



**TREES FOR CLIMATE CHANGE,
BIODIVERSITY, AND PEOPLE**

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BOOK OF ABSTRACTS

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Poster

Physiological responses of temperate trees species: Interactive effect of elevated temperature, CO₂, with waterlogging of in Northern Europe tree saplings

The exchange of carbon, water, and energy between the land and the atmosphere is controlled by the physiological processes of terrestrial plants, yet few studies have assessed the physiological responses of temperate trees to climate change. Here we assessed the responses of chlorophyll content, chlorophyll fluorescence, photosynthesis, stomatal conductance, transpiration, and biomass accumulation to the interaction between elevated temperature and CO₂ with waterlogging in a 2-year growth room experiment with saplings of *Alnus glutinosa*, *Betula pendula*, *Betula pubescens*, *Salix pentandra* and *Salix aurita*. We found that the physiological responses to the interactive effect of elevated temperature and elevated CO₂ with waterlogging is specie-specific, and no evidence of an overall interactive effect of elevated temperature x waterlogging or elevated CO₂ x waterlogging. However, we found significant interactive effect of elevated temperature x waterlogging and elevated CO₂ x waterlogging on chlorophyll content and chlorophyll fluorescence. For one specie, *Alnus glutinosa*, elevated temperature significantly increased photosynthesis, stomatal conductance and transpirations rates following recovery after waterlogging. The wider implications of these findings are that *Alnus glutinosa* and *Betula pubescens* will thrive better in future climate scenarios.

Temperate trees communities' compositions and ecosystem function may be altered as a result of specie-specific responses to elevated temperature and elevated CO₂ combined with waterlogging.

Dr Alessandro Gimona

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Poster

Land Use Transformation for Carbon, Biodiversity ,Ecosystem Services . The case of Scotland.

To effectively address the current biodiversity and climate crises, the expansion of woodlands must be studied within the broader context of the land use change required to achieve multiple objectives. This study looked at the land use transformations needed in Scotland to mitigate climate change, improve woodland connectivity, and reduce diffuse pollution. In a strategic spatially explicit analysis, encompassing the whole of Scotland, we assessed options to expand woodlands and agroforestry and its effects on improved connectivity, and mitigation of GHG emissions, while also not encroaching on important non-woodland habitat and avoiding soil carbon loss due to planting woodlands in inappropriate locations. Different priority areas and levels of expansion are highlighted according to the importance attributed to the multiple objectives considered in the study.

Ms Amy Willox

Co-authors: none

Poster

Demonstrating the impact of sustainable forest management on ecosystem services with FSC.

Positive impacts of sustainable forest management on ecosystem services can be quantified and verified via an audit performed by independent and accredited certification bodies, according to the FSC Ecosystem Services (ES) Procedure. By demonstrating links between their management and positive outcomes, the ES Procedure provides a framework for forest managers to make specific FSC-verified claims about maintaining or enhancing ecosystem services under five headings: biodiversity, carbon, water, soil and recreation.

Verified FSC ES Claims are used for reporting across a land holding and provide integrity and assurance for investment into forestry projects. There are 52 projects globally with verified ecosystem service impacts totaling 2,076,206ha of forest area.

This poster will also highlight how the ES Procedure is implemented through the case of the Pavia Walkways in Portugal. In this project, a group of smallholders have verified claims for biodiversity, recreation and climate benefits. They demonstrated how their activities positively contribute to the restoration of natural forest cover, maintaining the Natura 2000 ecological network and restoring carbon stocks, and conserving the Pavia Walkways important for tourism in the area. The forest owners have been sponsored for their actions through the Re flora Initiative.

Dr Andrew Weatherall

Co-authors: none

Poster

Right place first - why woodland creation and commercial afforestation are land use strategy decisions.

Selecting the right trees is easy. Forest Research's Ecological Site Classification provides information (on productivity, appropriate National Vegetation Classification communities, climate suitability and mixtures) to combine with local knowledge.

Decision making should start with place, if it is already high carbon value land, high conservation value land, or highly productive farmland, there will be better places (although integrating some trees, through agroforestry, may be possible).

Where place is appropriate, the right reasons should be determined. These may be a combination of nature's recovery, domestic timber supply, climate mitigation, flood alleviation, recreational access, health, etc.

Place plus reasons guides tree cover type, or types, all of which should contain diverse species and structures for resilience to pests, diseases and abiotic threats (e.g., drought, wind, fire) associated with climate change. Tree cover types include; native woodland creation, commercial afforestation (with natives as well as non-natives), agroforestry and trees outside of woods.

A flow chart will be presented to illustrate how right place, right reasons, right tree cover type can guide policymakers and practitioners to land use change decisions selecting trees for climate change, biodiversity and people (i.e., pertinent to the title of the symposium, rather than any individual theme).

Ms Anna Gee

Co-authors: Dr Bonnie Waring, Imperial College London; Oscar Verduzco, Plant-for-the-Planet Mexico

Poster

Understanding the future of secondary forests: the effects of environmental heterogeneity on the recruitment of seedlings during restoration

Our research aims to understand the processes affecting the species composition of regenerating tropical dry forests. According to theory, areas with greater environmental heterogeneity will have a greater number of potential niches, and therefore can support higher species diversity.

We measured the two aspects of environmental heterogeneity (magnitude of variability and scale of spatial autocorrelation) across a gradient of land use intensity and successional stage. We coupled these measurements with spatially explicit tree seedling surveys. We modelled the impact of environmental heterogeneity on seedling diversity at different spatial scales.

We find that the magnitude of environmental variability peaks at mid-succession, while the scale of spatial autocorrelation increases with land use intensity. Our results suggest that a greater magnitude of environmental variability is associated with increased seedling diversity but that this relationship only appears at scales greater than 6 metres. Interestingly, we also find that maintenance activities involved in forest restoration activities may impact the regenerating seedling community, perhaps by modifying the spatial structure of the environment.

These results can improve our understanding of the future composition of secondary forests, both those created by natural regeneration on abandoned agricultural land, and those created through active restoration methods such as tree planting.

Ms Annabel Everard

Co-authors: Dr Ed Schofield, University of Aberdeen; Dr Tim Mighall, University of Aberdeen; Dr Gill Plunkett, Queen's University Belfast; Dr Scott Timpany, University of Highlands and Islands

Poster

An 'ancient' problem? Long-term woodland resilience to climatic and human pressures

Modern ecological change in native woodlands needs to be understood within their longer-term context. Pollen and plant macrofossils preserved within forest hollow sediments are used to explore stand-scale woodland dynamics and floral diversity over the past 3000 calendar years, a timeframe spanning multiple generations of long-lived tree species. We focus upon remnant oak-dominated woodlands designated for conservation in Scotland. Our study sites span a climatic gradient from the drier northeast to the iconic 'temperate rainforest' habitats on the west coast. The palaeoecological

records of changes in woodland species composition and structure are closely comparable to those of long-term woodland monitoring at c. 20-100 year sample intervals. Particular attention is paid to sub-canopy and field layers, of which there have been concerns over potential long-term decline in species diversity, which could be masked by canopy stability. The data provides evidence of past woodland resilience to disturbances induced by climatic, natural and human activity and its implications for floral diversity. We critique associations between woodland continuity and conservation value, providing a new narrative on ideas of ‘ancientness’ and ‘naturalness’ of old sessile oak wood habitats, highlighting the potential for ‘shifted baselines’ in woodland management, which may better inform future ecosystem restoration strategies.

