr **Thomas Pugh** with support from **Deanne Brettle**. The conference brought us closer to a shared vision for a [‘Global Forest Observatory.’](#) The conference was described by keynote speaker, Prof. **Jérôme Chave** as “packed with jaw-dropping talks, from physiology, ecology, social sciences, forestry, remote sensing and modelling.” The posters and recordings of some of the talks are still available on our [website](#).



A highlight was the FACE session, wherein for the first time we had live talks from [Amazon FACE](#) (**David Lapola**, Brazil), [BIFoR FACE](#) (**Sami Ullah** in person) and [EucFACE](#) (**Belinda Medlyn**, Australia). This was with thanks to the hybrid nature of the meeting and the commitment of our collaborators to endure the time differences!



Our conference had 417 registrations with one third of these attending ‘in person.’

An update on the BIFoR global MEMBRA project can be found on [pages 10 & 11](#).

Prof. **Vincent Gauci** was co-author of a *Nature* paper which revealed that substantial cuts in global greenhouse gas emissions could be achieved by raising water levels in agricultural peatlands ([Evans et al.](#) 2021). Amongst six other papers, he published in *Nature Communications* on the role of tropical forests as drivers of lake carbon burial ([Amor-Nogueira et al.](#) 2022) and in the world’s oldest scientific journal, (*Philosophical Transactions of the Royal Society*) on [Amazon tree methane emissions](#). Vincent also gave a keynote presentation at the BIOGEOMON conference, in Estonia

Adriane Esquivel Muelbert took part in the first of a series of meetings aiming to generate a synthesis of tree biodiversity across tropical Americas. This initiative is part of the project [Syntreesys](#) which aims to understand the drivers of tree biodiversity across the tropical Americas and assess the extinction risk of different tree species across the region. Syntreesys is funded by the French [Foundation for Biodiversity Research \(FRB\)](#) and was hosted in the [Centre of Synthesis and analyses for the biodiversity \(CESAB\)](#) in Montpellier, France. Adriane is a co-investigator of Syntreesys. The project involves data networks and collaborators from across many South and Central American countries.



[Syntreesys](#) team at the first workshop in Montpellier.

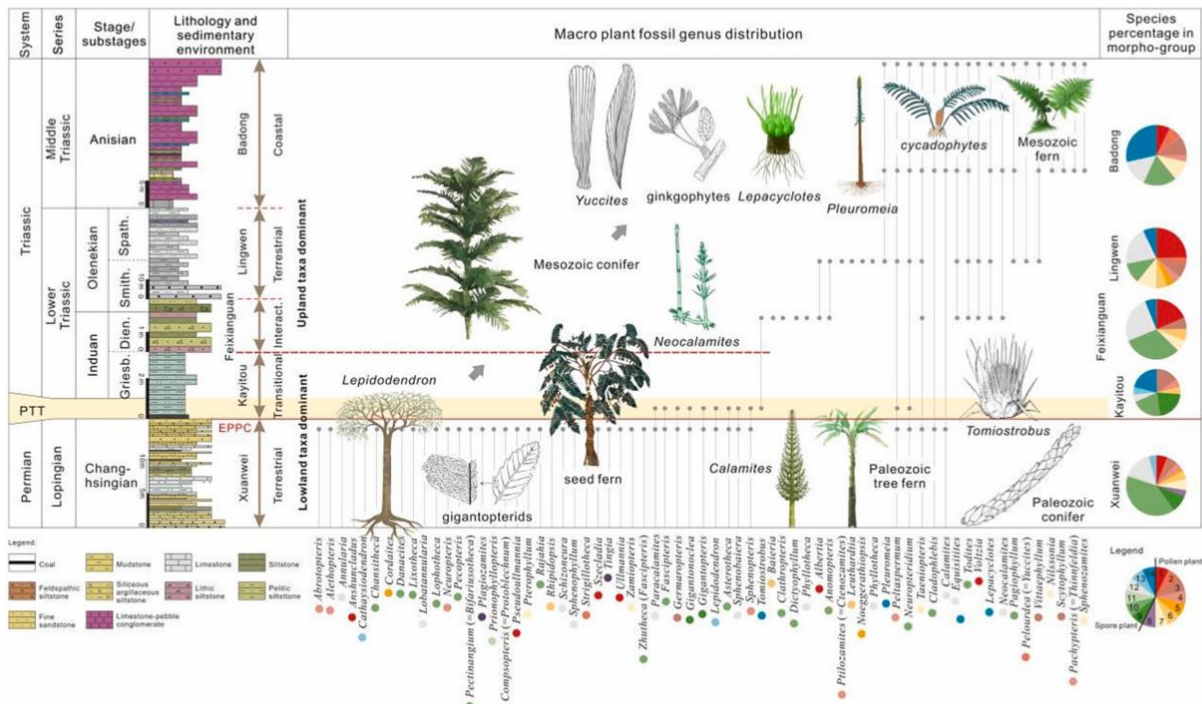


Nick Harper (above) travelled to the site of the FACE facility under construction in the Amazonian forest, Manaus. **Nick** is our Senior Engineer and he went to offer his expertise. They are very near construction of their first two FACE arrays. **Dr Adriane Esquivel Muelbert** will now sit on their scientific advisory board and **Prof. Rich Norby** who has been very involved for many years will continue his involvement further to a contract between BIFoR and the Met Office. Indeed a new partnership was announced this year which is certainly good news for BIFoR - the Met Office Academic Partnership ([MOAP](#)) will aim to blend the research excellence of the Met Office and leading universities in order to advance the science and skill of weather and climate prediction and we are proud to say that Birmingham will be one of the partners.

Dr Adriane Esquivel Muelbert and **Dr Tom Pugh** participated as mentors in a workshop on tropical tree mortality organized by the AccelNet NSF-funded project ITFSA. The meeting was held in Cartagena, Colombia and involved 21 participants from 8 countries and had the goal of promoting collaborations across the tropics to work on tree-mortality related questions and to mentor early career researchers.



Our congratulations go to **Jason Hilton** for his recent promotion to Professor. **Jason** is a very talented palaeobotanist and evolutionary plant biologist. Details of his most recent paper are on [page 21](#) and see an image from his paper below.



Interdisciplinary Research - Understand the wider importance of trees and forests to human and non-human actors

Much of our grant-funded work is strongly interdisciplinary: [MEMBRA](#), [CASTOR](#), and [Voices of the Future](#). New this year is the **DiversiTree** project ([page 22](#)), in which BIFoR collaborates with the James Hutton Institute, Bangor University, the RSPB, the Royal Botanic Gardens Edinburgh, the Woodland Trust and other stakeholders to develop and disseminate practical routes to diverse and resilient UK forests.

Work at the interface of 'the built' and 'the green' continues strongly under **Emma Ferranti's** leadership. Her [Trees and Design Action Group](#) webinars regularly draw audiences of over 200 and her series of 'First Steps' guides to the use of green infrastructure in urban practice now number four with the inclusion of [First Steps in Trees and New development](#) and [First Steps in Urban Heat](#). Emma also leads the Urban Design and Green Infrastructure strand, which is BIFoR's contribution to the £4.88million WM Air project looking at practical approaches to improve air quality in the West Midlands.

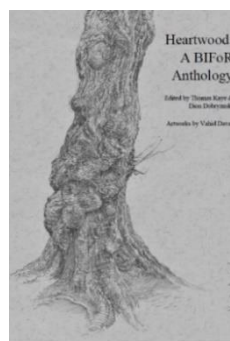
Frank Uekötter's €2M (~£1.74M) grant from the European Research Council for [The Making of Monoculture: A Global History](#) is picking up pace. Two research fellows, **Kapil Subramanian** and **Justine Philips** started in October; two more will join him next year. **Justine** works on almond production in California while **Kapil** discusses the career of eucalyptus plantations in post-colonial India. **Frank** has produced a thought-provoking and highly entertaining short [video](#), using his appetizing breakfast to illustrate the size and scope of the issue! For the fall term, a video blog, "[Making Food History](#)," chronicles the discussion of some food history classics in his reading group.

Our interdisciplinary flagship for doctoral research, [Forest Edge](#), initially funded by a £1.05M grant from the Leverhulme Trust and now continuing as a training vehicle for

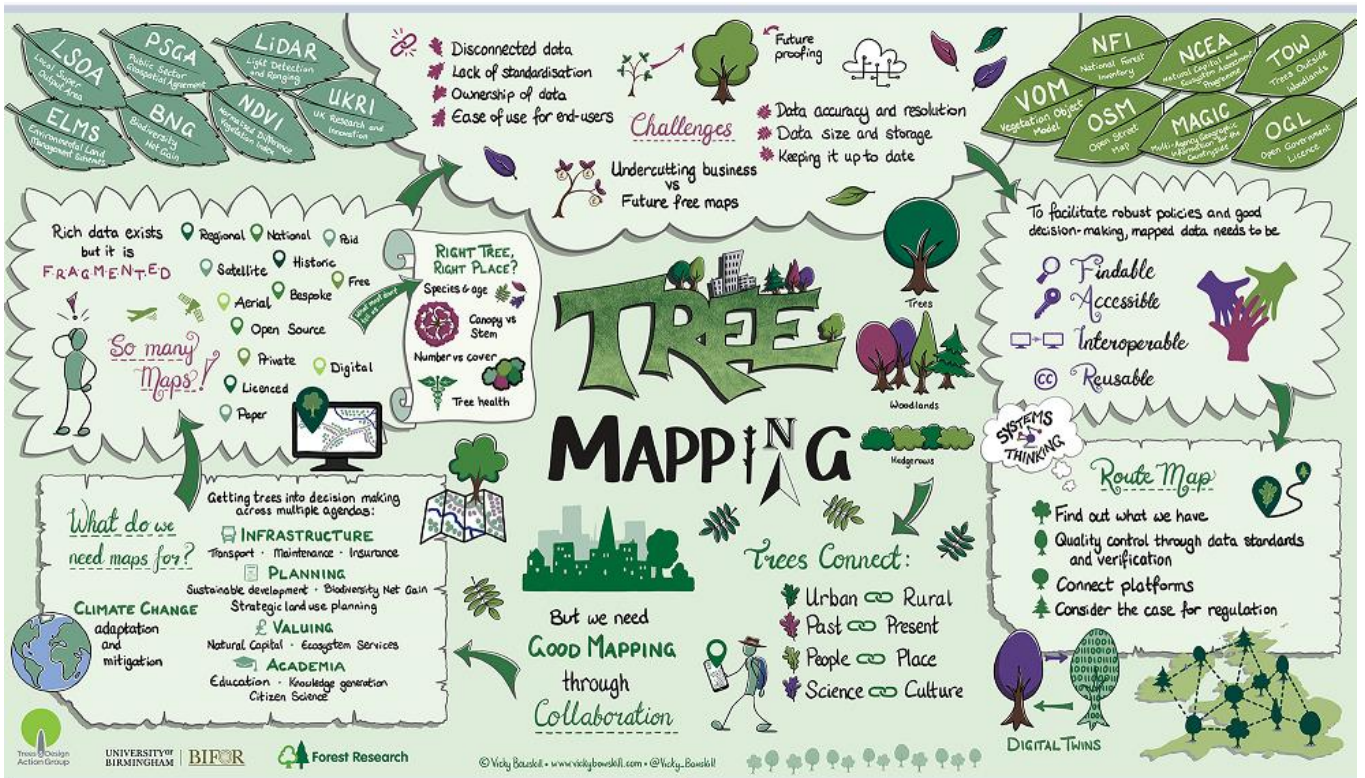
interdisciplinary doctorates, is celebrating its first alumni: these have been submitted by **Ben Howard** ("Instream wood as a potential nature-based solution to nutrient pollution.") **Polly Jarman** ("Children's encounters with urban woodlands, digital technologies and materialities"), and **Eszter Toth** ("The Effect of Urban versus Nature Exposures on Cognitive Control and Well-being").

Doctoral researcher [Dion Dobrzynski](#) has been capturing responses to forests in literature and literature in forests through a series of enchanting events at [Ruskin Land](#) in the Wyre Forest and through an exhibition at the University's Winterbourne Gardens. Prof. **John Holmes** is leading our deepening relationship with Ruskin Land and is connecting BIFoR to the newly formed Institute for STEMM in Culture and Society ([ISTEMMICS](#)). As a start, **John**, **Dion**, and Ruskin Land colleagues have explained the depth the Arts can bring to our understanding of the forest environment in a short [video](#).

Cultural practice associated with BIFoR has taken a strong step forward this year. In September, **Clare Hewitt** took her exhibit "[Everything in forest the is the forest](#)", centered on BIFoR FACE, to the [Landskrona Foto Festival](#), Sweden. **Ben Wigley's** art and film work-in-progress, [Hart of the Wood](#), featuring the Institute's very own **Kris Hart** and **Anna Gardner**, has been shown several times, including [in Comer Woods](#).



BIFoR now has its own Anthology, called 'Heartwood' which was edited by [Thomas Kaye](#) and [Dion Dobrzynski](#). They invited contributors to select a piece of imaginative literature and meditate on how it has shaped the way they have thought about trees and forests, or their research in a more general sense.



Graphic output from the extremely well attended and highly praised [‘Tree Mapping workshop’](#) led by **Emma Ferranti**



The Forest Edge students at the Wyre Forest for interdisciplinary talks.



Clare Hewitt’s exhibit in Sweden. Images were exhibited throughout the city (indoors and outdoors). Included in the exhibit were 362 oak leaf lumen prints (pictured). Watch Clare’s [introductory video](#) online to find out more.



Dion Dobrzynski asked students to create pieces of art and jot down their reflections in notebooks during one of a number of workshops he held at the Wyre Forest exploring [‘Forests in Fantasy Literature’](#). These were then displayed at the Winterbourne House and Gardens.

Education

Our thriving community networks through weekly science seminars and a fortnightly journal club run by postdoctoral research fellows Dr **Carolina Mayoral** and Dr **Diana Vinchira Villarraga**. The new intake of PhD students due to start next academic year will take the total number of doctoral researchers to 61 with 16 graduated / submitted. The research topics cover a wide selection of forested landscape research. Very many congratulations to the BIFoR core funded students Dr **Liam Crowley**, Dr **Angeliki Kourmouli** and Dr **Clare Ziegler** who have all graduated! Further details of postgraduate research including current/submitted/graduated are listed in [Appendix 1](#).

Our Leverhulme-funded Forest Edge Doctoral Scholarship Programme has enabled the broad training of 18 postgraduate doctoral researchers in forestry and related areas over a broad set of disciplines. The first cohort of 5 students are now very close to graduation ([page 14](#)). In 2022 we welcomed 7 new students to Forest Edge who, although not financially benefitting, will benefit from engaging with this interdisciplinary group of students who meet monthly for knowledge sharing and training.

Our development of forest sciences teaching resources is three pronged:

- Undergraduate teaching
- A level, GCSE and Key Stage 3
- Outreach

Our efforts are set to be greatly enhanced from November 2022: as thanks to the generous donation by alumni donors **John** and **Lorna Powell**, we have been able to recruit a 'BIFoR Learning and Engagement Officer' for 3 years. A key focus will be around developing teaching materials linked to the research at the BIFoR FACE facility, incorporating real datasets.