Dr Ben Silver

Co-authors: Dominick V. Spracklen, University of Leeds; Callum Smith, University of Leeds; Jessica Baker, University of Leeds

Poster

Temperate rainforest conservation in a changing climate

Temperate rainforests are a globally rare and threatened biome that rely on a cool and moist climate to sustain their endemic species. Little is known about how sensitive temperate rainforests are to climate change. We use high resolution climate data to map the effect of global heating on the distribution of temperate rainforests. Using historical weather data, we find that the global area suitable for temperate rainforests has already contracted by 13% during 1966-2021. Using model projections estimates of future climate, we find that up to 86% of temperate rainforests could be lost by 2100. Restricting climate warming to less than 2C could reduce future loss of temperate rainforest to 44%. We combine a range of satellite datasets to assess the current threats to temperate rainforests and opportunities for conservation. We highlight regions of temperate rainforest loss over the past few decades with forest fire becoming an increasing threat. The United Kingdom and Ireland have a unique potential for temperate rainforest restoration, with currently only 10% of their temperate rainforest climate zone covered by trees, compared with the global average of 51%.

Ms Broghan Mareighd Erland

Co-authors: Rachel Gaulton, Newcastle University; Glyn Jones, Fera Science; Naomi Jones, Fera Science

Poster

Flora, Fauna, and Agroforestry: Assessing the carbon and biodiversity benefits across agroforestry systems in the United Kingdom

Current agricultural practices create vast homogenous landscapes which exacerbate habitat fragmentation. By planting trees in agricultural fields, agroforestry can also provide an essential intermediary between natural woodland and agriculturally intensive landscapes. There is very limited research on the carbon and biodiversity benefits of different agroforestry systems in the United Kingdom. Diverse vegetation layers in agroforestry can provide essential food, nesting, shelter, and habitat connectivity for a wide range of species, which in turn provide food sources for

predators in higher trophic groups, to increase the overall fauna biodiversity. Remote sensing provides a useful tool for measuring plant biodiversity and extrapolating from field survey data to landscape connectivity. A key focus of this study will be on the utility of near-ground and unmanned aerial vehicle (UAV) imaging (e.g. terrestrial laser scanning, multispectral imaging) in conjunction with field data to estimate plant functional trait diversity (e.g. plant height, leaf mass per area, leaf chlorophyll) in agroforestry. In collaboration with Newcastle University and Fera Science, this project will work with landowners and The UK Tree Council to estimate and compare the interplay between above ground carbon and plant biodiversity, given different UK agroforestry systems and their associated agricultural productivity.

Dr Cecilia Dahlsjö

Co-authors: Yadvinder Malhi, University of Oxford; Tom Atkins, University of Oxford

Talk - Tree Health

What happens to ecosystems when trees die? A story of ash dieback

Plant-associated fungal pathogens have major impacts on forested ecosystems worldwide. Globalised trade and imperfect biosecurity, coupled with long-lived environmental stages are some of the key reasons why tree associated fungal pathogens have increased in recent decades. A rise in temperature due to climate change is expected to increase the geographical range of fungal pathogens which will result in even higher frequencies of pathogen outbreaks. The European ash tree (*Fraxinus excelsior*) is one of the latest tree species to be affected by an introduced non-native pathogen. The disease (ash dieback) is caused by an invasive fungus (*Hymenoscyphus fraxineus*) which was first detected outside its native range in the early 1990s in Poland and was confirmed in Britain in 2012. In this talk I will present selected results from our study on the ecological impact of ash dieback in Wytham Woods, a deciduous woodland in southern Britain. Using an experimental approach that simulates different stages of the disease we find that the loss of ash trees will have a major impact on the growth of the remaining trees and nutrient cycling dynamics. These results indicate what will happen to woodland ecosystems when ash trees are lost and provide useful insights for management.

Dr Charles Cunningham

Co-authors: Jane Hill, University of York; Colin Beale, University of York; Diana Bowler, CEH; Michael Pocock, CEH; Piran White, University of York; Lindsay Maskell, CEH; Merryn Hunt, CEH

Poster

Woodland connectivity has idiosyncratic impacts on invertebrate species distributions over the past three decades

Species declines are reported to have been most severe in woodland habitats but it is unclear the extent to which connectivity affects woodland occupancy. It is crucial to understand the role of connectivity to inform landscape management of woodlands – in what contexts is it most important to consider connectivity in order to maximise biodiversity? Here we use a multi-taxa Bayesian modelling analysis approach over the past three decades at a 1x1 km resolution across the UK. We

look at whether woodland connectivity has increased with tree cover over the last three decades, and under what landscape contexts woodland connectivity is associated with higher species occupancy. Our preliminary results show that species occupancy is highly idiosyncratic and depends on the interaction between connectivity and woodland coverage within the landscape.

Dr Chris Nichols

Co-authors: Ruth Mitchell (James Hutton Institute); Norman Dandy (Bangor Uni); Seumas Bates (Bangor Uni); Rob Jackson (University of Birmingham); Harriet Downey (Woodland Trust); Karen Hornigold (Woodland Trust); Catherine Payne (Alcedo Conservation); John Crawford (Woodland Trust); Dom Spracklen (University of Leeds); Eleanor Tew (Forestry England); Bill Sutherland (University of Cambridge)

Talk - Culture, Heritage, and Histories of Trees

NWO: Deconstructing the apparent ‘New Woodland Order’ – a culture of polarisation between scientists, foresters and conservationists

As a society, our connection to woods and trees is increasingly seen as a panacea. Whether it’s improving health and wellbeing, tackling climate change or reversing biodiversity loss. However, we live in a polarised world and key players in the conservation/forestry sector are increasingly divided. A culture of division rages between those managing woods for different objectives, and there is an apparent disconnect between academics working to improve the effectiveness of practices, and practitioners delivering outcomes. This presentation will illustrate the Woodland Trust’s role in leading and supporting those striving to bridge these divides and show that through increased understanding of differing objectives, mutual respect and collaborative working, a framework can be produced to achieve higher impact outcomes for multiple stakeholders and society. Highlights include: the Woodland Trust’s central role in the DiversiTree project’s Practitioner Panel, enhancing academic research through integration of woodland managers with diverse objectives (both commercial and conservation). Also: the use of our sites as research assets to bridge the academic-practitioner gap with reference to a new site in the Yorkshire Dales. And our expanding role in improving conservation effectiveness and evidence-based decision making with University of Cambridge’s Conservation Evidence group and the Conservation Measures Partnership.

Ms Christine R Coppinger

Co-authors: Monica Gorman, Anne Markey, Dara A Stanley

Poster

Measuring forest use sustainability and pollinator dependence, and investigating attitudes, and perceptions of forest users in rural south-central Africa

Humanity’s reliance on natural resources such as forests and on associated ecosystem goods and services including pollination is well recognised but data for some regions is scarce. Many threats imperil these goods and services, and there is a global effort to move toward sustainable resource use but measuring sustainability, which is multidimensional and context specific, is challenging. Set in the African dry forest region, we conducted 574 household interviews collecting information on the dependence of rural livelihoods on forests and pollinators, and on attitudes to forests,

pollinators, and forest management, and investigated any linkages between attitudes and forest use behaviours. As composite indicators are a useful way to measure and track sustainability, an indicator was developed to measure forest use sustainability, enabling calculations of mitigated impacts under theoretical future scenarios. Most households utilised forest products (97%) and 79% of crop and forest product types were pollinator dependent. Although attitudes were generally pro-conservation, forest use showed signs of unsustainability. There were low levels of understanding of pollination and a general dislike of insects. Considering attitudes is central to developing effective policies governing natural resource use, as these are often linked to behaviours impacting natural ecosystems.

Mr Colin Brock

Co-authors: Virginia Morera-Pujol; UCD, Killian Murphy; UCD Maarten Nieuwenhuis; UCD Simone Ciuti; UCD

Talk - Tree Health

Predicting forest damage using relative abundance of multiple deer species and national forest inventory data.

Deer at high densities can damage forest ecosystems impacting biodiversity and ecological functioning at multiple levels, inflicting large ecological and economic costs. The ecological drivers of forest damage and the roles deer play are poorly understood due to a lack of coordinated high resolution data. Here, we aim to disentangle the relationship between forest damage, forest characteristics and the roles deer play in damaging forest ecosystems on a national scale. Understanding this relationship will help to conserve, restore, and expand vulnerable forest ecosystems that remain in landscapes dominated by human disturbance. To achieve this, we adopted a novel approach integrating recent high resolution deer distribution data for multiple deer species (native and non-native) and combining it with forest inventory data to provide risk scenario predictions for practitioners to use. We characterized which deer species are most likely to cause forest damage. We produced risk scenarios of forest damage by co-occurring deer species and predicted where damage is likely to occur nationwide. This study highlights the ecological drivers and the role that co-occurring native and non-native deer species have on forest damage within a large spatial scale while providing a tool to help alleviate and mitigate forest damage and human wildlife conflict.

Dr Cristina Garcia

Co-authors: Francisco Lloret Maya

Poster

Genetic and ecological factors determine tree responses to extreme drought

The persistence of trees depends on the suitability of local environmental conditions and the level of standing population genetic variation but both factors are rarely considered to forecast plant responses to extreme climatic events. Here we used climate suitability models to predict the response of 26 juniper populations to a prolonged drought as a function of local conditions, tree genetic diversity, size, and population density. Based on our previous findings, we first derived the

climatic niche of the species and then estimated the distance of each population to the margin of the climatic niche (rather than to the centroid) to improve our forecast ability of trees to drought. We show that high to moderate levels of genetic diversity did not influence tree survival, but low genetic diversity strongly increased tree decay, even in populations predicted as suitable when considering the reference climatic period that overlooks the impact of rare, but increasingly frequent, extreme events. Our study shows that new metrics and the combination of ecological and genetic data improve our forecast ability to predict the persistence of tree populations to extreme climatic events and inform action.

Dr Daniel Hayhow

Co-authors: Claire Narraway, Earthwatch Europe

Talk - Culture, Heritage, and Histories of Trees

Building cultural significance and connection through a national network of urban Tiny Forests – lessons learnt through engagement and citizen science

Understanding challenges to implementation and success of urban tree planting initiatives is essential in the current context of government tree planting targets and the push to improve urban green infrastructure to mitigate the effects of climate change and ensure that everyone has access to quality greenspace. To ensure trees in urban areas thrive and benefits are maximised for the environment and people genuine community engagement needs to be considered to allow cultural heritage to build affording a level of protection to the trees.

Tiny Forest is a growing network of 170 urban Miyawaki forests, living laboratories (each 200m²), contributing towards urban greening and reconnecting people with trees and nature through long-term citizen science to improve understanding of the important ecological role of trees. Since the project began in March 2020, communities have planted nearly 200 forests and around 15,000 people have participated planting and/or citizen science activities. Through our experience it has become clear that cultural significance can start accruing quickly.

In this presentation we share stories and lessons learnt from Tiny Forest expansion and explore the role that engagement models, such as citizen science, can play in building cultural significance both for urban trees and the communities around them.

Ms Eleanor Smith

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Poster

Mapping urban forests through time to investigate ecosystem services

Urban forests play an important role in the UK's towns and cities, providing food and fuel as well as climate, cultural and health benefits. Collectively these benefits are known ecosystem services. To understand the benefits urban forests have provided through time, we need to identify locations of urban trees and how this has changed.

Here we present early results from an assessment of tree cover for Leeds and Edinburgh during the late-1800s, obtained by applying machine learning to historic Ordnance Survey maps. Using a combination of machine learning techniques, we are able to reconstruct the historical distribution of trees in these two cities for the first time. Our aim is to combine our historical assessment with information on urban trees from contemporary sources to understand how the role of urban trees has evolved over time.

Dr Eleanor Tew

Co-authors: none

Talk - 30x30 and Landscape Restoration

Growing the Future: how the nation's forests will meet society's challenges

Forestry England manages the nation's forests on behalf of the general public, shaping landscapes for people, wildlife and the economy. The natural capital value of the nation's forests is estimated at £61.5 billion, and further increasing this extraordinary value is part of Forestry England's core purpose. As identified by the theme of this symposium, the three greatest challenges facing society today that woodlands can help to tackle are climate change, biodiversity collapse and people's lack of connection with nature. In response, Forestry England has developed a strategic plan "Growing the Future", detailing the goals and actions that we will take over the next five years for the climate, wildlife and people. In this talk, I will present our practitioner's perspective in translating ambition into practical action, ensuring the nation's forests answer today's challenges and are fit for the future. I will illustrate this with key examples, such as our approach to forest wilding, natural capital and increasing forest resilience.