Thanks to funding from the LES College Education Fund, we were able to purchase four virtual reality headsets to showcase the virtual tour of BIFoR FACE. These will be used for outreach, including University Undergraduate Open Days and are already proving to be a great success in bringing the forest to campus.

A new pilot project will launch in November 2022. '**BIFoR in a box**' will provide high school educators the knowledge and resources they need to measure trees on their school grounds. Educators can then share the data they collect into one large 'citizen science-style' database of tree growth in the UK. They will be able to incorporate the data into lesson plans provided through the 'Virtual BIFoR' education website.

In the near future, we will install automated dendrometers (tree growth measurements) on trees on both the Birmingham and Dubai campuses, which will provide live data perfect for teaching and outreach.

Progress is being made on a new optional 20 credit undergraduate module, covering topics such as woodland creation, the circular economy of forests, wellbeing, recreation, pollution, pests and disease.

Through BIFoR's involvement with the Forestry Skills Forum we have contributed to a Forestry STEM ambassador's booklet, an [Induction Pack](#) for Forestry Employer's and helped support the visit of over 300 school children to APF 2022 - the UK's largest forestry exhibition.

Volunteering with BIFoR continues to go from strength to strength. Volunteering affords students the opportunity to get some hands on experience. There has been over **3,000 hours** of volunteering logged (mostly by undergraduate students). The regular requests for job references for students confirms that this is a valuable mutually beneficial endeavour.

New Doctoral Research

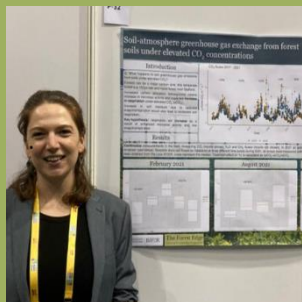
We welcomed 12 new PhD students in 2021/2022 and we are delighted to say that a further 9 students will commence in September 2022. The ^ symbol denotes students who will carry out their research at BIFoR FACE.

- **Rehab Almutairi** - funded by the Saudi Arabian Government. Rehab is evaluating the response of oak seedling growth to drought and elevated CO₂; and how drought and elevated CO₂ affect nutrient availability. The experiments are mainly based at the Advanced Wolfson Glasshouse where oak seedling are grown in typical low-nutrient loamy soils to mimic field plantation/restoration conditions for woodlands. A sub-experiment on nitrogen addition will be undertaken as well. The outcomes of this research will shed light on the resilience of oaks plantation under global change. Supervised by Prof. **Sami Ullah**, Prof. **Nick Kettridge (GEES)** and Prof. **Jeremy Pritchard (Biosciences)**
- **Octavia Brayley** - A study of the adaptations, ecological impacts, and future distribution of an invasive insect species on Signy Island (Antarctica), *Eretmoptera murphyi*, in partnership with the British Antarctic Survey, partner labs in the US, Chile, and France, and industry stakeholders such as the International Association of Antarctica Tour Operators and the Scientific Committee on Antarctic Research. This project will investigate the adaptations that have allowed Antarctic insects to persist in this extreme environment for millions of years, the implications of climate change on their future survival and distribution, and the broader ecosystem consequences of invasive insect species within the Antarctic region, specifically on soil biogeochemistry through experimental work and field studies. Supervised by Dr. **Scott Hayward** (School of Biosciences), Prof. **Sami Ullah** (School of Geography, Earth and Environmental Sciences), and Prof. **Pete Convey** (British Antarctic Survey).
- **Xinshi Cheng** – Xinshi is studying seed plant diversity and evolution from a systematic investigation of exceptionally well-preserved fossil seeds from the late Permian of China. The project will use seed morphology and anatomy and consider functional and ecological adaptations that will unravel how seed plants adapted to the environments and climates in which they lived. A key aspect of the project is to evaluate seed plant diversity through the Permian-Triassic Mass extinction approximately 252 million years ago in which some groups died out while others went on to dominate younger floras globally. Methodologies include analysis and reconstruction of fossil seeds from 3D X-ray computer tomography and synchrotron sources, comparative anatomy with fossil and living seed plants, and phylogenetic analysis. Supervised by Prof. **Jason Hilton** (GEES) and Dr **Andy Plackett** (Bio)
- **Nicholas Cork** – A study into optimised stewardship of Green Infrastructure along linear transportation corridors under changing climatic conditions. The project will research concepts for optimised composition and structure of lineside vegetation to enhance habitat connectivity and biodiversity whilst understand any negative impacts on day-to-day operations – aiming to maximise ecosystem services to the operator (such as water management and slope retention), maximise ecosystem resilience and biodiversity under climate change whilst balancing this against operational risks posed by increases in lineside vegetation (such as leaf fall and windthrow). The methodology will include GIS modelling of Green Infrastructure and habitat suitability, experimental work into productivity and resilience of mixed plant species and animal/ plant dispersal under changing climate as well as the development of sound advice for Asset Managers of Linear Transportation Networks. Supervised by Dr. **Emma Ferranti** (School of Engineering) and Prof. **Andrew Quinn** (School of Engineering)
- **Estelle Darko** - Research into forest diversity, dynamics, and resilience globally. I will be performing analyses at large-scales using data from forest inventory networks such as RAINFOR to investigate the effects of forest dynamics on diversity. For instance, I will be testing whether the range of species life history strategies within forest influence its diversity and the effects of diversity and dynamics on forest resilience. I will be applying a variety of metrics in order to determine how forests may potentially, variably respond to climate driven disturbances. Supervised by Dr **Adriane Esquivel Muelbert** (GEES), Dr **Tom Matthews** (GEES), Dr **Laura Graham**

(GEES), Dr **Tom Pugh** (GEES and University of Lund), Prof. **Oliver Phillips** (University of Leeds), Dr **Carolina Tova** (Kew Gardens), and Dr **Lindsay Banin** (UKCEH).

- **Xianbang Feng**, funded by Chinese Scholarship Council and based at Exeter University. Xianbang's research is focused on productivity of mycorrhizal biomass and its implications for carbon and nutrient cycling at BIFoR-FACE. Supervised by Prof. **Iain Hartley** at Exeter University, and co-supervised by Prof. **Sami Ullah** and Dr **Liz Hamilton** and Prof. **Rob MacKenzie**, University of Birmingham.
- **Grace Handy** - Impact of CO₂ rise on root, leaf and wood production: the future of tree C allocation. Previous research suggests that trees can carry out increased levels of photosynthesis under elevated CO₂, but growth cannot increase indefinitely due to other limiting factors such as nutrient availability. This project will focus on a tree's ability to combat this by allocating extra carbon belowground by increasing root growth, exudation, and microbial activity to explore and obtain more nutrients and water. The research for this project will be carried out at BIFoR FACE, in collaboration with Forest Research and the Met Office. Root production will be measured through the collection of images using a minirhizotron camera, a non-destructive root investigation technique, which will then be vectored and converted to rates of root production. This methodology will be used alongside more traditional methods of root extraction and examination using soil cores. Data on root production will then be considered alongside other relevant carbon storage data collected in the previous years of the BIFoR experiment, such as leaf area, to further understand where trees will allocate extra carbon under elevated CO₂ and provide vital information to understand the future of the global carbon sink. Supervised by Dr **Marie Arnaud** (GEES), Dr **Adriane Esquivel Muelbert** (GEES) and Prof. **Rob MacKenzie** (GEES) in collaboration with Forest Research and the Met Office.
- **Novalia Kusumarini**, Funded by the Indonesian Government. Novalia is investigating differences in the chemistry of root exudates of newly planted nitrogen-fixing alder (*Alnus* spp.) and non-nitrogen fixing oak (*Quercus* spp) saplings in the Mill Haft catchment adjacent of BIFoR-FACE. The key question is to find out whether the two tree types use different strategies for nutrient acquisition. A method for targeted metabolomics of exudates is currently being developed in the School of Chemistry at Birmingham as part of the exudate characterization. A follow-on experiment on growing oak and alder saplings in the Wolfson Glasshouse under eCO₂ will be undertaken to elucidate changes in exudation seasonality, chemistry and amount and how it affects nutrients availability in the soils to guide future forest restoration strategies. Supervised by Prof. **Sami Ullah**, Prof. **Iseult Lynch** (GEES) and Dr **Liam Cox** (School of Chemistry).
- **Dee Phillips**- A study of the greenhouse gas emissions and efficiency of woody constructed wetlands for wastewater treatment in conjunction with industry stakeholders. The project will research concepts for reducing methane and nitrous oxide emissions, improving phosphate removal, and enhancing carbon sequestration of existing wastewater treatment works – aiming to reduce the net emissions from facilities without compromising treatment efficacy. The methodology will include experimental work and practical design for future applications. Supervised by Prof. **Philip Davies** (School of Engineering) and Dr **Joshua Larsen** (GEES)

Nine Douwes Dekker won the 'Three-minute thesis challenge.' Catch up on [YouTube](#). **Nine** was also the only doctoral researcher to give an oral presentation at the 'Trees for the Future' conference. **Nine** is currently writing up with her co-supervisor at EucFACE.



Thomas Kaye, spent ten days at the Forestry History Society, North Carolina, USA, using their extensive archives to support his PhD research on forests and forestry in modern and contemporary American literature. Thomas received an Alfred D. Bell Jr. Travel Grant to help with his travel expenses.



Strategic Stakeholder Engagement

Thanks to honorary Professor **Jon Drori**, awareness of BIFoR is being strengthened through his many speaker engagements through 2022 ([page 40](#)).

The University of Birmingham is committed to engagement across civil society and BIFoR participates enthusiastically in this. BIFoR Director and Defra Chief Plant Health Officer, Prof. **Nicola Spence**, advises the BIFoR team on effective engagement with policy-making.

Prof. **Rob MacKenzie** chairs the Trees and Woodlands Scientific Advisory Group (TaW-SAG). Prof. **Rob Jackson** is a member of the group updating the UK Forestry Standard and President-Elect of the British Society of Plant Pathology (BSPP). Prof. **Sami Ullah** continues on the Nutrient Management Expert Group at Defra. Prof. **Jeremy Pritchard**, chairs the Royal Society of Biology curriculum committee. Prof. **Christine Foyer** sits on the independent Sustainable Nutrition Scientific Board and Dr **Josh Larsen** sits on the scientific advisory panel of the UK Beaver Trust. Dr **Emma Ferranti** has joined the West Midlands Forests and Woodlands Advisory Committee (WM FWAC) and the FWAC Urban Forest. Emma also co-runs the Trees Design and Action Group (TDAG) which has a vibrant membership, with some 80-250 people attending each seminar and many more [catching up](#) later. Dr **Sabrina Dhaouadi** joined the committee of the new 'Applied Trees Forests and Biology group' of the Association of Applied Biology (AAB). Doctoral student **Jenny Knight** is an Advisor for Trees and Timber Deep Dive Delivery Board and Welsh Government and Advisor for the National Forest for Wales Task and Delivery board.

COP26 was a major event in the world's calendar. As reported in our 2020/21 report, during COP BIFoR was very active ([page 43](#))

including co-organising the 'Trees for the Future' conference. A 'White Paper' was produced post conference '[Forest Innovation to tackle the Climate and Biodiversity Emergencies.](#)' Prof. **Sami Ullah** contributed to a follow up report '[Keeping 1.5 degrees alive](#)' including information about BIFoR FACE and stating:

"Nitrogen is the next carbon, & it has to be considered seriously. It has implications for food security & net zero as well as for the environment, through air, water, & soils."

In 2021/2022 we had 21 tours of the BIFoR FACE facility and 11,500 more hits on the virtual tour of the BIFoR FACE facility. International visitors include; visitors including Prof. **Arvind Nema** from IIT Delhi; members of the Technical University of Munich; members of the Faculty of Forestry and Wood Technology, [Mendel University](#) in Brno, Czech Republic and the [Forestry and Game Management Research Institute \(FGMRI\)](#) Opočno, Czech Republic.

BIFoR research has been disseminated at both international and national conferences with highlights being the 'International Plant Health Conference' and our own conferences 'Trees for the Future' and 'Transforming our Understanding of Global Forests.' Further details of our stakeholder engagement can be found in [Appendix 2](#) and [3](#).

The BIFoR newsletter circulation outside of the University of Birmingham consistently exceeds 1,000 people. The newsletter is produced twice a year – spring and autumn. Previous versions of the newsletter are available on our [website](#). Our presence on social media strengthens as this year for the first time we had coverage on Tik Tok, thanks to undergraduate student volunteer **Ester Konecna** who described the research underway at BIFoR FACE and her [video](#) received almost 10,000 'likes.'



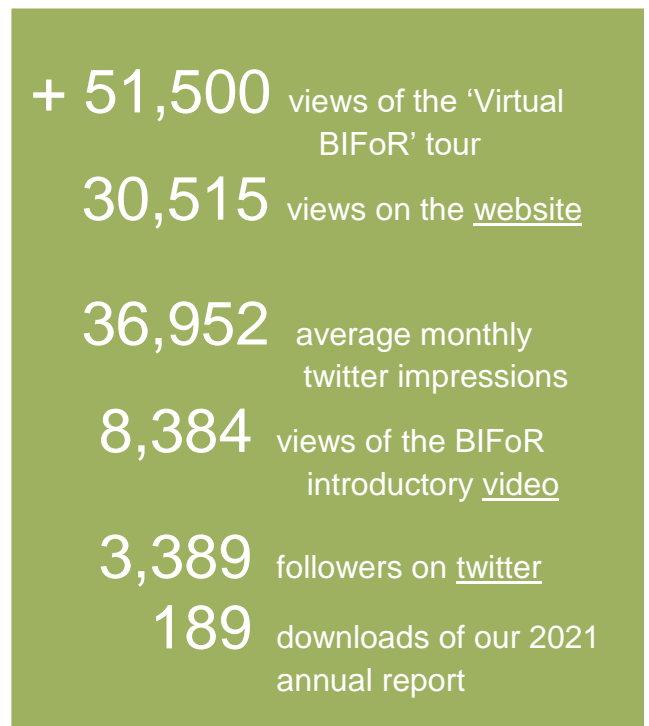
The inaugural exhibition at The Exchange, the University of Birmingham's newly refurbished city-center building, was called the 'Air We Breathe' and it featured BIFoR FACE research. It ran throughout the year closing in July 2022. Alongside the exhibition, a public programme of events was run. Our team ran three family workshops and two late night talks (Prof. **Christine Foyer** and Dr **James Levine**). The Exhibition can now be accessed as a [virtual tour](#) so the legacy continues.



In July 2022, BIFoR had a stand at the Royal Welsh Show, inside the CONFOR tent. Of particular interest to passers-by were two cross sections of larch, one grown in monoculture and one grown in a mixed forest (courtesy of Norbury Park Estate). They prompted discussion around future tree planting and many copies of our new White Paper '[Forest Innovation to tackle the Climate and Biodiversity Emergencies](#)' were eagerly taken.



The new '[History through Objects](#)' Exhibition in the Aston Webb Corridor of the University, contains objects from BIFoR FACE. In addition, a display at the British Science Museum - [Our Future Planet](#) has information about BIFoR FACE and some of our old equipment on show.



Outputs

A full list of papers (n=35) can be found in [Appendix 4](#). 2021/22 saw about 50% of journal articles published in the first-rank of general science journals (i.e., the *Nature* family, *Science*, PNAS) this is an increase compared to 2021 (circa 14%). Three research highlights are summarised below:

Coevolution of plants and the environment

By Prof. **Jason Hilton**

From paper: Xu, Z., **Hilton, J.** et al (2022) in *Earth-Science Reviews*

<https://doi.org/10.1016/j.earscirev.2022.104136>

Recent BIFoR research on forest evolution in deep time including **Jason Hilton** investigated vegetation changes through the End Permian Mass Extinction, the most severe biocrisis of the last 400 million years. They used a new method to show that, after the demise of the tropical Gigantopteris flora, it took approximately 15 million years for complete floral recovery to occur. Their results highlighted links between terrestrial and marine systems with massive terrestrial nutrient fluxes from land washing into the oceans causing eutrophication, different timings for extinctions on land and in the oceans, and a five million year interval after the extinction where lethally hot temperatures restricted life on Earth.

Seeing the unseen: birth and death of tree roots under a future atmosphere

By Prof. Iain Johstone

From paper Ziegler et al. (2022) in *Science of the Total Environment*

<https://doi.org/10.1016/j.scitotenv.2022.158661>

Increased carbon dioxide in the atmosphere causes trees to put more resource into developing root systems below ground. This flow of extra carbon below ground is an important, and often overlooked, way in which the natural world will respond to ongoing and future greenhouse gas emissions.

The team gathered thousands of images of tiny tree roots, sometimes less than a millimetre wide, over two years in the BIFoR FACE forest. These images were used to build a mathematical picture of the birth, growth, and death, of roots in an oak forest. The results provide hard evidence that the extra carbon available under elevated CO₂ is being used, in part, to help the trees explore the nutrient-rich world beneath them.

A climate risk analysis of Earth's forests in the 21st century

By **Nezha Acil**

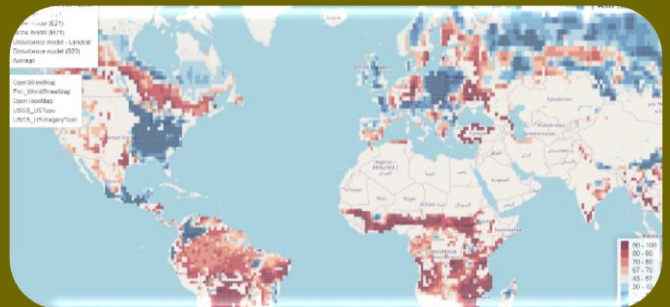
From new paper: Anderegg, W., Wu, C., **Acil N.** et al (2022) in *Science*

DOI: [10.1126/science.abp972](https://doi.org/10.1126/science.abp972)

To efficiently tackle the climate crisis, we need to understand where forests are the most at risk from the different impacts of climate change. Researchers from BIFoR, University of Birmingham, contributed to a study, led by William Anderegg, from the University of Utah, to identify those forests most threatened by combined changes in carbon stocks, biodiversity and disturbance regimes, as projected in the future by modelling. Results consistently highlighted the vulnerability of transitional boreal forests in Central Canada and Russia and dry tropical forests throughout the Amazon and Africa. These results will help design better targeted-adaptation and mitigation strategies, but substantial uncertainties remain calling for more in-depth research.

In blue, lowest climate risk and red, highest climate risk.

wilkescenter.utah.edu/tools/globalfrestclimaterisk/



Funding

Further details of all funding received in 2021/22 can be found in [Appendix 5](#). The following are just a few examples. The Institute has been involved in projects bringing in an additional £2,206,738 to the forest sciences area. The pipeline of funding proposals in development reflects the vigour of the research within the Institute.

NERC Standard Grant, The role of mesophyll CO₂ diffusion in modulating the response of photosynthetic carbon uptake to CO₂ enrichment of a mature temperate forest. PI Dr **Florian Busch**, Total value £870,000, value to UoB £870,000 2022 – 2025. Dr **Florian Busch** will use cutting-edge technology and mathematical modelling to advance our understanding of plant carbon uptake. Dr Busch will make use of the BIFoR FACE facility to determine how much CO₂-diffusion processes inside the leaf limit photosynthesis in trees, both under current and future environments. The project addresses a major uncertainty in carbon cycle modelling, which currently does not include this process.

The research will initially investigate the basic mechanism of CO₂-diffusion inside the leaf using plants grown at the Wolfson Advanced Glasshouses to measure instantaneous changes in CO₂ diffusion in response to environmental stimuli, before testing the capacity of forest trees to acclimate to higher CO₂ concentrations in a natural environment.

College of Life and Environmental Sciences, Maximising the full potential of the Wolfson Advanced Glasshouses, University of Birmingham Equipment Fund, £29,366.00, PI Dr **Megan McDonald**.

Wheat plants grown under LEDs are healthier, produce more seed and have more rapid generation time, enabling completion of more experiments in the same time span. This funding has enabled the installation of LED lighting into two 12 m² spaces in the recently refurbished Wolfson Advanced Glasshouses on campus. This has brought the facility up to full capacity and increased the growth space available by 26% - maximising the full potential of this brand-new facility.

UKRI Future of UK Treescapes call, DiversiTree: diversifying our woodlands to increase resilience, Led by **Ruth Mitchell** (James Hutton Institute), PI for UoB is **Robert Jackson**. Total value £637,920, value to UoB £154,574. Bangor University, RSPB, Royal Botanic Gardens Edinburgh and Woodland Trust (2022-2024). DiversiTree addresses four knowledge gaps related to the diversification of woodlands:

- 1) How do stakeholders understand forest diversity, their diversification strategies, and their visions and ambitions for diverse future forests?
- 2) Are the microbes found on the leaves of trees more diverse in woodlands with mixed tree species and does this help trees to better defend themselves against diseases?
- 3) How may diversification of tree species within a wood allow the continued support of woodland biodiversity?
- 4) How do we implement and communicate management strategies to increase woodland resilience?

Royal Society Research Grant, Amazonian Mega Flora, £20,000 PI **Adriane Esquivel Muelbert**. The 1% largest tropical trees are responsible for >50% of the carbon stock and carbon capture in these forests, yet we know very little about the life and climate sensitivity of these tropical giants. This project will integrate field and remote sensing to quantify the drivers (wind, drought, pathogens and lightning) of mortality of large trees in Central Amazonia. The methods developed here will be the basis for larger projects across different tropical forests. Collaborators include INPA (Brazil) and from the Cary Institute of Ecosystem Studies (US).

Going Forward

Our main priorities through academic year 2021/22 are below with a short response:

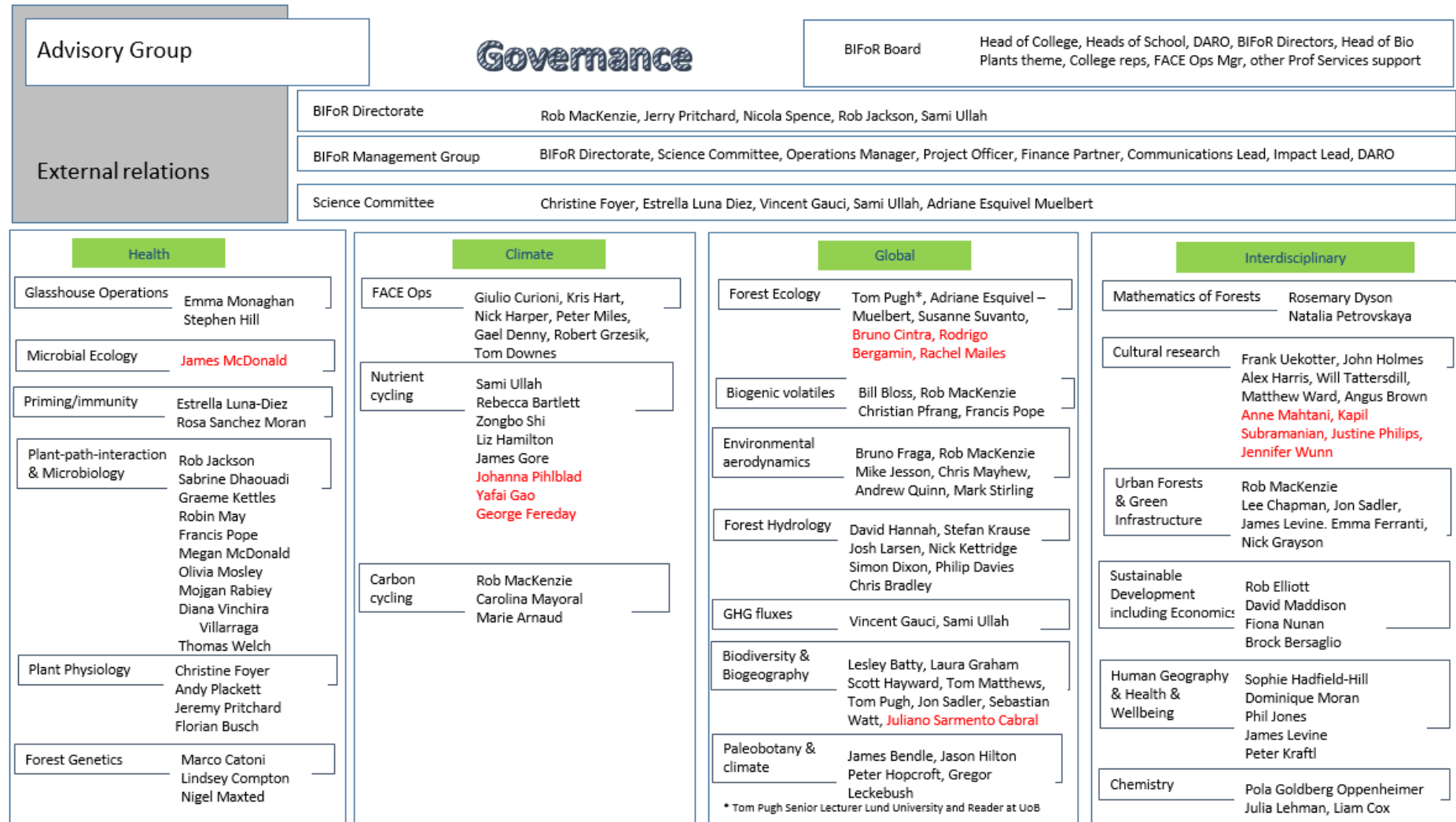
- Agree, embed, and deliver our 5-year plan - **plan received by Vice Chancellor Integrated Review (VCIR) panel and BIFoR Advisory Group. The BIFoR Management Group (BMG) continue to meet regularly with rolling agenda items that cover each section of the Business Plan.**
- Manage and mitigate external risks (e.g., supply chain issues; energy prices; CO₂): **A new partnership for CO₂ provision has been secured. CO₂ fumigation in 2022 ensured with agility with minimal disruption under a highly volatile CO₂ market. (page 5)**
- Respond with agility to COP26 outcomes to shape research and engagement for policy outcomes - **'Forest Innovation to tackle climate and biodiversity emergencies' published and disseminated, the Association of Applied Biologists (AAB) now has specialist Tree Biology group and their Presidential Meeting in 2022 will have tree related talks Contributed to Keeping the 1.5 degrees alive initiative of UoB following COP26 and Dr Adriane Esquivel Muelbert will attend COP27.**
- Evidence equality, inclusivity and culture change for greater scientific coherence:
 - **Drafted code of conduct to be circulated to BIFoR members**
 - **Establishment of EDI committee within larger LES committee**
 - **Held first workshop to raise EDI issues in BIFoR in March 2022. Over 20 institute members, including senior academics, PDRA, technical team and Postgraduate researchers participated in the workshop.**
 - **Supported the application of ring-fenced CENTA student, who was successful in the application and is now a BIFoR PhD student.**
 - **Promoted gender balance and a diverse set of nationalities including participants from the Global Majority for the BIFoR annual meeting.**
- Focus engagement through high-quality science outputs: **Publications in 2022 in Nature, New Phytologist and Science of the Total Environment (Appendix 4)**
- Develop and trial innovative teaching materials for new undergraduate programmes: **education and virtual reality headsets (page 16)**

Our priorities through academic year 2022/23 are:

- Reflect and act upon the recommendations from the Vice Chancellor Internal Review Panel
- Support early career staff to apply for prestigious research fellowships (e.g. UKRI-FLF, Royal Society, Leverhulme Trust, NERC, BBSRC) to work in BIFoR.
- Establish a hub for global forest dynamics and ecology research incorporating different existing data streams and supporting new field collections and/or investigations
- Send at least two ECRs on exchange visits to overseas field and laboratory forest research laboratories to expand the geographic scope and impact of the research of BIFoR
- Secure and/or apply for another large research grant (UKRI) as well as standard grants (UKRI, Leverhulme Trust, Horizon Europe, NSF-UKRI, etc.) incorporating interdisciplinary approaches where possible.
- Provide evidence of equality, inclusivity and culture change for greater scientific coherence
- Continue to develop and trial innovative teaching materials for new undergraduate and forest taught masters programs
- Improve upon how we as an Institute measure 'Impact'
- Maximise scientific and wider societal reach of high-quality science outputs
- Continue international engagement and presence in scientific conferences and policy forums
- Build stronger links across the colleges within UoB - organise i) Engineering and Physical Sciences (EPS) away day for the Head of School and academics to BIFoR FACE ii) a Chemistry school away day to BIFoR FACE
- Plan for COP28 engagement via the University of Birmingham-Dubai campus node.
- Promote the science case for potential funding for the continuation of CO₂ fumigation at BIFoR FACE beyond a decade.

Appendix 1: People

Organisational diagram of BIFoR - new 2021/22 additions to the team / structure are in red. Many research areas will cross the themes.



BIFoR Advisory Group Members

Chaired by Prof. William Bloss, Head of College of Life & Environmental Sciences
Caroline Ayre, National Manager for England, CONFOR
Prof. Bradwell, Honorary Professor Immunology University of Birmingham
Dr Alice Broome, Project Leader for Protected Species, Forest Research
Dr Anna Brown, Head of Tree Health and Contingency, Forestry Commission England
Dr Clive Elphick, independent Director with the National Grid Gas Plc and National Grid
Electricity Transmission Plc, on the Board of the Environment Agency.
Dr Jeanette Hall, Woodland Advisor, Scottish Natural Heritage
Prof. David Johnson, Chair in Microbial Ecology, University of Manchester
Prof. Richard Norby, University of Tennessee, USA
Prof. Sir Ghilleen Prance, formerly Director of Royal Botanical Gardens KEW
Prof. Malcolm Press, Vice Chancellor, University of Manchester
Prof. Nicola Spence, Chief Plant Health Officer, Defra and University of Birmingham

BIFoR Directors

The Directors of BIFoR are Professors Rob Jackson, Rob MacKenzie, Jeremy Pritchard, Nicola Spence and Sami Ullah.