Dr Elena Cantarello

Co-authors: Aralisa Shedden, Bournemouth University, Marin Cvitanovic, Bournemouth University

Poster

Assessing and Enhancing Forest Ecosystem Service Resilience to Climate Change in Diverse Biogeographical Contexts

Assessing the resilience of forest ecosystem services is a complex task that requires a multidisciplinary approach that considers the interactions between biotic and abiotic factors. To achieve this, it is necessary to collect and analyse data, develop resilience indicators, and evaluate ecosystem service resilience over space and time. Additionally, understanding how to implement this approach in different biogeographical contexts is crucial.

In the EU-funded project RESONATE, we developed a resilience framework aimed at facilitating cross-case study comparisons and establishing a common narrative. We applied this framework in

nine European case studies, including the New Forest National Park in the south coast of England, which has been remarkably resilient as a socio-ecological system over the past 900 years, having withstood many mega-disturbances. However, some elements of this system are currently undergoing major changes in structure and composition due to the co-occurrence of multiple stressors, including climate change.

By presenting our approach and findings, we aim to contribute to the development of effective management strategies that maintain and increase forest ecosystem services resilience in the face of changing environmental conditions. The New Forest National Park case study highlights the importance of understanding past and recent resilience and the need for adaptive management practices to maintain and enhance the resilience of forest ecosystems.

Dr Elizabeth Elliot Noe

Co-authors: Anita Wreford, Lincoln University

Poster

Barriers to planting native trees on New Zealand dairy farms

Pastoral farming accounts for approximately half of New Zealand's land area, which also contains over 25% of the country's remaining native vegetation – the highest proportion outside of public conservation land. Farm management has great potential to contribute to biodiversity conservation nationally by providing important reservoirs of biodiversity and corridors between them. Currently, however, many farming practices have significant detrimental impacts on the environment, and agricultural intensification has resulted in biodiversity losses worldwide. Dairy farms represent more intensive farming systems, where it is considered less practical to retain native vegetation. Studies have shown, however, that hedgerows and riparian strips can contribute substantially to biodiversity conservation in these systems. Given the patchiness of regulatory policy, New Zealand is largely reliant on farmers voluntarily adopting biodiversity-supporting farming practices. Our research explores the goals, motivations and worldviews that inform dairy farm management and the relationship between these values and planting native trees on farm. We asked farmers for a tour of their farm to explore how they perceive their relationship with their land, their responsibilities for it, what they are doing to promote native biodiversity, their motivation for adopting any pro-biodiversity farming practices, and to identify barriers to adoption of these practices.

Dr Elizabeth Raine

Co-authors: Hastina Purnama - KKI Warsi, Indonesia; Emmy Primadona - KKI Warsi, Indonesia; Fredi Yusuf - KKI Warsi Indonesia, Nicholas Berry - Plan Vivo, UK; Kristin Olsen - Plan Vivo, UK; Matthew Struebig - University of Kent, UK; Lindsay F. Banin - UKCEH, UK

Poster

High spatio-temporal resolution land cover mapping for community-led forest management in Sumatra

Tropical forest protection and restoration at local levels is reliant on effective monitoring tools. Despite advances in technology and the availability of remotely sensed data, methods capable of

quantitatively capturing fine-scale and subtle vegetation cover change are scarce. We developed a high-resolution land cover map to facilitate forest management in a village forest in Bengkulu, Indonesia.

We extracted spectral bands and derived vegetative and textural indices from optical and radar satellite imagery for the 6 months up to February '23. During the same period, field teams implemented 148 ground checks to classify land cover into the categories: closed canopy forest, open canopy forest, sparse degraded forest and agroforestry. These ground check points were used to define polygons of land cover classes with 70% of pixels used as training data in a random forest classifier, and the remaining 30% were used to assess the accuracy of the model.

The final map gave a good accuracy estimate of land cover at 3.125 m resolution for the 16 km² community managed forest. This approach can provide a flexible and reproducible tool to monitor forest cover and restoration status. With capacity building support, this approach shows promise for open-source community-led land management and monitoring.

Dr Emily Sloan

Co-authors: none

Poster

Planting the Northern Forest: Woodland Creation Through Partnership

The Northern Forest is a partnership between the Woodland Trust, Mersey Forest, Manchester City of Trees, White Rose Forest, Humber Forest, and the Community Forest Trust, with funding from Defra's Nature for Climate Fund. Working together, the aim is to plant 50 million trees from coast to coast and in and around cities across the north of England, with the potential to absorb up to 7.5 million tonnes of carbon dioxide by 2050. These trees will help to keep our urban areas shaded, and play a real part in reducing the risk of floods. The new woodlands will connect people with nature, create growth and investment opportunities, and improve health and wellbeing. Under the Grow Back Greener programme landowners can apply for up to 100% of the costs of woodland creation. Through collaborative working with landowners and government and other advisory bodies, Woodland Trust advisers and our delivery partners create well thought out, quality woodlands in the right place. The Northern Forest is an exciting example of policy being put into practice; this poster is based on work undertaken by the Woodland Trust, 'fighting for the health of people and planet with every tree.'

Dr Emily Waddell

Co-authors: Emily H. Waddell (University of Stirling); Elisa Fuentes-Montemayor (University of Stirling); Kirsty J. Park (University of Stirling); Peter Carey (University of Stirling); Jack Forster (Forest Research); Matt Guy (Forest Research); Nicholas A. Macgregor (University of Kent); Scott Wilson (University of Stirling); Kevin Watts (Forest Research & University of Stirling)

Poster

Have woodland plants been able to colonise new woodland: Results from a long-term, large-scale natural experiment

There is a growing interest in how biodiversity responds to newly created woodland. Specifically, what species are able to colonise these woodlands, what factors influence their occurrence and is it possible to speed up these species colonisation and establishment processes. The Wren (Woodland creation & Ecological Networks; www.wren-project.com/) project is a long-term, large-scale natural experiment which uses historical woodland creation sites in the UK as test landscapes to assess the effects of past woodland creation on current biodiversity to inform future conservation actions. In this study, we examine the responses of vascular plants across 101 secondary woodlands planted between 1860 and 2000. Specifically, we examine the influence of local (e.g. age, forest structure) and landscape variables (e.g. the composition and configuration of the surrounding landscape) on the occurrence of woodland specialist and generalist species. Additionally, we investigate whether the plant communities in these newly created woodlands are a subset of those found in mature woodlands, or if novel communities are forming.