BIFoR Board

Chair of the BIFoR Board is Prof. William Bloss, Head of College of Life & Environmental Sciences
Gary Bilham (Development and Alumni Relations Office - DARO)
Prof. Richard Butler (College of Life and Environmental Sciences - GEES)
Lesley Ann Ford (College of Life and Environmental Sciences)
Prof. Christine Foyer (College of Life and Environmental Sciences)
Dr Eva Frickell (College of Life and Environmental Sciences - Biosciences)
Prof. Vincent Gauci (College of Life and Environmental Sciences - GEES)
Nicola Goodall (College Finance)
Prof. David Hannah (College of Life and Environmental Sciences)
Dr Kris Hart (College of Life and Environmental Sciences)
Prof. Rob Jackson (College of Life and Environmental Sciences - Biosciences)
Amy Kendrick (Director of Operations - College of Life and Environmental Sciences)
Dr Estrella Luna Diez (College of Life and Environmental Sciences - Biosciences)
Prof. Rob MacKenzie (College of Life and Environmental Sciences - GEES)
Prof. David Maddison (College of Social Sciences)
Dr Jon Oldfield (College of Life and Environmental Sciences - Head of School GEES)
Prof. Jeremy Pritchard (College of Life and Environmental Sciences - Biosciences)
Dr Andrew Quinn (College of Engineering and Physical Sciences)
Dr Frank Uekötter (College of Art and Law)
Prof. Sami Ullah (College of Life and Environmental Sciences - GEES)
Yuliya Walters (College Finance)

BIFoR Management Group

Prof. Rob Jackson Chair (College of Life and Environmental Sciences - Biosciences)
Dr Adriane Esquivel Muelbert, (College of Life and Environmental Sciences - GEES)
Prof. Christine Foyer (College of Life and Environmental Sciences)
Prof. Vincent Gauci (College of Life and Environmental Sciences - GEES)
Dr Kris Hart (College of Life and Environmental Sciences – GEES)
Dr Estrella Luna Diez (College of Life and Environmental Sciences - Biosciences)
Prof. Rob MacKenzie (College of Life and Environmental Sciences – GEES)
Prof. James McDonald (College of Life and Environmental Sciences – Biosciences)
Dr Megan McDonald (College of Life and Environmental Sciences – Bioscience)
Prof. Jeremy Pritchard (College of Life and Environmental Sciences - Biosciences)
Prof. Nicola Spence (Defra and Honorary Professor at the University of Birmingham)
Prof. Dr Sami Ullah (College of Life and Environmental Sciences - GEES)
Yuliya Walters (Finance)
Deanne Brettle Secretary (College of Life and Environmental Sciences - GEES)

BIFoR Science Committee

Dr Adriane Esquivel Muelbert (College of Life and Environmental Sciences – GEES)
Prof. Christine Foyer (College of Life and Environmental Sciences - Biosciences)
Prof. Vincent Gauci (College of Life and Environmental Sciences - GEES)
Dr Kris Hart (College of Life and Environmental Sciences – GEES)
Dr Estrella Luna Diez (College of Life and Environmental Sciences - Biosciences)
Prof. Sami Ullah (College of Life and Environmental Sciences – GEES)

BIFoR Professional Service Staff

Deanne Brettle - Project Administrator
Dr Giulio Curioni - Data Manager & Analyst
Gael Denny - Field Technician BIFoR FACE facility
Thomas Downes - Apprentice Engineer
George Fereday – Research Technician, FACE underground
James Gore – Research Technician, QUINTUS
Robert Grzesik – Senior Research Technician, QUINTUS
Nicholas Harper - Senior Engineer FACE facility
Dr Kris Hart - Operations Manager
Rachel Mailes – MEMBRA researcher
Peter Miles - Field Technician BIFoR FACE facility

International visiting scientists in 2021/2022

Dr Shoaib Amjad visiting Assistant Professor from Women University AJ&K Bagh

Honorary members of the Institute

Prof. Jonathan Drori - Honorary Professor of science communication.
Dr Debbie Hemming – Scientific Manager, Vegetation-Climate Interactions group, Met Office
Prof. Richard Norby – Honorary Professor BIFoR FACE

The number of academic members of staff affiliated to BIFoR has continued to grow. The Institute is open to University of Birmingham staff and students whose research interest is related to the natural science, social science or cultural relevance of forested landscapes.

College of Engineering and Physical Sciences

Academic Staff

Prof. Mark Sterling
Dr Andrew Quinn (College Rep. for BIFoR)
Prof. Phillip Davies
Dr Rosemary Dyson
Dr Emma Ferranti
Dr Bruno Fraga
Dr Mike Jesson
Dr Chris Mayhew
Prof. Pola Goldberg Oppenheimer
Dr Natalia Petrovskaya

Postdoctoral Researcher

Dr Galene Luo

Doctoral Researchers

Kieran Clark
Nicholas Cork
Bradly Deeley
Dee Phillips
Bruno Santos

College of Arts and Law

Academic Staff

Dr Frank Uekötter (College Rep. for BIFoR)
Dr Angus Brown
Prof. Alexandra Harris
Prof. John Holmes
Dr Annie Mahtani
Dr Will Tattershill

Postdoctoral Researcher

Kapil Subramanian
Justine Philips

Doctoral Researchers

Dion Dobrzynski
Thomas Kaye

College of Social Sciences

Academic Staff

Prof. David Maddison (College Rep for BIFoR)
Dr Allan Beltran
Dr Brock Bersaglio
Prof. Robert Elliott
Prof. Fiona Nunan

Doctoral Researchers

Harriet Croome
Maria Teresa Gonzalez Valencia

College of Life and Environmental Sciences

School of Biosciences

Academic Staff

Dr Florian Busch
Dr Marco Catoni
Dr Lindsey Compton
Prof. Christine Foyer
Dr Scott Hayward
Prof. Rob Jackson
Dr Graeme Kettles
Dr Estrella Luna Diez
Prof. James McDonald
Dr Megan McDonald
Prof. Nigel Maxted
Prof. Robin May
Dr Andrew Plackett
Prof. Jeremy Pritchard
Dr Juliano Sarmiento Cabral

Postdoctoral Researcher

Dr Sabrine Dhaouadi
Dr Carolina Mayoral
Dr Olivia Mosley
Dr Mojgan Rabiey
Dr Rosa Sanchez Lucas
Dr Thomas Welch
Dr Diana Vinchira

Doctoral Researchers

Octavia Bradley
Anna Gardner
Emily Grace
Katherine Hinton
Vanja Milenkovic
Mark Raw
Amy Webster
Jiaqi Wei

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Dr Shoaib Amjad
Dr Rebecca Bartlett
Dr Lesley Batty
Dr James Bendle
Prof. William Bloss
Dr Chris Bradley
Dr Lee Chapman
Dr Julian Clark
Dr Simon Dixon
Dr Adriane Esquivel Muelbert
Prof. Vincent Gauci
Dr Laura Graham
Dr Nick Grayson
Dr Sophie Hadfield-Hill
Dr Liz Hamilton
Prof. David Hannah
Prof. Jason Hilton
Dr Peter Hopcroft
Dr Phil Jones
Prof. Nicholas Kettridge
Prof. Peter Kraftl
Prof. Stefan Krause
Dr Joshua Larsen
Dr Gregor Leckebush
Dr James Levine
Prof. Rob MacKenzie
Dr Thomas Matthews
Dr Dominique Moran
Dr Christian Pfrang
Prof. Francis Pope
Dr Tom Pugh*
Prof. Jon Sadler
Prof. Zongbo Shi
Prof. Sami Ullah
Dr Sebastian Watt

*Tom Pugh Senior Lecturer Lund University and
Reader at UoB

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Dr Rodrigo Bergamin
Dr Bruno Cintra
Dr Yafei Gao
Dr Joanna Pihlblad
Dr Susanne Suvanto

Doctoral Researchers

Rehab Almutaira
Nezha Acil
Alex Armstrong
Sijeh Asuk
Gemma Baker
Aileen Baird
Edward Bannister
Hector Carmago
Xinshi Cheng
Estelle Darko
Nine Douwes Dekker
Katy Faulkner (Warwick)
Xianbang Feng (Exeter)
William Hagan Brown (Plymouth)
Grace Handy
Ben Howard
Tony Hyacinth
Laura James
Polly Jarman
Jordan Johnston
Fatima Khan
Thomas King (Lancaster)
Jennifer Knight
Alex Kulawska
Novalia Kusumarin
Kerryn Little
Yanzhi Lu
Nicholas Lugg
Sophie Mills
Nigar Parvin
Sue Quick
Andrea Rabbai
Jordan Rowling
Manon Rumeau
Klaske van Wijngaarden
Bridget Warren
Joseph Wayman

School of Psychology

Academic Staff

Dr Ali Mazaheri

Continuing Doctoral Research

^research at BIFoR FACE

*Forest Edge Scholarship student

Climate

- ^**Alex Armstrong** - Effects of atmospheric Nitrogen pollution on Soil Carbon Storage and Greenhouse Gas Emission from Forests Soils. Supervised by Prof. **Sami Ullah** (GEES) & Dr **Liz Hamilton** (GEES) [Poster 2022](#)
- *^**Nine Douwes Dekker** – Greenhouse gas emissions from soils under elevated CO₂. Supervised by Prof. **Sami Ullah** (GEES), Prof. **Vincent Gauci** (GEES) & Prof. **Rob MacKenzie** (GEES) [Poster 2022](#)
- ^**Katy Faulkner** - looking at the resistance and resilience of forest soil microbial communities and greenhouse gas emission to extreme weather events and a high CO₂ world. Supervised by Prof. **Gary Bending** (Warwick) and Prof. **Sami Ullah** (GEES) [Poster 2022](#)
- ^**William Hagan Brown** - Climate Change Impacts on Forest Canopy Temperatures: From Mechanisms to Implications. Supervised by **Sophie Fauset** (Uni. Plymouth), Prof. **Ralph Fyfe** (Uni. Plymouth), Prof. **Emanuel Gloor** (Uni. Leeds), and Prof. **Rob MacKenzie** (BIFoR).
- ^**Anthony Hyacinth** - Plant volatile compounds under elevated CO₂. Supervised by Prof. **Rob MacKenzie** (GEES) and Prof. **Francis Pope** (GEES)
- *^**Laura James** – ‘Talking’ trees; the impacts of ozone and elevated CO₂ on chemical communication networks. Supervised by Dr **Christian Pfrang** (GEES), Dr **Robbie Girling** (Reading) and Prof. **Rob MacKenzie** [Poster 2022](#)
- ***Fatima Khan** – Tree water isotopes at BIFoR FACE facility. Supervised by **Joshua Larsen** (GEES)
- ^**Thomas King**, based at Lancaster University: Ecophysiology of plant volatiles under elevated carbon dioxide. Supervised by Dr **Kirsti Ashworth** (Lancaster) and Prof. **Rob MacKenzie** (GEES)
- ^**Sophie Mills** – The effect of elevated CO₂ on primary biological aerosol (bioaerosol) production, in particular pollen and fungal spores, in woodlands. Supervised by Prof. **Francis Pope** (GEES) and Prof. **Rob MacKenzie** (GEES) [Poster 2022](#)
- ^**Sue Quick** - Tree-soil-water relations under elevated CO₂. Supervised by Prof. **Stefan Krause** (GEES) and Prof. **Rob MacKenzie** (GEES) [Poster 2022](#)
- *^**Mark Raw** - Priming of defence in an elevated CO₂ world. Supervised by Dr **Estrella Luna Diez** (Bio) and Dr **Scott Hayward** (Bio) [Poster 2022](#)
- ^**Andrea Rabbai** - Trends in soil moisture and temperature dynamics in juvenile forests align to those of mature forest from the time of canopy closure. Supervised by Prof. **Stefan Krause** (GEES), Prof. **Nicholas Kettridge** (GEES) and Prof. **Sami Ullah** (GEES) [Poster 2022](#)
- ^**Manon Rumeau** - Exploring the effects of elevated CO₂ on free living N fixation as well as on other N cycle processes. Supervised by Prof. **Sami Ullah** (GEES) & Prof. **Rob MacKenzie** (GEES) [Poster 2022](#)
- *^**Klaske van Wijngaarden** - Woody carbon dynamics of the trees at the BIFoR FACE and EucFACE experiments. Supervised by Dr **Tom Pugh** (GEES), Dr **Josh Larsen** (GEES), Prof. **Ben Smith** (Western Sydney University (WSU) Prof. **Belinda Medlyn** (WSU) [Poster 2022](#)

Health

- ***Kieran Clarke** - Study and Fabrication of Rapid Engineered Spectroscopic Technology (FoRESTech) for Identification of Filamentous Pathogens in Leaves. Supervised by Prof. **Pola Goldberg Oppenheimer** (Chem Eng) and Dr **Estrella Luna Diez** (Bio) [Poster 2022](#)
- **Emily Grace** - Analysis of phage that infect oak pathogens and the dynamics of phage population changes and bacterial community change in a disease lesion. Supervised by Prof. **Rob Jackson**. [Poster 2022](#)
- **Katherine Hinton** - Examining risk of new disease outbreaks in a diseased population using ash as a model. Supervised by Prof. **Robert Jackson** (Bio) Dr **Megan McDonald** (Bio), Prof. **Richard Buggs** (Kew Gardens) [Poster 2022](#)
- **Vanja Milenkovic** - Examining the impact of soil on tree health and disease progression. Supervised by Prof. **Robert Jackson** (Bio) and Prof. **Vincent Gauci** (GEES). [Poster 2022](#)
- **Amy Webster** - A study of tree disease on the Island of St Helena. Supervised by Prof. **Rob Jackson**. [Poster 2022](#)
- **Jiaqi Wei** - Evaluating the threat of Xylella on UK trees. Xylella fastidiosa is a bacterium that is endemic to Central America. Supervised by Prof. **Robert Jackson** (Bio) and Dr **Graeme Kettles** (Bio). [Poster 2022](#)

Global

- **Hector Camargo Alvarez** - describe and model the deleterious effect of ozone pollution on cereal production and its economic consequences in China. Supervised by Dr **Tom Pugh** (GEES)
- ***Jordan Johnston** - Understanding how forest ecosystems react and recover in the wake of a destructive event. Supervisors: Dr **Seb Watt** (GEES), Dr **Tom Pugh** (GEES), Dr **Tom Matthews** (GEES) and **Susanna Ebmeier** (Leeds) [Poster 2022](#)
- **Aleksandra Kulawska** - On thin ice: predicting the effects of future permafrost thaw on boreal forest ecosystems. Supervised by Dr **Thomas Pugh** (GEES), Dr **Nick Kettridge** (GEES), Prof. **Rob MacKenzie** (GEES) & Prof. **Sami Ullah** (GEES)
- **Joe Wayman** - Biodiversity-climate interactions, looking at a variety of sites across the tropics. Supervised by Dr **Thomas Pugh** (GEES) and **Thomas Matthews** (GEES)

Interdisciplinary

- ***Gemma Baker**– Life on the edge: New tools to track animal-forest trophic interaction across intact to degraded ecosystems. Supervised by Dr **Sarah Greene** (GEES), Dr **James Bendle** (GEES) and **Lydia Greene** (Duke Lemur Centre, Duke University) [Poster 2022](#)
- ***Harriet Croome** - understanding how elephant behaviours have changed with wildlife conservation initiatives in Mukogodo Forest. Supervised by Dr **Brock Bersaglio** (International Development Department (IDD)), Prof. **Fiona Nunan** (IDD) [Poster 2022](#)
- ***Bradly Deeley** – Mathematics of biological invasion of plant species poses a major threat both to the ecosystem and the economy. Supervised by Dr **Natalia Petrovskaya** (EPS) and Dr **Rosemary Dyson** [Poster 2022](#)
- ***Dion Dobrzynski** - Forest Ecology in Fantasy Fiction: Mobilising the Imaginative Resources of Fantasy Fiction for Living with Forests. Supervised by Prof. **John Holmes** (English), Prof. **Jon Sadler** (GEES) and Dr **Will Tattersdill** (English) [Poster 2022](#)
- ***Thomas Kaye** - The Forestry of Writing. Supervised by Prof. **Alexandra Harris** (English), Dr **Matthew Ward** (English) [Poster 2022](#)

- ***Jennifer Knight** - Exploring the desirability of forest landscapes in a natural flood management context. Supervised by Dr **Steve Emery** (GEES) and Dr **Simon Dixon** (GEES) [Poster 2022](#)
- **Yanzhi Lu** - The potential of urban trees to remove air pollutants, carbon and heat: a large-scale analysis based on Google Street View. Supervised by Dr **Christian Pfrang** (GEES), Dr **Emma Ferranti** (Chemical Engineering), Prof. **Lee Chapman** (GEES) [Poster 2022](#)
- **Nigar Parvin** – Urban heat island impact on human health of Dhaka Megacity, Bangladesh. Supervised by Dr **Emma Ferranti** (Chemical Engineering) [Poster 2022](#)
- ***Bruno Santos** - Wastewater treatment trees: can forests filter helps solve our wastewater crisis? Supervised by Prof. **Philip Davies** (School of Engineering) and Dr **Joshua Larsen** (GEES) [Poster 2022](#)
- ***Maria Teresa Gonzalez Valencia** - Using satellite and house price data our research will identify the size and persistence of the impact of pure information effect on the perception of forest fire risk. Supervised by Prof. **David Maddison** and Dr **Alan Beltran Hernandez** [Poster 2022](#)
- ***^Bridget Warren** - Development and application of novel ecological and environmental proxies based leaf wax lipids. Supervised by Dr **James Bendle** (GEES) and Dr **Florian Busch** (Bio) [Poster 2021](#)

Doctoral researchers submitted and / or graduated 2021/2022

- **Nezha Acil** - global forest dynamics – storm related tree mortality and its influence on global forest cycling. Supervised by Dr **Tom Pugh** (GEES) and Prof. **Jon Sadler** (GEES)
- **Sijeh Asuk** - Population ecology and phenological responses of food-producing forest trees to climate change: implications for rural food security. Supervised by Dr **Tom Pugh** (GEES), Prof. **Nick Kettridge** (GEES) & Prof. **Jon Sadler** (GEES)
- **^Aileen Baird** - Fungal biodiversity. Supervised by Prof. **Francis Pope** (GEES) & Prof. **Robin May** (Bio) [Poster 2022](#)
- **^Ed Bannister** - environmental aerodynamics of the BIFoR FACE site. Supervised by Dr **Xiaoming Cai** (GEES) and Prof. **Rob MacKenzie** (GEES)
- **^Liam Crowley** - Insects as key drivers of change in woodland systems under climate change. supervised by Dr **Scott Hayward** (Bio), Prof. **Jeremy Pritchard** (Bio) and Prof. **Jon Sadler** (GEES)
- **^Anna Gardner** - Leaf physiology under elevated CO₂. Supervised by Prof. **Rob MacKenzie** (GEES), Prof. **David Ellsworth** (WSU) and Prof. **Jerry Pritchard** (Bio) [Poster 2021](#)
- **Lavinia Georgescu** - Machine learning to find patterns and relationships regarding droughts and forests at a biogeographical level. Supervised by Dr **Tom Pugh** (GEES)
- ***^Ben Howard**, Coppice management to reduce nutrient loads in forest streams. Supervised by Prof. **Stefan Krause** (GEES), Prof. **Nick Kettridge** (GEES), Prof. **Sami Ullah** (GEES) and **Ian Baker** ([Small Woods](#)) [Poster 2021](#)
- ***Polly Jarman** - Young people's experiences of and learning in urban woodlands. Supervised by Prof. **Peter Kraftl** (GEES) and Dr **Sophie Hadfield-Hill** (GEES) [Poster 2022](#)

- **^Angeliki Kourmouli** - Soil respiration & biogeochemistry at BIFoR FACE – supervised by Dr **Rebecca Bartlett** (GEES), Dr **Liz Hamilton**(GEES), Prof. **Iain Hartley** (Exeter University) & Dr **Zongbo Shi**
- ***Eszter Toth** - Focus on Cognition: Can forests balance the brain? Supervised by Dr **Ali Mazaheri** (Psychology) and Prof. **Jane Raymond** (Psychology)
- **^Clare Ziegler** - Quantitative modelling of root growth and carbon allocation bridging theory and experiment. Supervised by Dr **Iain Johnston** and Dr **Rosemary Dyson** (Maths)

Doctoral Researcher submitted and / or graduated prior to 2021

- **Alfred Bockarie** – charcoal research Africa. Supervised by Prof. **Rob MacKenzie**
- **Vilane Goncalves-Sales**, Satellite monitoring of deforestation and the role of clouds in Maranhão
- **Jennifer Kirby**, High resolution leaf fall monitoring and low adhesion forecasting using hemispherical near-infrared imagery

Appendix 2: BIFoR Presence at Sectoral Conferences and Workshops

Date	Details
8 September 2021	'Building a database of global forest disturbance information' oral presentation by Nezha Acil BEAR PGR Conference 2021
Oct.-Nov. 2021	Online poster for COP26 UK Universities' Climate Innovation Showcase, Glasgow, by John Holmes
7 October 2021	'Rising methane: is warming feeding warming?' by Vincent Gauci , Royal Society Discussion Session 4 - Vincent Gauci
20 October	'Managing Terrestrial Carbon including role of forests with research aspects of BIFoR-FACE' by Sami Ullah at the Royal Society of Chemistry COP26 Discussion Panel on Climate Impacts of Agriculture. Watch recording
21 October	'High rainfall disturbs soil microbial structure and function and a temperate forest under elevated CO ₂ ' by Katy Faulkner , European Soil Observatory Forum
October 2021	'Understanding plant responses to climate change: redox-based strategies.' Invited speaker Christine Foyer , UNIA Congress
3-4 November	Trees for the Future conference 'Assessing physiological responses of trees to experimental CO ₂ enrichment – an opportunity to improve predictions of future carbon uptake' by Florian Busch . 'Research, action and action-research in response to the Climate crisis' by Rob MacKenzie 'Soil Fluxes under elevated carbon dioxide' by Nine Douwes Dekker . Poster presentations by Iwan Evans, Anna Gardner, Sue Quick, Manon Rumeau and Klaske van Wijngaarden,
21 November 2021	COP 26 Resilience Hub, Resilient Infrastructure Co-Lead Glasgow, UK. Emma Ferranti took part by <i>curating, charring and presenting at a series of events with global partners on the theme of infrastructure within Blue Zone</i>
December 2021	Mexican Congress on Plant Physiology, invited speaker Christine Foyer
12 – 15 December	British Ecological Society Poster presentations from Laura James (GEES/FACE) and Susan Quick (GEES/FACE)
6-8 December 2021	British Society of Plant Pathology, Our Plants our Future conference Presidential address entitled 'Plant health science and policy in the UK' by Nicola Spence Posters: 'The impact of elevated CO ₂ on the resistance of oak seedlings to powdery mildew' by Mark Raw, Carolina Mayoral, Pastor V and Estrella Luna Diez 'Can oaks express priming of defence?' by Rosa Sanchez Lucas, Bosanquet J, Pastor V, Estrella Luna Diez 'Pathogenicity testing of pseudomonads isolated from epiphytic populations.' by Phoebe Swift, Hulin MT, Zeng Z, Mansfield JW, Harrison RJ, Robert Jackson and Mojgan Rabiey 'Identifying candidate resistance genes against acute oak decline and oak powdery mildew using transcriptome sequencing.' Thomas E Welch and Graeme Kettles
9-11 December 2022	National Conference on Plant Physiology-2021 (NCP-2021) jointly organized by ICAR-National Institute of Abiotic Stress Management (NIASM), Baramati and Indian Society for Plant Physiology, New Delhi. Invited speaker Christine Foyer
13-17 December 2021	American Geophysical Union (AGU) Fall Meeting 2021 'Humans asymmetrically amplify and homogenise forest disturbance rates across biomes.' Oral presentation by Nezha Acil , https://agu.confex.com/agu/fm21/meetingapp.cgi/Paper/919456

19 April 2022	'Propagation of invasive plants in the presence of a road in the 1-D spatial domain', by Bradly Deeley Spatial Ecology Workshop: Integrating mathematical theory and ecological applications (Sheffield UK)
10 January 2022	'Effects of high CO ₂ on the growth and stress tolerance' by Christine Foyer 'What limits photosynthesis? Identifying targets for crop improvement' by Florian Busch , EMBO workshop: Molecular responses of plants facing climate change, Montpellier, France.
8 February 2022	'Analytical and computational study of the spread of invasive species in the presence of a road in the spatial domain', by Bradly Deeley , 13th Conference on Dynamical Systems Applied to Biology and Natural Sciences
24 February 2022	'Understanding cherry canker bacterial population, diversity and pathogenicity' by Mojgan Rabiey , NIAB Tree Fruit Day:
22 March 2022	'The need for climate resilient planning' invited speaker Emma Ferranti Futurebuild, EXCEL London, UK.
4-7 April 2022	'Impact of elevated CO ₂ in oak defence against powdery mildew' selected oral presentation by Mark Raw at the International IOBC Induced Resistance Conference – Sheffield
April 2022	' Effects of high CO₂ on plant growth and stress tolerance ' by Christine Foyer Advanced Plant Growth Centre (APGC), James Hutton Institute, Scotland.
2-6 May 2022	'Implications of forest definition for quantifying disturbance regime characteristics in Mediterranean forests.' Conference paper by Nezha Acil XV World Forestry Congress, Seoul, South Korea. 2022
3-5 May 2022	'Response of Forests to Climate Change at BIFoR-FACE' invited speaker Sami Ullah Forum for Global Challenges, Birmingham UK 'Harnessing the Humanities for Nature – A Forest Partnership' conference presentation with John Holmes and Dion Dobrzynski , Forum for Global Challenges, Birmingham 2022)
13 May 2022	'Research update from the BIFoR FACE Facility' invited speaker Rob MacKenzie Ecological Continuity Trust webinar series https://www.youtube.com/watch?v=vLdYampyWxM
16 – 18 May 2022	'Drivers of changing forest dynamics in Europe' invited speaker Thomas Pugh Swedish Climate Symposium
25 May 2022	3rd Plant Microbiome Symposium, Dundee, invited speaker, Rob Jackson
25 May 2022	European Geosciences Union (EGU) (to be updated) Session Chair by Thomas Pugh 'Nitrogen cycling in forest soils under elevated CO ₂ : response of a key nutrient to climate change' Manon Rumeau (Highlighted talk) 'Soil - atmosphere exchange of greenhouse gases under future climates' Nine Douwes-Dekker Xylem sap dynamics of 175-year-old Quercus robur under elevated CO ₂ at BIFoR FACE, UK Susan Quick 'Root exudation rate increases, and composition changes in a mature temperate forest under elevated carbon dioxide' Michaela Reay 'High summer precipitation reduces soil methane sink capacity and alters decomposition processes in a mature temperate forest' Katy Faulkner 'From branch to forest to globe: how do tree choices regarding growth affect forest response to elevated CO ₂ levels?' Klaske van Wijngaarden 'Fertigation management of mixed-species plantation versus monoculture in plantation forestry: key aspects and future perspective' Andrea Rabbai 'Characterising volatile organic compound emission changes in native black poplar under elevated carbon-dioxide (CO ₂), elevated ozone (O ₃) and herbivory' Laura James 'Restoring the liver of the river: Instream wood as a nature-based solution to nutrient pollution in agricultural watercourses' Ben Howard

	<p>'Examining the impact of instream wood additions on hyporheic exchange in a lowland agricultural catchment' Nick Lugg</p> <p>'Impacts of post-photosynthetic fractionation on the carbon isotopic composition of leaf wax n-alkanes under elevated CO₂' Bridget Warren</p> <p>'Temporal and spatial effects of elevated CO₂ on greenhouse gas fluxes from tree stems in an upland temperate forest' Josep Barba</p>
7 June	'Oak research for protection against powdery mildew.' Invested presentation by Estrella Luna-Diez at the Action Oak Partner's event (Kew Gardens)
14th June 2022	'How Roads Impact the Propagation of Invasive Plants in the 1-D Spatial Domain' by Bradly Deeley , Models in Population Dynamics, Ecology and Evolution 2022 (Italy),
21 – 23 June 2022	<p>BIFoR annual meeting 2022</p> <p>Talks</p> <ul style="list-style-type: none"> • Forest dynamics in a changing world, Adriane Esquivel Muelbert, Watch online • Methane uptake by upland forests, Vincent Gauci, Watch online • How are forests harvested across Europe? Quantification of the contemporary forest harvest patterns from inventory data, Susanne Suvanto Watch online • BIFoR FACE: response of carbon and nutrient dynamics in temperate deciduous forests to five years of CO₂ fumigation, Sami Ullah, Watch online • Revisiting carbon isotope discrimination in C3 plants – an opportunity to improve predictions of plant carbon uptake, Florian Bush Watch online • Plant wax n-alkane biomarkers under elevated CO₂: understanding plant isotopic response in the geologic record, Bridget Warren Watch online • Phage and prophage: beauty and the beast, Mojgan Rabiey Watch online • Using functional genomics to understand a complex disease of oak trees, Graeme Kettles Watch online • Root exudation rate increases, and composition changes in a mature temperate forest under elevated carbon dioxide, Michaela Reay Watch online • Evidence for increased net primary productivity at BIFoR FACE in response to elevated CO₂, Rich Norby Watch online • Greenhouse gas fluxes from tree stems under elevated CO₂: the BIFoR FACE study case, Josep Barba Ferrer Watch online • Tree species climatic affiliation determines demographic balance across mature Northern Hemisphere forests, Julen Astigarraga Watch online • Global biogeography of forest disturbances, Nezha Acil Watch online • What is the effect of fragmentation on biodiversity? A meta-analysis, Laura Graham, Watch online <p>Plus poster presentations by 35 BIFoR staff and students View all posters https://www.birmingham.ac.uk/research/bifor/about/annual-meetings/2022-annual-meeting/2022-poster-submission.aspx</p>
26 -30 June	Vincent Gauci plenary speaker BIOGEMON 2022, Estonia
27 th June-1 st July	'Forests in transition: lessons learned from large data on forest dynamics' invited talk by Adriane Esquivel Muelbert 'Effect of mixed plantations and neighbouring species in the resistance to ash dieback disease' selected oral presentation by Estrella Luna-Diez International Association of Vegetation Science (IAVS) Annual Symposium (Madrid).
3-8 July 2022	14th International Conference on Plant Pathogenic Bacteria. Assisi (Italy) Invited talk by Mojgan Rabiey ('Do phages antagonise each other to reduce efficacy of killing bacteria?'), Rob Jackson and Megan McDonald
12 July 2022	'The nature of Amazonian tree mortality,' speaker Adriane Esquivel Muelbert 'Title TBC', speaker Thomas Pugh Association for Tropical Biology and Conservation (ATBC), held in Cartagena, Colombia