Dr Emily Warner

Co-authors: Alison Smith, School of Geography & the Environment, University of Oxford; Audrey Wagner, Department of Biology, University of Oxford; Caitlin Hafferty, School of Geography & the Environment, University of Oxford; Mark Hirons, School of Geography & the Environment, University of Oxford; Zach Posnik, School of Geography & the Environment, University of Oxford; John Lynch, Department of Biology, University of Oxford; Nathalie Seddon, Department of Biology, University of Oxford

Poster

Scaling up Nature-based Solutions in the UK

Nature-based Solutions (NbS) have huge potential to contribute to climate change mitigation and adaptation, nature recovery, food security, rural economy, and human well-being. Implementation of NbS must also be just and equitable, maximise benefits for biodiversity, and optimise socioeconomic and ecological outcomes. We are producing tools and guidance to support practitioners in mapping, assessing and strategically planning the delivery of high quality NbS. An open-source opportunity mapping tool will identify suitable locations for different types of NbS. This will be supported by guidance to embed the maps within a collaborative governance process, to implement equitable and economically viable projects that deliver multiple objectives and avoid trade-offs. We are also producing protocols for understanding and monitoring key soil, biodiversity and socio-economic outcomes. A set of case studies supports the mapping, modelling and evidence synthesis, providing inspiring examples of high-quality NbS. The overall project will give high-level policy recommendations, underpinned by land-use modelling to show the potential for NbS across the UK, as well as tools and guidance for project development on the ground. Our work also showcases an integrative approach, bringing the ecological and socio-economic dimensions together, to successfully deploy future high-quality NbS.

Dr Emma Aspin

Co-authors: Becki Gawthorpe, Forestry Commission; Barnaby Wylder, Forestry Commission

Poster

Personal Biosecurity – a minimum standard for all

Managing problems caused by invasive non-native species currently costs the UK on average £1.9 billion every year.

The Plant Biosecurity Strategy for Great Britain, published on Monday 9 January, sets out a five-year vision for plant health, consisting of an action plan to secure national biosecurity, protect native species and drive economic growth. The strategy emphasises the collective role and responsibilities we all have in upholding high standards of biosecurity.

Biosecurity threats can easily be introduced to the UK and spread between sites via the movement of infected plants, animals, or contaminated material. This movement may be via natural pathways but is more frequently a result of human activity. In addition, human-assisted pathways can spread biosecurity threats much further and faster than natural pathways.

This presentation will provide an overview of what biosecurity is in relation to tree health. We will discuss the importance of carrying out appropriate personal biosecurity measures, how to report tree health concerns and the need to raise the current awareness of biosecurity across all levels of society.

Mrs Emma Dear

Co-authors: Dan Abrahams

Poster

Natural Regeneration: more than just a tool in the box

Ash dieback is one of many challenges currently facing native woodland across the UK. As our ash woods now start to collapse, managers are taking action in their woods. Among the varied guidance available to them however, alternative planting mixes and different silvicultural techniques are most frequently suggested to “add resilience”: natural regeneration does not feature as often as it should. Natural regeneration allows natural selection to occur, not against a single threat, but against all threats concurrently. Genetic selection in the lab can target specific issues, but reduces the overall genetic variation of the population. Here we make the case not just for why it should be part of the answer, but why it should always be included in the answer, and that understanding and addressing the barriers to natural regeneration is fundamental to the future resilience of our woods. Natural England has guidance on managing of ash dieback on SSSIs which can be more widely used.

Dr Emma Gardner

Co-authors: none

Poster

Taking biodiversity into account in decision-making

Trees play a wide variety of ecological roles. They provide essential habitat for some species, while other species may need trees in combination with other habitat resources or find areas with trees

uninhabitable. Changing the amount, distribution and type of tree cover in our landscapes therefore has huge consequences for biodiversity. How do we take this into account and ensure that our efforts to restore landscapes recognise the multiple ecological roles of trees? And how do we ensure the multitude of species that inhabit those landscapes are given a voice in decision-making?

We present findings from a collaborative, multi-disciplinary project that brings together researchers, policy-makers, NGOs, creative practitioners, local government officers, conservation volunteers and community groups to examine how biodiversity is represented in UK decision-making. We outline the knowledge available for assessing biodiversity consequences (from computer modelling to Local Ecological Knowledge) and critique current techniques for representing other species' interests in decision-making (from the Biodiversity Net Gain metric to interactive storytelling). We highlight key barriers (in data, governance, society and language) that hinder representation of other species' interests across strategic national planning and local action. Finally, we recommend options for tackling these barriers to improve opportunity mapping and practical delivery.

Ms Ennia Bosshard

Co-authors: Harrison Carter (University of Exeter); Dr Chris Kaiser-Bunbury (University of Exeter); Dr Chris Kettle (Alliance of Bioersivity and CIAT); Dr Ana Nuno (Universidade NOVA de Lisboa)

Poster

Smallholder planted trees: Exploring drivers for diversifying woody habitat that support pollinators in Western Kenya

While the world's natural forests continue to shrink rapidly, landscape-scale restoration of forests and trees is urgently needed to contribute toward climate change mitigation and to provide critical ecosystem services. Smallholder-planted trees harbour an untapped potential for landscape restoration and the provision of ecosystem services, such as crop pollination; a key component of ecosystem functioning at the intersection of the climate, biodiversity, and food insecurity crises. While proximity to natural habitat can increase crop pollination in adjacent farms, a diversity of on-farm habitats is crucial to support wild pollinator species in landscapes where only little natural habitat remains. Understanding farmers' decision-making in land management is thus an important step toward successfully implementing landscape-scale restoration. We conducted surveys with 625 smallholder farmers in Western Kenya using the Theory of Planned Behaviour to investigate the factors that influence smallholder intentions to diversify the shrubs and trees on their farms. Our findings suggest that smallholder farmers are concerned with meeting short-term needs such as hunger and provision of fuelwood which might compete with realising the benefits of diversifying on-farm shrubs and trees that can take several years. This highlights the importance of incorporating socio-psychological factors in policies for effective landscape-scale restoration.

Dr Ewan Mchenry

Co-authors: none

Talk - 30x30 and Landscape Restoration

Operationalising functional connectivity to target and measure nature recovery at landscape scales

Lofty goals for increasing woodland cover abound, stemming from international treaties, government legislation, organizational policy and the aspirations of individual people. Trees are oft touted as a key tool to combat the twin crisis of climate and nature, but to be most effective they must contribute to well functioning and structurally complex ecosystems that connect to form Bigger, Better and More Joined habitat networks. These "Lawton Principles" are well understood and widely cited in the nature conservation sector as the ultimate goal for habitat creation and restoration, and yet no concerted attempt is made to reliably measure how conservation organisations contribute towards achieving that goal. Over recent decades landscape and population research ecologists have developed a concept of functional connectivity that combines elements of habitat area, quality and connectedness. Here I present a further development of that work: a metric that can be used to measure landscape-scale change in habitat integrity and discuss how it can be used to track progress towards nature recovery and guide decision making at different levels, from site management to organisational reform.

Ms Francesca Darvill

Co-authors: Professor Dominick Spracklen (University of Leeds); Dr Cat Scott (University of Leeds); Professor Pippa Chapman (University of Leeds), Professor Mike Kirkby (University of Leeds), Dr John Crawford (Woodland Trust), Dr Robert Mills (University of York), and Robyn Wrigley (University of Leeds)..