13 July 2022	'How to study and use phages to treat tree diseases?' by Mojgan Rabiey , Phage KTN event
21st July 2022	'Plants Vs Roads: The 1D Case', by Bradly Deeley , British Early Career Mathematicians' Colloquium 2022 (Birmingham UK)
29 August - 3 September 2022	'Characterising the structure of wind-related forest disturbances across the world' oral presentation by Nezha Acil at ForestSat 2022
31 July – 5 September	'Stimulation of soil nitrogen cycling processes after three years of Free Air CO ₂ Enrichment of mature temperate forests at BIFoR-FACE' presentation by Sami Ullah Poster Presentation by Nine Douwes Dekker World Congress on Soils, Glasgow
September 2022	International Conference on Advanced Biology, Kariavattorn, India, invited speaker Christine Foyer
5 September 2022	'Understanding the mechanisms of phage-bacteria coevolution' by Mojgan Rabiey , Phage Oxford Conference
7 September 2022	'Jumping genes: phage mediated transfer of a <i>Pseudomonas</i> effector in the cherry phyllosphere bacterial community' speaker Mojgan Rabiey British Society of Plant Pathology (BSPP) Annual Meeting- Microbial Lifestyles: from symbionts to pathogens, Newcastle, UK
6-9 September 2022	'Effect of mixed plantations and neighbouring species in the resistance to ash dieback disease' selected oral presentation by Rosa Sanchez-Lucas 'Impact of elevated CO ₂ in oak defence' selected oral presentation by Mark Raw 'Exploring defence priming in oak seedlings against powdery mildew' session organiser keynote presentation Oral presentations at the IUFRO All-Division 7 2022 Conference (Lisbon):
6 September 2022	Presentations by Nicholas Harper , Giulio Curioni , Jeremy Pritchard , Sami Ullah and Diana Vinchira Controlled Environment User Group (CEUG) conference
6-8 September 2022	'Leveraging global Earth Observation data and high-performance computing systems for characterising global forest disturbances' oral presentation by Nezha Acil UK National Earth Observation Conference 2022
11-14 September 2022	'Exploring defence priming in oak seedlings against powdery mildew' selected presentation by Rosa Sanchez-Lucas 7th IUFRO International Workshop on the Genetics of Tree-Parasite Interactions in Forestry in Pontevedra (Spain)
13 – 15 September	ICOS Science conference in Utrecht Session chair, Thomas Pugh
19 September 2022	'Understanding the human element in forest disturbances: observation-based quantification of harvest in European forests' by Susanne Suvanto 'Vulnerability of the Terrestrial Carbon Sink to Increases in Tree Mortality' by Adriane Esquivel Muelbert 'Title TBC' by Thomas Pugh Forest Disturbances and Ecosystem Dynamics in a Changing World Symposium. Berchtesgaden National Park, Germany
22 September 2022	'Overview of the MEMBRA project' by Estrella Luna Diez 'Exploring the history, culture and value of our treescapes' panel discussion member Adriane Esquivel Muelbert Treescapes Conference
21-23 September 2022	International Plant Health Congress- Side Event, London, UK Forest Health in a Changing Climate – risks, mitigations and tools Organiser/Moderator: Rob Jackson and Rob Mackenzie Speaker: Sami Ullah Panel Members: Sami Ullah and Megan McDonald

Appendix 3: BIFoR Stakeholder Engagement

The following programme of engagement gives a flavour of our stakeholder engagement in 2021/2022. Without stakeholders, our research will lie unused. The following programme of engagement gives a flavour of our stakeholder engagement in 2021/22.

<i>External Stakeholder Engagement - Academic</i>			
Date	Details	BIFoR contact	Location
Longer term Visiting Academics Dr Muhammad Shoab Amjad , Assistant Professor at Department of Botany, Women University AJ&K Bagh, Pakistan, arrived in May for a 9-month fellowship from the Higher Education Commission of Pakistan to study aboveground productivity under elevated carbon dioxide at BIFoR FACE. Prof. Richard Norby from the University of Tennessee visited twice during 2022			
March 2022	Academic visit to Faculty of Forestry & Wood Technology, Mendel University in Brno, Czech Rep./ Forestry & Game Management Research Institute (FGMRI) ,Czech Rep.	Robert Grzesik Angeliki Kourmouli	Other
04/03/2022	Introduction to interdisciplinary MEMBRA Biosciences Academic Away Day	Estrella Luna-Diez	UoB
08/03/2022	Presentation to St Helena researchers	Rob Jackson	Other
17/03/2022	Patricia Thornley, Aston University, Director of the Energy and Bioproducts Research Institute	Rob MacKenzie	UoB
30/03/2022	Research seminar The Hebrew University of Jerusalem	Rob Jackson	Other
10/05/2022	University of Munich staff visit to campus and BIFoR FACE	Sami Ullah	UoB and BIFoR FACE
23/05/2022	Research seminar at John Innes Centre	Rob Jackson	Other
May 2022	Roel Brienen (University of Leeds) Andy Smith (University of Bangor)	Bruno Ladvocat Rodrigo Bergamin Adriane Esquivel Muelbert	UoB
21 – 23/06/2022	Invited speakers as part of the BIFoR Annual meeting Oliver Phillips , <i>University of Leeds</i> Filipe França <i>University of Bristol</i> Cornelius Senf , <i>Technical University of Munich, Germany</i> Paloma Ruiz-Benito , <i>University of Alcalá, Spain</i> Anja Rammig , <i>Technical University of Munich</i>	Thomas Pugh and Adriane Esquivel Muelbert	UoB and BIFoR FACE
July 2022	Visit of Rossella Guerrieri, Assitant Professor, University of Bologna	Sami Ullah	UoB and BIFoR FACE
September 2022	Newton-Bhabha Indo-UK Link Workshop on Sustaining Food Production Under Environmental Stress.	Christine Foyer	Other
8-10 /08/2022	Visit to the Hawkesbury Institute for the Environment Collaborative visit with Dr. Jürgen Knauer at HIE to discuss his involvement in NERC-funded project at UoB.	Florian Busch	Other
October 2022	TreeMort Writing Retreat	Thomas Pugh	Other
October 2022	Academic visit from 2 members of Faculty of Forestry & Wood Technology, Mendel University in Brno, Czech Rep./ Forestry & Game Management Research Institute (FGMRI) ,Czech Rep. Jakub Cerny and Radek Pokorny		UoB and BIFoR FACE

<i>External Stakeholder Engagement - Education</i>			
05/11/2021	Bangor Urban Forestry staff and students University of Birmingham	Rob MacKenzie	UoB
16/11/2021	COP26 - CPD event for high school Geography and Biology teachers at The Exchange	Jerry Pritchard	The Exchange
30/11/2021	King Edwards VI Handsworth School visit to BIFoR FACE	Jerry Pritchard	BIFoR FACE
24/01/2022	Biosciences students and staff visit to BIFoR FACE	Rob Jackson	BIFoR FACE
24/02/2022	CPD events for teachers (Bishop Challoner Catholic College, Birmingham)	Jerry Pritchard	Other
30/03/2022	Big Quiz	Jerry Pritchard	UoB
08/02/2022	Sparsholt College staff and students tour of BIFoR FACE	Anna Gardner	BIFoR FACE
16/02/2022	UCL staff and students tour of BIFoR FACE	Rob MacKenzie	BIFoR FACE
15/02/2022	UoB Carbon Management MSc students	Rob MacKenzie	BIFoR FACE
22/06/2022	Early Career Researcher Conference, University of Birmingham. Keynote talk by Emma Ferranti, <i>'Careers in academia: from Post Doc to Associate Professor'</i>	Emma Ferranti	UoB
04/07/2022	Global Challenges Mini Lectures for 11 high schools (circa 160 students) invited to University	Adriane Esquivel Muelbert Rob MacKenzie Rosa Sanchez Lucas	UoB
06/07/2022	Solihull Sixth Form Biology students	Jeremy Pritchard	BIFoR FACE

<i>External Stakeholder Engagement – Private, Public & Third Sector</i>			
Date	Details	BIFoR contact	Location
2/10/2021	Launch of the Public Programme at the Exchange, interactive activities	Jeremy Pritchard	The Exchange
October 2021	Online workshop on Fair collaboration in Global Networks in Forest Science.	Adriane Esquivel Muelbert	Other
6/10/2021	Presentation to DEFRA colleagues	Rob Jackson	UoB
6/11/2021	COP26 Green Zone, Universities 21 area, "Hart of the Wood at the BIFoR Facility"	Anna Gardner Ben Wigley	Other
6/11/2021	COP26 Green Zone, UKRI area. Information shared about BIFoR FACE	Anna Gardner	Other
09/11/2021	Defra Trees Team visit to BIFoR FACE	Rob MacKenzie	BIFoR FACE
09/11/2021	COP26 event at the Exchange	Christine Foyer	The Exchange
12/11/2021	Stafford University staff and student visit to BIFoR FACE	Kris Hart	BIFoR FACE
15/11/2021	Amazon FACE representatives visit to BIFoR FACE	Rob MacKenzie	BIFoR FACE
29/11/2021	BIFoR stand at Sustainability Town Hall event	Deanne Brettle	UoB

January 2022	"What Street Planting Does (and doesn't do) for Air Quality lecture		James Levine	The Exchange
January 2022	Anna Gardner talk ICF members hours		Anna Gardner	Other
21/01/2022	Ruskin Land visit to BIFoR FACE		Rob MacKenzie	BIFoR FACE
16/02/2022	Air Liquide senior staff tour of BIFoR FACE		Rob MacKenzie Rob Jackson	BIFoR FACE
Feb 2022	Secret World of trees x 2 family workshops at the Exchange		Megan McDonald Jerry Pritchard Deanne Brettle	The Exchange
21 – 25 February 2022	U21 Early Career Workshop		Susan Quick	Other
March 2022	John Ruskin, Environmental Justice and the Arts (online presentation for Good Living project panel, Nature of Cities Festival)		John Holmes	Online
05/04/2022	Natural England tour of BIFoR FACE		Aileen Baird	BIFoR FACE
28/04/2022	Birmingham Tree People visit to BIFoR FACE		Peter Miles	BIFoR FACE
May 2022	BIFoR stand at the Norbury Canal Festival		Deanne Brettle Megan McDonald Anna Gardner	Other
25/05/2022	Gnossal Pheonix Club, presentation about BIFoR FACE		Kris Hart	Other
11/05/2022	Royal Forestry Society members		Rob MacKenzie Rob Jackson & many more	BIFoR FACE
07/04/2022	University of Third Age Harborne Group		Deanne Brettle	Other
09/05/2022	Presentation Fatima Khan Pint of Science		Fatima Khan	Other
11/05/2022	Presentation Gemma Baker, Pint of Science Birmingham		Gemma Baker	Other
12/05/2022	Woodland Trust		Many	BIFoR FACE
19/05/2022	MEMBRA team		Estrella Luna Diez	BIFoR FACE
17/05/2022	UKRI team		Sami Ullah and many more	BIFoR FACE
18/05/2022	Event for World Fascination of Plants Day - a virtual tour of BIFoR FACE		Jerry Pritchard	Other
30/05/2022	Secret World of trees family workshops at the Exchange		Megan McDonald Deanne Brettle	The Exchange
16/06/2022	Tree Mapping Workshop organised by TDAG, Forest Research & BIFoR more information		Emma Ferranti	Other
TBC	RSB Plant Health and UK STEM conference		Jerry Pritchard Joe Berry	Other
18 - 21/07/2022	Royal Welsh Show (stand within the CONFOR marquee)	Rob Jackson Sabrine Dhaouadhi Vanja Milenkovic		Other
26/07/2022	Wonder Women in Science Event, Hong Kong		Christine Foyer	Other

29/06/2022	Municipal Tree Officers Association (MTOA) members	Emma Ferranti Rob MacKenzie	BIFoR FACE
04/09/2022	Staffordshire Women's Institute	Deanne Brettle	BIFoR FACE
02/10/2022	'Forests in Fantasy' day-school and exhibition	Dion Dobrzynski	UoB

List of speaker engagements by Prof. Jon Drori

Date	Description	Location
	All solo events of about 1 hour, unless otherwise stated)	
10/09/2021	Garden in the Woods, Massachusetts USA, lecture about 'Around the World in 80 Plants'	Online
25/09/2021	Chelsea Physic Garden, London. Plants, history and uses	
26/09/2021	Milim Literature and Ideas Festival, Leeds	Online
01/10/2021	PlantLife International, in conversation with the CEO, Ian Dunn	Online
02/10/2021	Radio New Zealand, national Saturday morning programme	National Radio
13/11/2021	Bridport Literary Festival main stage solo event	Main stage, in person
18/11/2021	Mumbai International Literary Festival 'Literature Live!'	Online
30/11/2021	Cambridge 105 Radio interview	Local radio
09/12/2021	Royal Society Club, after dinner speaker to Fellows of the Royal Society on tomatoes.	In person
17/12/2021	Podcast recording with Adam Shaw of BBC for Woodland Trust	Online
12/01/2022	Jtree event, lecture	In person
18/01/2022	Montreal botanical society online event	Online
29/01/2022	BBC Radio 4 'Open Country', substantial part of the 30min episode about a forest of redwoods in Wales and the pinetum nearby.	National radio
16/02/2022	Podcast recording for The Tree Council	Online
26/02/2022	Kings Place, London JBW, joint event with author Elif Shafak about trees.	In person, main stage
26/02/2022	Garden in the Woods, Massachusetts, USA 'Botany Slam' panellist	Online
28/02/2022	Milim Online Festival	Online
01/03/2022	Podcast recording for Royal Institution	Online
07/03/2022	Dorset annual science festival large audience at Thomas Hardy School	In person
27/04/2022	Resurgence online event, "Ten Botanical Stories to Change the World"	Online
28/04/2022	Oundle Literary Festival	In person
06/05/2022	5 x 15' Popular online science and literature events. In conversation with Sir Tim Smit and Rosie Boycott about botanical matters	Online
10/05/2022	Linnean Soc charring and interviewing event around collections - with natural History Museum, Rothamsted research, RHS etc.	Online
21/05/2022	Radio New Zealand, Saturday Morning national show. Substantial interview on plant topics	National radio
07/06/2022	Song for the Trees', theatrical joint event with Sam Lee, singer/songwriter and folk song collector, JW3 Centre, London	In person, main stage
23/06/2022	5 x 15' Popular online science and literature events. In conversation with Dr. Suzanne Simard about 'Finding the Mother Tree' and my book 'Around the World in 80 Trees'	Online
29/06/2022	Guided tree walk on Hampstead heath for WWF major donors	In person
04/07/2022	Compton Verney presentation to Trustees and senior staff on charity strategy	In person
05/07/2022	Talk at Worshipful Company of Apothecaries. 'Around the World in 80 Trees'	In person
14/08/2022	Canberra Writers Festival, online, main event interview	Online
21/09/2022	International Plant Health Conference, opening keynote speech	Westminster, London
11/10/2022	5 x 15' Popular online science and literature events. In conversation with Prof Nicola Spence about plant health in the UK.	Online

Appendix 4: BIFoR Papers

Papers from previous years can be found [online](#)