Poster

Before and After Planting: Assessment of soil carbon variability and response to native woodland creation in the English uplands.

Driven by global net-zero and biodiversity targets, woodland creation is a critical nature-based solution and lies at the heart of the UK Government's Environmental Improvement Plan. Increased woodland cover in degraded upland landscapes is expected to improve delivery of vital ecosystem services (ES) for climate adaptation. This can be through flooding alleviation via improving soil functioning and carbon sequestration by increasing biomass input. Despite future reliance on changing upland land management for ES benefits, soil carbon response to native woodland creation (NWC) in England's uplands are relatively under researched. Recent space-for-time studies suggest that even low disturbance planting could result in a net ecosystem loss of organic soil carbon (SOC). At present, there is a lack of pre-planting soil carbon data, meaning it is difficult to determine the net carbon trajectories of tree planting schemes, particularly within heterogeneous soil-scapes. Here we demonstrate how a distance-weighted sampling strategy will be applied to map spatial variability of upland soil properties at Snaizeholme, a large NWC site in the Yorkshire Dales. This will not only provide high resolution baseline data, but also inform a future monitoring strategy to measure change in SOC overtime to further understanding of upland soil response to woodland creation.

Ms Fritha West

Co-authors: Dr Rehema White; Dr Mariella Marzano; Dr Althea Davies

Talk - Culture, Heritage, and Histories of Trees

Restoration of 'lost' tree species: assessing cultural significance of and management options for elm species

Many tree species are under threat from invasive pests and diseases, with species such as field elm and wych elm (*Ulmus* sp.) having almost disappeared from large areas of the UK. Developments in genetic research and tree breeding mean restoration of species like elm may now be biologically feasible, however, the social acceptability of different restoration methods is poorly understood.

This project sought to explore cultural significance of a once widespread species and to identify management options and methods for investigating the values and expectations associated with different restoration strategies. A review of literature regarding cultural relationships with elm revealed that environmental, industrial, and personal perspectives have changed since the outbreak of Dutch elm disease. Initial analysis of restoration opportunities has identified different concepts of restoration and management options with varying philosophical, practical and policy approaches. However, generational and regional variations in views require further investigation. A methodological framework was developed to explore the social acceptability and ecological feasibility of approaches with land managers, policy makers and local communities. It was concluded that the road to restoration may rely on understanding emotional connection as much as environmental and policy contexts.

Dr Gail Austen

Co-authors: Rob Fish, DICE; Kate Irvine, James Hutton Institute; Martin Dallimer, University of Leeds; Jess Fisher, DICE; Zoe Davies, DICE

Poster

The influence of biodiversity on human wellbeing in woodland soundscapes

It is widely recognised in research, policy and practice that natural environments are beneficial to human wellbeing. However, people's interactions with nature are multifaceted, multisensory, and critical questions remain as to which attributes of biodiversity elicit wellbeing. Through a series of seasonal, participatory workshops, we explored the multisensory context of human experiences of woodland and found sound to be a key component.

We show that people's interactions with sounds relating to biodiversity goes beyond the act of hearing. People interacted with sound passively (e.g. listening to birdsong), actively (e.g. twigs snapping underfoot), and wellbeing was affected both positively and negatively. A key factor in determining the wellbeing outcome was whether people's sound experience matched their expectations, which were formed through prior encounters with nature, how previous woodland visits had affected them, and from cultural influences. Some people sought peace in woodland, but rather than seeking an absence of any sound, they wished to escape everyday anthropogenic sounds and experience the forest soundscape unhindered.

Mr George Porton

Co-authors: Robyn Wrigley; Cat Scott;

Poster

Natural regeneration under different conservation grazing strategies, following the removal of Sheep

Expanding native woodland within the UK uplands will help store carbon, increase biodiversity and alleviate flood risk. Natural regeneration is a cost effective approach but is often limited by current grazing practices and proximity to existing woodland. However, there is currently little evidence to support particular grazing strategies for natural regeneration. No grazing will reduce browsing pressure however extensive grazing using livestock such as cattle will help disturb the soil and control more competitive plants, providing more regeneration niches.

We used Ingleborough as a case study of natural regeneration under sheep grazed, cattle grazed or ungrazed treatments, with all sites having been grazed by sheep in the past. We surveyed plots across Ingleborough and recorded natural regeneration. Linear models were used to test the effects of years since removal of sheep, current grazing management, geology and distance to the nearest woodland on natural regeneration.

We show significantly more natural regeneration in cattle grazed and ungrazed areas compared to sheep grazed. This demonstrates that even at relatively low intensity, sheep limit natural regeneration in the uplands. We found no significant difference between natural regeneration in cattle grazed compared to no grazing, suggesting either can be used to promote natural regeneration.

Mr Graeme Duncan

Co-authors: Amelia Heath ; Forth Rivers Trust

Poster

Ballimore Landscape Restoration Project

The Ballimore Landscape Restoration Project is an ambitious and exciting plan to restore 1800ha of historic upland farmland in the Loch Lomond and Trossachs National Park in Highland Scotland. Previously overgrazed by livestock, the multi-year project aims to bring together a number of nature positive schemes such as riparian woodland creation, peatland restoration, river restoration, floodplain enhancement, rural SUDS alongside a grazing and land management plan. This plan will go a long way to protecting and enhancing habitat networks for iconic Scottish wildlife such as Atlantic Salmon and Golden Eagles as well as a multitude of birdlife, invertebrates, amphibians, mammals and other freshwater species.

Working with partners, landowners and other stakeholders, our work will further enhance the wider landscape by creating green corridors for wildlife and people to benefit from. Along with our neighbours, The Woodland Trust at Glen Finglas and Forestry and Land Scotland, this vital work could strengthen resilience in the area, contribute to the Great Trossachs Forest, protect endangered species and combat climate change.

Mr Adrienne Bennett

Co-authors: Graham Osborn

Poster

Creating a Legacy - a network of Tiny Forests and the Commonwealth Games Forests

As the Carbon and Nature Partner for the 2022 Birmingham Commonwealth Games we are creating the legacy of a healthier, happier, better connected, and more prosperous Midlands that addresses the twin threats of climate change and the loss of nature.

Severn Trent delivered a series of initiatives to assist Birmingham 2022 in their pledge to be the first carbon-neutral Commonwealth games, leaving a legacy across the region. This included the creation of 2022 acres of legacy forests, as well as 72 tennis-court-sized Tiny Forests, established in urban areas, leaving a positive social and environmental legacy.

This is improving connectivity and contributing to a greater habitat mosaic as per the Lawton Principles, and also links nature and people. The forests will play an important role in connecting thousands of people with nature on their doorstep and environmental education. As part of this the local community will be invited to help collect data and assess the benefits of the Tiny Forest in their area, including carbon absorption, flood management and the benefit on biodiversity.

These new green spaces will live on long past the games for future generations to enjoy as a space where biodiversity and nature can thrive and flourish.

Dr Harry Marshall

Co-authors: Bianca Ambrose-Oji, Forest Research; Liz O'Brien, Forest Research; Gabriel Hemery, Sylva Foundation; Gill Petrokofsky, Sylva Foundation; Alice Goodenough, Countryside and Community Research Institute (CCRI); Julie Urquhart, CCRI; Paul Courtney, CCRI

Talk - Tree Health

Collaboratively designing and delivering a new policy initiative to enable land managers to respond to tree health threats

Trees are vital economic, environmental and social assets, but they face increasing threats from novel pests and pathogens. The government has ambitions to improve environmental quality, but it falls to land managers to enact this and create resilient treescapes. Knowing how to act, where to find support, and how to meet the costs of statutory plant health notices remains a real challenge for many.

As part of Defra's aim to involve land managers in policy intervention design, Forest Research has for the last five years, led on the co-design and co-evaluation of the Tree Health Pilot, an initiative aimed at helping land managers respond to the risks and reduce the spread of novel tree pests and diseases, and restore tree cover.

The co-design phase (2017-2021) involved over 600 land managers across England to help define the scope and elements of the new scheme. This included awareness raising materials, incentive rates, and novel forms of support. The scheme is being piloted (2021-2024) with land managers to test and refine initial design. Engagement with 165 land managers to date has suggested improvements to increase uptake and effectiveness. Here, we present key lessons from the process, and reasons why co-designed policy initiatives have the potential to improve responses to tree health threats.

Ms Hazel Mooney

Co-authors: Cat Scott; Steve Arnold; Piers Forster (University of Leeds); Peter Coleman, Department for Energy Security and Net Zero

Poster

Trees and air quality: exploring the potential impacts of large-scale woodland expansion in the UK on air quality

Trees have become a focal point for governments across the world seeking to achieve significant levels of carbon dioxide removal in order to help mitigate climate change. Though trees can sequester large quantities of carbon dioxide, there are complicated biogeophysical and biogeochemical interactions with the atmosphere. Trees naturally emit biogenic volatile organic compounds (BVOCs) to help respond to stress and communicate within their ecosystem. These emissions have the potential to elevate concentrations of major air pollutants, acting as a precursor to ozone and particulate matter. This project will examine the impact of a range of afforestation scenarios on air quality under a changing climate. Here, we present early results quantifying the impact of afforestation on the emission of BVOCs, using the Community Land Model (CLM) and MEGAN (Modelling Emissions of Gases and Aerosols from Nature) model. Afforestation scenarios presented here consider tree species that are already widely planted but are also expected to continue making a significant contribution to woodland creation in the UK. Improving our understanding of the impact of popular tree species on future air quality will be essential to avoid unintended consequences of plans to reach net-zero.

Dr Heather Gilbert

Co-authors: Dr Tom Martin; Sam Lattaway

Poster

Creating spaces for nature in a previously degraded landscape

The National Forest is a 200 square mile area of the Midlands where over 9 million trees have been planted over the last 30 years. The resultant newly created green spaces are often close to where people live and work, and have no formal protection or designation. However, this does not mean they can't be beneficial to nature.

Priority habitats, including woodland and water, are key for wildlife to thrive in this area. Following over 8,500 hectares of landscape-scale restoration, these habitats now represent over 25% of the Forest. To assess the impact of this change, biodiversity records were collated from three local environmental records centres: Derbyshire, Staffordshire and Leicestershire. Trends for four species groups (birds, bats, non-volant small mammals and butterflies) show that both species richness and abundance have increased substantially in the National Forest across the last 30 years.

This suggests that increased habitat availability has positively affected local wildlife, despite the lack of formal protection. Habitat transformation is still ongoing in the National Forest, with current progress on target to have 30% of land managed for biodiversity by 2030. This provides a practical example of how nature can be recovered and restored in a previously degraded landscape.

Dr Henrike Schulte To Bühne

Co-authors: Sarah M. Durant, Institute of Zoology; Joseph A. Tobias, Imperial College London; Nathalie Pettorelli, Institute of Zoology

Poster

Assessing risks to forests when threats interact: Mapping climate change-land use interactions in gallery forests in a West African biodiversity hotspot

Climate change threatens forests and wooded landscapes globally, but this threat occurs in the context of other pressures, such as intensive human land use. Where these threats overlap and interact, it is often difficult to predict their combined outcomes, making it challenging to identify appropriate management strategies. Here, I will present a novel risk assessment framework that allows scoring risks from climate change and its interactions with the surrounding landscape to pinpoint priority areas for forest conservation intervention when threats interact. The framework was applied to gallery forests in the W-Arly-Pendjari transboundary protected area complex (West Africa). Gallery forests are thin bands of forests along permanent and temporary rivers that are distinct from the surrounding savannah in terms of tree species and microclimate. By combining a satellite data-derived map of gallery forests with data on projected changes in precipitation and existing land use (here: agriculture), a map of interaction risk hotspots was created to identify priority areas for conservation intervention across the 35,000 km² protected area complex. Counterintuitively, risks from climate change to gallery forests are elevated in areas far away from agriculture due to the mechanisms through which the presence of cropland interacts with changes in precipitation.

Mrs Holly Woo

Co-authors: Sarah-Jane Davies, The Open University; Kadmiel Maseyk, The Open University; Philip Wheeler, The Open University.

Poster

The plant communities of urban ancient woodlands: post-urbanisation changes in ground flora species composition.

Ancient woodlands are home to complex communities of plant species that have developed over several centuries. Despite protections in the planning process, cumulative effects of development mean that as towns and cities expand, ancient woodlands near urban areas face numerous insidious threats including atmospheric pollution, nutrient deposition, soil compaction and invasive species.

When the “new town” of Milton Keynes was built from the late 1960s, three significant patches of ancient woodland become surrounded by urban fabric. We compared botanical species records from these three urban ancient woodlands with those from rural comparator sites. Post-1990, more non-native species were found in urban woodlands compared to rural ones, which may be due to the naturalisation of garden plants. Detailed ground flora surveys of one urban woodland over an eight-year period provide a more spatially nuanced demonstration of floristic change, indicating that community composition at the woodland edge has changed more than in the interior, where more ancient woodland indicator species were recorded.

This work provides evidence for increasing buffer zones between ancient woodland and urban development. Additional management may be needed to mitigate for changes in soil nutrients and the spread of introduced species in urban ancient woodlands.