Climate

1. **Baird, A., Bannister, E., MacKenzie, A.R. and Pope, F. (2022).** Mass concentration of bioaerosols in a mature temperate woodland affected by temperature and wind speed, but not relative humidity or two years of elevated CO₂. *Biogeosciences*, 19(10), 2653-2669 <https://bg.copernicus.org/articles/19/2653/2022/>
2. **Bannister, E., Jesson, M., Harper, N., Hart, K., Curioni, G., Cai, X. & MacKenzie, A. R., (2022)** Air-parcel residence times in a mature forest: observational evidence from a free-air CO₂ enrichment experiment Preprint <https://doi.org/10.5194/acp-2022-318>
3. **Gardner A., Ellsworth D. S., Pritchard J, and MacKenzie A. R. (2022).** Are chlorophyll concentrations and nitrogen across the vertical canopy profile affected by elevated CO₂ in mature *Quercus* trees? *Trees*. <https://doi.org/10.1007/s00468-022-02328-7>
4. Roberts, A.J., **Crowley, L.M. Gardner, A., Sadler, J.P., Nguyen, T.T.T., Hayward, S.A.L.** and Metcalfe, D.B. (2022). Effects of Elevated Atmospheric CO₂ Concentration on Insect Herbivory and Nutrient Fluxes in a Mature Temperate Forest. *Forests*, 2022, 13, 998. <https://doi.org/10.3390/f13070998>
5. **Ziegler, C., Kulawska, A., Kourmouli, A., Hamilton, L., Shi, Z., MacKenzie, A.R., Dyson, R.J.,** Johnston, I.G. (2022). Quantification and uncertainty of root growth stimulation by elevated CO₂ in a mature temperate deciduous forest. *Science of The Total Environment* 854 <https://doi.org/10.1016/j.scitotenv.2022.158661>

BIFoR Health

1. Collinge, D.B., Jensen, D.F., **Rabiey, M.**, Sarrocco, S., Shaw, M.W. and Shaw, R.H. (2022). Biological control of plant diseases – What has been achieved and what is the direction? *Plant Pathology*, 71, 1024–1047 <https://doi.org/10.1111/ppa.13555>
2. **Rabiey, M., Welch, T., Sanchez-Lucas, R., Stevens, K., Raw, M., Kettles, G.J., . . . Luna Diez, E. (2022).** Scaling-up to understand tree–pathogen interactions: A steep, tough climb or a walk in the park? *Current Opinion in Plant Biology*, 68, 102229 <https://doi.org/10.1016/j.pbi.2022.102229>
3. Wagemans, J., Holtappels, D., Vainio, E., **Rabiey, M.**, Marzachì, C., Herrero, S., Ravanbakhsh, M., Tebbe, C. C., Ogliastro, M., Ayllón, M. A., and Turina, M. (2022). Going Viral: Virus-Based Biological Control Agents for Plant Protection. *Annual Review of Phytopathology*, 60(1), 21-42 <https://doi:10.1146/annurev-phyto-021621-114208>

BIFoR Global

1. Amora-Nogueira, L., Sanders, C.J., Enrich-Prast, A., Sanders, L.S.M., Abuchacra, R.C., Moreira-Turcq, P.F., Cordeiro, R.C., **Gauci, V.**, Moreira, L.S., Machado-Silva, F. and Libonati, R. (2022). Tropical forests as drivers of lake carbon burial. *Nature communications*, 13(1), pp.1-7 <https://doi.org/10.1038/s41467-022-31258-8>
2. Anderegg, W.R.L., Wu, C., **Acil, N.**, Carvalhais N., **Pugh T.A.M., Sadler J.P.** and Seidl, R. (2022). A climate risk analysis of earth's forests in the 21st century. *Science*, 1099–1103 <https://doi.org/10.1126/science.abp9723>
3. Baker, J.C.A., **Cintra, B.B.L.**, Gloor, M., Boom, A., Neill, D., Clerici, S., et al. (2022). The changing Amazon hydrological cycle—Inferences from over 200 years of tree-ring oxygen isotope data. *Journal of Geophysical Research: Biogeosciences*, 127, e2022JG006955. <https://doi.org/10.1029/2022JG006955>
4. **Bannister, E.J., MacKenzie, A.R., and Cai, X.M. (2022).** Realistic Forests and the Modeling of Forest-Atmosphere Exchange. *Reviews of Geophysics*. 60(1) <https://doi.org/10.1029/2021RG000746>

5. Brookhouse, M.T., Bush, D., Ivkovich, M., **Busch, F.**, Farquhar, G.D. and Pinkard, E., (2022). Early-growth results within a Eucalyptus globulus breeding population suggest limited scope for selection focused on CO₂ responsiveness. *Tree Genetics & Genomes* 18, 6 <https://doi.org/10.1007/s11295-022-01547-w>
6. Brush, M., **Matthews, T.J.**, Borges, P.A.V. and Harte, J. (2022). Land use change through the lens of macroecology: insights from Azorean arthropods and the maximum entropy theory of ecology. *Ecography*, e06141 <https://doi.org/10.1111/ecog.06141>
7. **Gauci, V.**, Figueiredo, V., Gedney, N., Pangala, S.R., Stauffer, T., Weedon, G.P. and Enrich-Prast, A. (2022). Non-flooded riparian Amazon trees are a regionally significant methane source. *Philosophical Transactions of the Royal Society A*, 380(2215), p.20200446 <https://doi.org/10.1098/rsta.2020.0446>
8. Jackson, F.L., **Hannah, D.M.**, Ouellet, V., and Malcolm, I.A. (2021). A deterministic river temperature model to prioritize management of riparian woodlands to reduce summer maximum river temperatures. *Hydrological Processes*, 35(8), e14314 <https://doi.org/10.1002/hyp.14314>
9. Klipel, J., Bergamin, R.S., **Esquivel Muelbert, A.**, de Lima, R.A.F., de Oliveira, A.A., Prado, P.I., and Müller, S.C. (2022). Climatic distribution of tree species in the Atlantic Forest. *Biotropica*, 54, 1170– 1181 <https://doi.org/10.1111/btp.13140>
10. Li, K., Zhang, X., Zhao, B., **Bloss, W. J.**, Lin, C., White, S., Yu, H., Chen, L., Geng, C., Yang, W., Azzi, M., George, C. & Bai, Z., (2022). Suppression of anthropogenic secondary organic aerosol formation by isoprene. *npj Climate and Atmospheric Science*. 5,12 <https://doi.org/10.1038/s41612-022-00233-x>
11. **Liu, D.**, Zhang, C., Ogaya, R., Estiarte, M., Zhang X., **Pugh, T.A.M.** and Peñuelas, J. (2022). Delayed and altered post-fire recovery pathways of Mediterranean shrubland under 20-year drought manipulation. *Forest Ecology and Management*, 506, 119970 <https://doi.org/10.1016/j.foreco.2021.119970>
12. **Matthews, T.J.**, **Wayman, J.P.**, Cardoso, P., Sayol, F., Hume, J.P., Ulrich, W., Tobias, J.A., Soares, F.C., Thébaud, C., Martin, T.E. and Triantis, K.A. (2022). Threatened and extinct island endemic birds of the world: distribution, threats and functional diversity. *Journal of Biogeography* 49, 1920– 1940 <https://doi.org/10.1111/jbi.14474>
13. Tobias, J.A., Sheard, C., Pigot, A.L., Devenish, A.J.M., Yang, J., Sayol, F., ...and **Matthews T.J.** ...et al. (2022). AVONET: morphological, ecological and geographical data for all birds. *Ecology Letters*, 25, 581– 597 <https://doi.org/10.1111/ele.13898>
14. Triantis, K.A., Rigal, F., Whittaker, R.J., Hume, J.P., Sheard, C., Poursanidis, D., Rolland, J., Sfenthourakis, S., **Matthews, T.J.**, Thébaud, C. & Tobias, J.A. (2022) Deterministic assembly and anthropogenic extinctions drive convergence of island bird communities. *Global Ecology and Biogeography*, 31, 1741-1755 <https://doi.org/10.1111/geb.13556>
15. Ulrich, W., **Matthews, T.J.**, Biurrun, I., Campos, J. A., Czortek, P., Dembicz, I., . . . and Dengler, J. (2022). Environmental drivers and spatial scaling of species abundance distributions in Palaearctic grassland vegetation. *Ecology*, 103, e3725 <https://doi.org/10.1002/ecy.3725>
16. Reis, S.M., Marimon, B.S., **Esquivel Muelbert, A.**, Marimon, B.H., Morandi, P.S., Elias, F., de Oliveira, E.A., Galbraith, D., Feldpausch, T.R., Menor, I.O., Malhi, Y. and Phillips, O.L. (2022). Climate and crown damage drive tree mortality in southern Amazonian edge forests. *Journal of Ecology*, 110, 876– 888 <https://doi.org/10.1111/1365-2745.138499>
17. Sousa, T., Schiatti, J., Ribeiro, I, Emilio, T, Fernández, R, Steege, H, de Castilho, C; and **Esquivel Muelbert, A.** et al.(2022). Water-table depth modulates productivity and biomass across Amazonian forests. *Global Ecology and Biogeography*, 31, 1571– 1588. <https://doi.org/10.1111/geb.13531>

18. Rodrigues, A.V., Pastório, F.F., Bones, F.L.V., **Esquivel Muelbert, A.**, Vibrans, A.C., and Gasper A.L. (2022). A test of the fast-slow plant economy hypothesis in a subtropical rain forest. *Plant Ecology & Diversity* <https://doi.org/10.1080/17550874.2022.2039313>
19. Warner E., Mayoral, C. et al (2022) Higher aboveground carbon stocks in mixed-species planted forests than monocultures – a meta-analysis [preprint] <https://www.biorxiv.org/content/10.1101/2022.01.17.476441v1.article-info>
20. Wayman, J.P., Sadler, J.P., Pugh, T.A.M., Martin, T.E., Tobias, J.A., and Matthews, T.J. (2022). Assessing taxonomic and functional change in British breeding bird assemblages over time. *Global Ecology and Biogeography*, 31, 925-939 <https://doi.org/10.1111/geb.13468>
21. Wu, A., Brider, J., **Busch, F.A.**, Chen, M., Chenu, K., Clarke, V.C., Collins, B., Ermakova, M., Evans, J.R., Farquhar, G.D., Forster, B., Furbank, R.T., Gorszmann, M., Hernandez, M.A., Long, B.M., Mclean, G., Potgieter, A., Dean Price, G., Sharwood, R.E., Stower, M., van Oosterom, E., von Caemmerer, S., Whitney, S.M. and Hammer, G.L. (2022). A cross-scale analysis to understand and quantify effects of photosynthetic enhancement on crop growth and yield across environments. *Plant Cell Environ.* Accepted Author Manuscript <https://doi.org/10.1111/pce.14453>
22. Xu, Z., **Hilton, J.**, Yu, J., Wignall, P.B., Yin, H., Xue, Q., Ran, W., Li, H., Shen, J., and Meng, F., (2022). End Permian to Middle Triassic plant species richness and abundance patterns in South China: Coevolution of plants and the environment through the Permian–Triassic transition. *Earth-Science Reviews*, 232 <https://doi.org/10.1016/j.earscirev.2022.104136>

BIFoR Interdisciplinary, policy and general papers

1. **Baird, A.** and **Pope, F.** (2022). 'Can't see the forest for the trees': The importance of fungi in the context of UK tree planting. *Food and Energy Security*, e371. <https://doi.org/10.1002/fes3.371>
2. Bateman, I.J., Anderson, K., Argles, A., Belcher, C., Betts, R.A.,and **Mackenzie A.R** (2022). A review of planting principles to identify the right place for the right tree for 'net zero plus' woodlands: Applying a place-based natural capital framework for sustainable, efficient and equitable (SEE) decisions. *People and Nature*, 00, 1–31 <https://doi.org/10.1002/pan3.10331>
3. Bradwell J.A, **Foyer C.H.**, and **MacKenzie A.R.**(2022). Forest Innovation to tackle the Climate and Biodiversity Emergencies. White Paper <https://doi.org/10.25500/epapers.bham.00004044>
4. **Deeley, B.** and **Petrovskaya, N.** (2022). Propagation of invasive plant species in the presence of a road. *Journal of Theoretical Biology*, 548, 111196 <https://doi.org/10.1016/j.jtbi.2022.111196>
5. **Howard, B.C.**, Baker, I., **Kettridge, N.**, **Ullah, S.**, and **Krause, S.** (2022). Increasing the scope of the resazurin-resorufin smart tracer system in hydrologic and biogeochemical sciences: The effects of storage duration and temperature on preservation. *Limnology and Oceanography: Methods* <https://doi.org/10.1002/lom3.10514>

Other outputs including book chapters

- 1) **Acil, A.**, **Sadler, J.P.**, and **Pugh, T.A.M.** (2022). Implications of forest definition for quantifying disturbance regime characteristics in Mediterranean forests. *XV World Forestry Congress. Proceedings paper.*
- 2) **Acton, W.J.F.**, **Ferranti, E.J.S.**, **Grayson, N.**, **Bloss, W.J.** and **MacKenzie, A.R.** (2022). Trees and urban air quality: a briefing note. *Project Report. University of Birmingham: WM-Air Project, Birmingham.* <https://doi.org/10.25500/epapers.bham.00004112>

- 3) **Ferranti, E.J.S., Fitcher, J., Salter, K., Hodgkinson, S.P.B., and Chapman L.** (2021). First Steps in Urban Heat for Built Environment Practitioners. 2021. *A Trees and Design Action Group (TDAG) Guidance Document*. UK: London. <https://doi.org/10.25500/epapers.bham.00003452>
- 4) Jaluzot, A., James, S., and **Ferranti, E.J.S.** (2022). First Steps in Trees and New Developments. *A Trees and Design Action Group (TDAG) Guidance Document*. UK: London. <https://doi.org/10.25500/epapers.bham.00004109>
- 5) Kondo, M., Birdsey, R., **Pugh, T.A.M.**, Lauerwald, R., Raymond, P.A., Niu, S., Naudts, K. (2022). Chapter 7 - State of science in carbon budget assessments for temperate forests and grasslands, Editor(s): Benjamin Poulter, Josep G. Canadell, Daniel J. Hayes, Rona L. Thompson, *Balancing Greenhouse Gas Budgets*, Elsevier, Pages 237-270
- 6) **Levine, J.G., Ferranti, E.J.S. and MacKenzie, A.R.** (2022). Green Infrastructure for Clean Air and One Health, in Čavoški, A., **Bartington, S., Bloss W.**, and Bryson J. (Eds.), *Policy Solutions to the Clean Air Challenge*, 9-12 <https://doi.org/10.25500/epapers.bham.00004048>

Social media and other grey literature

- We are extremely grateful to Prof **Alice Roberts** who offered to help make some informational videos about BIFoR FACE. The videos are all available on YouTube:
 - [Longer BIFoR FACE video](#)
 - [Shorter BIFoR FACE video](#)
- Further promotional videos about BIFoR FACE and the Wolfson Advanced Glasshouses were created – our thanks to [‘Spoke’](#) and [Creative Media](#) at the University of Birmingham for producing these videos.
 - [Promotional video about BIFoR FACE](#)
 - [Promotional video about the Wolfson Advanced Glasshouses](#)
- Our research was promoted in the Chronical of Higher Education.
 - [Predicting the fate of forests in a warmer world](#)
- With the release of the first academic paper from the BIFoR FACE facility, came an increase in quality coverage in the media, our thanks go to **the press office** for all their support, the **BIFoR Operations Team, Rob MacKenzie** and of course the first author of the paper PhD student **Anna Gardner**. The story was covered in:
 - Special edition of BBC Gardner’s World on Trees (8:30pm BBC2 on 8 October)
 - [BBC Radio 4 - Costing the Earth, Seeing the Wood for the Trees.](#)
 - BBC Radio 4 [Inside Science](#) an interview with Anna Gardner.
 - ITV news [“We need to do our bit”](#) with accompanying blog article by [Lewis Warner](#).
 - BBC [Midlands news](#) coverage 4 October 2022.
 - The research was also picked up by a number of other media organisations including, The Times, The Independent, Cable News Network (CNN), ABC News.
- BBC ‘Crowd Science’ interviewed, Dr **Estrella Luna Diez** and **Peter Miles** for a special edition [“Do plants have immune system?”](#)
- BBC Learning English featured the research project MEMBRA led by **Estrella Luna Diez**.
 - [BBC Learning English MEMBRA video](#)
- Dr **Emma Ferranti** spoke to BBC Midlands Today about the local weather effects caused by climate change.
- Three articles in ‘The Conversation’:
 - Rob MacKenzie** [A 150-year-old note from Charles Darwin is inspiring a change in the way forests are planted](#)
 - Thomas Pugh** [Why tackling deforestation is so important for slowing climate change](#)
 - Rob MacKenzie** [Climate crisis: what can trees really do for us?](#)
- Article for Marine Scotland by **David Hannah**.
 - [Trees and River Temperature](#)
- Article for Geographical Directions by **Rob MacKenzie** and **Christine Foyer**.

[A 150-year-old note from Charles Darwin is inspiring a change in the way forests are planted](#)

- The online streaming platform, WaterBear, created a documentary featuring student **Liam Crowley**, “The Trees of Life” programme is available to watch for free but registration to their platform is required. [WaterBear – The Trees of Life](#)
- The Trees for the Future conference received international press attention in *Technology Times* (Pakistan), *Eco Voice* (Australia) and *Foreign Affairs* (New Zealand).
- The COP26 featuring Amazon FACE research and plans was recorded and is online. [Will the rainforest slow climate change? World leading science in the Brazilian Amazon](#)
- **Dr Annie Mahtani** Head of School of Music was interviewed by BBC Radio 3 for COP26. [The New Music Show COP 26 Special](#)
- **John Holmes** and **Dion Dobrynski** created a new video regarding their exciting new project to create artwork on the themes of nature and environmental justice. [Reconnecting Birmingham to Ruskin Land - University of Birmingham](#)
- New Podcast with **Rob MacKenzie** and **Emma Ferranti**. [The People place and Nature Episode 10](#)
- Podcast interview with **Vincent Gauci** for Royal Geographical Society with IBG. [‘39 Ways to Save the Planet’](#)
- **Adriane Esquivel Muelbert** gave an Interview for [Mongabay](#).
- **Adriane Esquivel Muelbert’s** research was mentioned in a [Mongabay article](#).
- **Adriane Esquivel Muelbert’s** research was mentioned as the stronger evidence of the Amazon tipping point in the Podcast [‘A Terra é redonda.’](#)
- **Curtis Gubb** and **Christian Pfrang’s** research was highlighted on **Morning Live** – houseplants removing Nitrogen dioxide. [Read new paper](#)
- **Rob MacKenzie** and **Edward Bannister** wrote an article for Eos the science news magazine for AGU. [Modeling Forest-Atmosphere Exchange - Eos](#)
- The video recorded of student **Amy Webster** for the Queens Baton Relay when the Baton reached St Helena had over 2,600 views. [Amy Webster talks about Tree disease on St Helena Island](#)
- Our undergraduate student volunteers have also been making videos about their experiences: [Ester Konenca](#) created several informational videos about to TikTok
[Claudia Alvarado](#) created a summary of her summer volunteering on LinkedIn

University of Birmingham, collection of essays for COP26 ‘Addressing the Climate Challenge.’

<https://www.birmingham.ac.uk/research/climate/climate-publications/publications.aspx>

- Not just standing there: the carbon utility of established forest by **Rob MacKenzie**
- Tree susceptibility and resilience to pests and disease by **Rob Jackson, Estrella Luna-Diez, Graeme Kettles** and **Megan McDonald**
- Improving the climate resilience of infrastructure networks by **Lee Chapman, David Jaroszweski** and **Emma Ferranti**
- The implications of net zero ambitions for infrastructure resilience to climate change, by **Sarah Greenham, Emma Ferranti, David Jaroszweski, Lee Chapman, Andrew Quinn** and **Ruth Wood**
- Clean Air: bringing local synergies to the global climate challenge by **William Bloss, Joe Acton** and **Jian Zhong**
- Embedding climate change adaptation as business as usual within the railway sector by **Emma Ferranti, Andrew Quinn, John Dora, Sarah Greenham, Rachel Fisher, Nick Pyatt** and **Tim Reeder**
- Building better, safer, healthier cities for children and young people by **Peter Kraftl, Sophie Hadfield Hill** and **Susanne Börner**
- The amenity value of the climate by **David Maddison**
- The air we breathe and clean air day by **William Bloss, Suzanne Bartington** and **John Bryson**
- ‘No wealth but life’: the role of the arts and humanities in tackling the climate crisis by **John Holmes** and **Dion Dobrynski**

Publications by Prof. **Jon Drori**

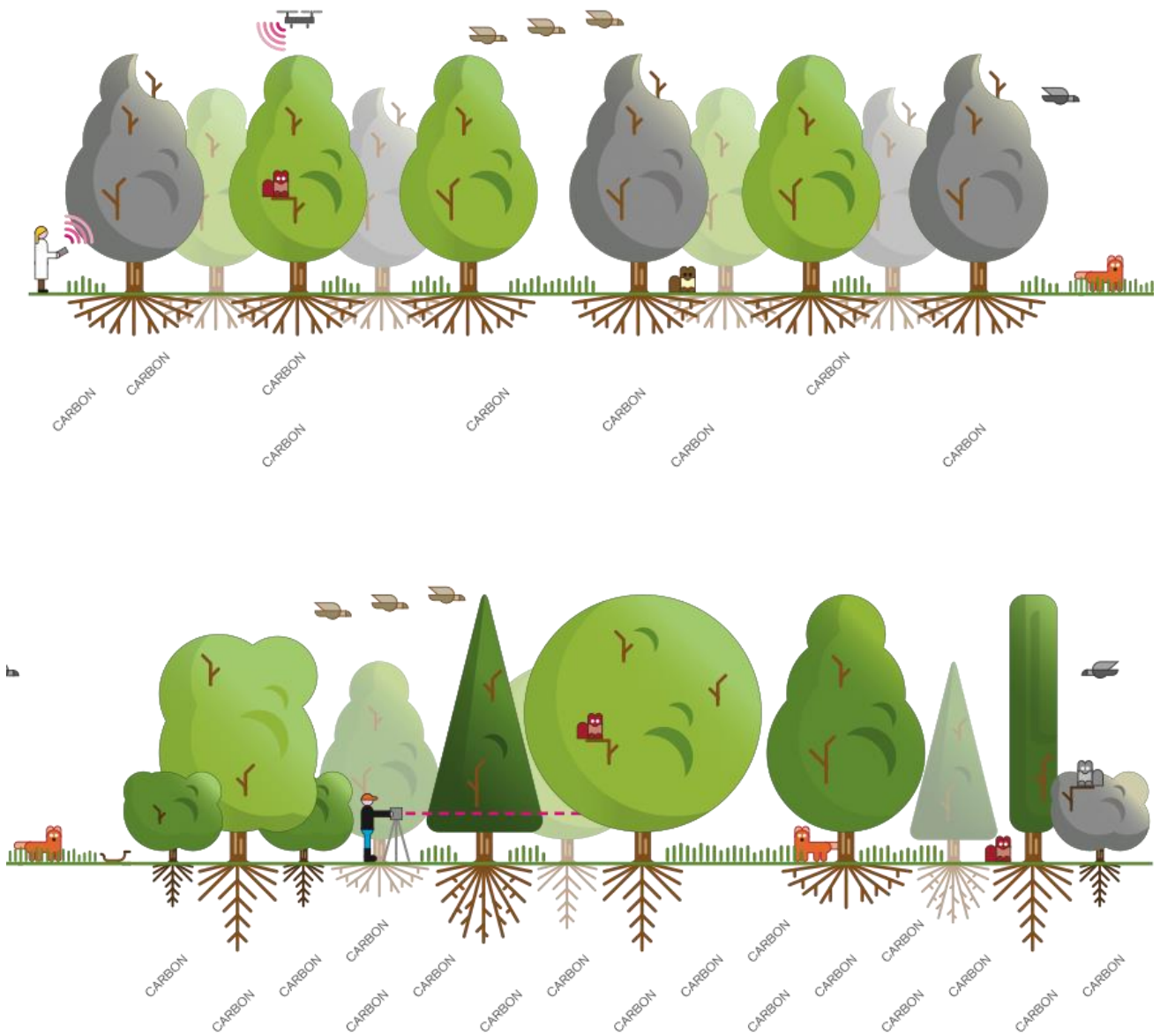
Surgeons' News (the Journal of the Royal College of Surgeons of Edinburgh) December 2021	"The not-so-mythical mandrake powers"
Surgeons' News (the Journal of the Royal College of Surgeons of Edinburgh) March 2022	"Liquorice: Kill or cure?"
Surgeons' News (the Journal of the Royal College of Surgeons of Edinburgh) June 2022	"The castor bean - A mixed blessing"
Surgeons' News (the Journal of the Royal College of Surgeons of Edinburgh) September 2022	"Gutta serena - a tree of play and profit"
Resurgence & Ecologist (magazine) Issue 333, July/August 2022	"The World in a Cedar"
Polination [sic] Festival, Birmingham, September 2022. Main online material	All written material about seven key plant species on which the Festival was based. Used online and in the Festival programme.

Appendix 5: Funding

The following awards were achieved in academic year 2021/ 2022

Title	Lead HEI	PI	Funder	Total Value	Value to UoB
The role of mesophyll CO ₂ diffusion in modulating the response of photosynthetic carbon uptake to CO ₂ enrichment of a mature temperate forest (2022 – 2025)	University of Birmingham	Florian Busch	NERC Standard Grant New Investigator	£870,000	£870,000
DiversiTree: diversifying our woodlands to increase resilience (2022 – 2024)	James Hutton Institute	Robert Jackson	UK Treescapes	£637,920	£154,574
Large-scale synthesis of tree biodiversity across tropical Americas (Syntreesys) project (started in 2021)	Universities of Toulouse & Birmingham	Adriane Esquivel Muelbert	French Foundation for Biodiversity Research (FRB) / CESAB	£192,000	NA
Post of a Learning and Engagement Officer for BIFoR for 3 years (20220 - 2026)	University of Birmingham	Jeremy Pritchard	John and Lorna Powell	£150,000	£150,000
CLEANFOREST Joint effects of CLimate Extremes and Atmospheric deposition on European FORESTs	University of Bologna	Sami Ullah	COST Program	Euro 120,000	NA
The soundscape of trees: a programme of activity that raises awareness of environmental issues through forest ecosystems and the sounds of trees. (2022 – 2023)	University of Birmingham	Mojgan Rabiey	UKRI-ESRC (Economic and Social Research Council)	£50,000	£50,000
Assessing the potential of clay-compost mix for plant growth (2022)	University of Birmingham & Harriot Watt University	Sami Ullah and Liz Hamilton	High Speed 2 (HS2) rail network	£48,500	£48,500
Infrastructure for Wolfson's glasshouses (2022)		Megan McDonald	Internal College Funding	£30,000	£30,000
Adaptation of novel COVID test methodology for rapid testing for tree pathogens (2022)	University of Birmingham	Robert Jackson	Defra /Forest Research	£24,688	£24,688
Investigating large Amazonian Trees (2022)	University of Birmingham	Adriane Esquivel Muelbert	Royal Society	£20,000	£20,000
Quantifying the net effect of photorespiration on the carbon uptake of C3 plants (2022)	University of Birmingham	Florian Busch	Royal Society	£20,000	£20,000
Response of nitrogen cycling processes to elevated atmospheric CO ₂ fumigation in Amazonian forests (2022)	University of Birmingham	Sami Ullah	Royal Society Mobility	£12,000	£12,000

Six Steps to Tree Success: decision-maker guidance on urban tree retention (2021)	University of Birmingham	Emma Ferranti	QR Funding	£11,000	£11,000
Visiting academic Dr Shoab Amjad (2022)	University of Birmingham	Rob MacKenzie	Women's University Pakistan	£5,400	£5,400
Pump Priming Fund (2022)	University of Birmingham	Mojgan Rabiey	University of Birmingham, Biosciences	£5,000	£5,000
BIFoR representation through art at COP26 (2021)	University of Birmingham	Deanne Brettle	Internal College Impact Funding	£4,900	£4,900
BIFoR in a Box (2022)	University of Birmingham	Deanne Brettle	Internal College Funding	£4,300	£4,300
Phenocam installation to support research into responses of young mixed and monoculture tree plantations to elevated H ₂ O and fertilisation (2022)	University of Birmingham	Andrea Rabbai	Ecological Continuity Trust Small Grants award	£2,560	£2,560
Travel grant to St Helena for cloud forest project research (2021)	University of Birmingham	Amy Webster	St Helena Government	£2,500	£2,500
BIFoR representation at the Royal Welsh Show (2022)	University of Birmingham	Robert Jackson	Internal College Impact Funding	£2,250	£2,250
Bringing BIFoR FACE alive with Virtual Reality (2022)	University of Birmingham	Jeremy Pritchard	Internal College Funding	£2,000	£2,000
Bartlett Tree Health and BIFoR workshop (2022)	University of Birmingham	Robert Jackson	Internal College Impact Funding	£1,700	£1,700
Travel grant to Brno University, Czech Republic (2021)	University of Birmingham	Angeliki Kourmouli and Robert Grzesik	University of Birmingham	£1,280	£1,280
Developing education resources for educators working in forest education and outdoor learning (2021)	University of Birmingham	Deanne Brettle	Internal Public Engagement with Research Fund	£1,044	£1,044
Support to leaf temperature measurements at BIFoR FACE (2022)	University of Plymouth/BIFoR	William Hagan Brown	Ecological Continuity Trust Small Grants award	£1,000	£1,000
Travel award (2022)	University of Birmingham	Mojgan Rabiey	University of Birmingham/Biosciences	£914	£914
Travel award (2022)	University of Birmingham	Mojgan Rabiey	British Society for Plant Pathology	£800	£800
Travel award (2022)	University of Birmingham	Thomas Kaye	Forestry History Society	£700	£700
BIFoR annual meeting sponsorship (2021)	University of Birmingham	Adriane Esquivel Muelbert	New Phytologist	£500	£500
BIFoR annual meeting sponsorship (2021)	University of Birmingham	Adriane Esquivel Muelbert	Elementar	£150	£150
TOTAL				£2,206,738	£1,34,072



In November 2021, BIFoR co-organised the 'Trees for the Future' conference. Further to the meeting the White Paper 'Forest Innovation to tackle the Climate and Biodiversity Emergencies' was published. It is available online <http://epapers.bham.ac.uk/4044/>