Dr Jessica Fisher

Co-authors: M. Dallimer (University of Leeds); K. N. Irvine (James Hutton Institute Aberdeen); S. G. Aizlewood (University of Kent); G. E. Austen (University of Kent); R. D. Fish (University of Kent); P. King (University of Kent); Z. G. Davies (University of Kent)

Poster

Species' effect traits underpin human wellbeing

Biodiversity loss has profound implications for human health and wellbeing, given our reliance on the goods and services provided by functioning ecosystems. Interactions with nature can deliver individual-level wellbeing gains, equating to substantial healthcare cost-savings when scaled-up across populations. However, critical questions remain about the role of biodiversity specifically, and which species and/or traits (e.g. colours, sounds, smells) elicit wellbeing responses. Here, we analyse a database of species' traits identified by people in UK broadleaf and conifer plantation woodlands. Using techniques from community ecology, we identify those that generate different types of wellbeing (following the biopsychosocial-spiritual model of health). These 'effect traits' (traits that elicit ecosystem services), are influenced by the identity and taxonomic kingdom of each species. While effect traits are complementary in the delivery of different types of wellbeing, both positive and negative, the species that support them overlap. Indeed, we find a plethora of effect traits from across the ecological community can elicit multiple types of wellbeing, illustrating the complexity of biodiversity experiences in UK woodlands. Our empirical approach, using such granular knowledge, is a step-change how to operationalise interdisciplinary thinking for biodiversity conservation and nature-based public health interventions designed to support human wellbeing.

Mrs Julie Ann Smith

Co-authors: Darren Evans, Newcastle University; Janet Simkin, Newcastle University

Poster

Assessing the development of tree associated invertebrate biodiversity in young millennial woodlands.

Recent woodland creation to increase biodiversity, address climate change and provide amenities for local residents means that over half of stocked broadleaved woodland in the UK is less than 40 years old. But we know very little about the insects that live in these young woodlands and how they compare with the ecologically diverse established semi-natural woodlands that we aspire to emulate. This is important as the long-term success of these trees and woodlands depends on positive interactions with pollinating insects as well as levels of damage by herbivorous ones.

This project is sampling the tree living invertebrate life in a number of 20-30 year old millennial woodlands and in a range of established woodlands, situated in Northwest England, to allow us to compare the structure and complexity of their plant-insect networks and look at levels of insect

herbivore damage. Have some of the specialist woodland insects that inhabit older woodlands already managed to colonise new woodlands? How much is growth of the young trees being affected by insect herbivory? With afforestation a policy priority in the UK, this understanding of the results of previous tree planting will enhance our ability to create more quality woodlands in the future.

Mr Juri Alexander Felix

Co-authors: Phil C. Stevenson, RBG Kew; Nadia Barsoum, Forest Research; Julia Koricheva, RHUL

Talk - Tree Health

Consequences of climate matching for oak resistance to herbivory

Planting trees from Southern Europe in the UK could help establish forests which are better adapted to climate change, however, it remains unclear what effect this might have on tree resistance to insect pests. Using the Climate Match tree diversity experiment in Hucking, Kent, we assessed whether young pedunculate oaks (*Quercus robur*) with English (native) or Italian (non-native) provenance differ in their defensive traits and resistance to insect herbivores, and whether planting non-native and non-native oaks together or in species mixture plots results in associational resistance and reduced leaf damage.

We found that Italian oaks were more susceptible to herbivore damage than local oaks across all neighbourhood types, and had leaves with lower concentrations of hydrolysable tannins, but higher concentrations of condensed tannins. Differences in the tannin profiles between Italian and local oaks did not directly explain variation in leaf damage, but instead may be a sign of phenological differences which predispose Italian oaks to greater rates of herbivory.

Ms Katerina Chernyuk

Co-authors: Markus Eichhorn, Mary O'Shaughnessy, Thomas Murphy, James Buckley

Poster

Restoring Atlantic Oak Forests - Strategies and Perceptions

Atlantic oakwoods, a form of temperate rainforest, are a rare and protected habitat type in the EU. Historically, this habitat spread throughout the western seaboard of Ireland and Great Britain but there are now only fragments remaining. Given this fragmented nature, it is important to map the remaining woodland and explore its ecological condition as well as the environmental conditions necessary for successful restoration. It is hoped this will provide a potential reference habitat and give valuable information on present-day Atlantic oakwood stands. Restoring these forests at a landscape-scale will require locating current and potential sites, reviewing restoration strategies and compiling best-practise monitoring and management procedures. Atlantic oakwood restoration should also factor in the perceptions of local landowners and communities, exploring how to promote reforestation whilst contributing towards sustainable rural development in line with the wants and needs of local people. This will involve data collection from local communities in key case-study sites in Ireland and Great Britain. Work will involve reviewing the socioeconomic factors of potential reforestation sites and the policy legislation surrounding reforestation schemes. It is hoped

that taken together, the findings can be used to inform current policy and management practices around Atlantic oakwoods and their restoration.

Dr Katherine Irvine

Co-authors: None

Poster

BIO-WELL: a human wellbeing scale that measures responses to biodiversity

Spending time in nature has multiple benefits for health and wellbeing. Yet there remains a lack of understanding as to which aspects of nature contribute to wellbeing and the role biodiversity plays specifically. This gap in knowledge hampers our ability to understand and manage natural environments, such as woodlands, from an ecological perspective to improve human wellbeing. To investigate the impact of biodiversity on wellbeing, there is a need for a psychometric scale. Here we discuss the development of a new quantitative biodiversity-wellbeing scale, BIO-WEL. The self-report scale is based on both metrics that might be used by an ecologist to assess objective levels of biodiversity (e.g. species richness) and biodiversity attributes (colours, smells, morphologies, sounds, textures, species behaviours) that people could be responding to, both positively or negatively. Five studies, involving 2962 participants, demonstrate that BIO-WELL is a valid and reliable scale with strong psychometric properties. We discuss ways it could be applied in research, policy and practice to further develop our conceptual and empirical understanding of the biodiversity-health relationship and assess the effectiveness of related interventions (e.g. nature-based interventions).

Ms Kathleen Conroy

Co-authors: Francesco Martini TCD; Yvonne Buckley TCD; Jane Stout TCD; Mary Kelly-Quinn UCD

Poster

Creating Extent Accounts to Understand Land Use Change in Terms of Irish Forests

Land use change, a leading cause of biodiversity loss and climate change, is impacting forest cover and composition globally. In Ireland, forests cover 11% of land area, but will reach 18% by 2050. Originally managed primarily for timber production, Irish forests are now being managed for a range of ecosystem services (ES) including timber, carbon sequestration, biodiversity enhancement and recreation. One way to better understand changes in land use and associated ES is through natural capital accounting and specifically, the System of Environmental Economic Accounting-Ecosystem Accounting (SEEA EA). The first step in the SEEA EA framework is developing extent accounts, i.e., the total area of each ecosystem within an accounting area.

We created extent accounts for 25 diverse forest sites throughout Ireland. CORINE land cover data for 2000 (opening extent) and 2018 (closing extent) were used. Results show that between 2000-2018, broad-leaf forest areas increased by 26% (230.04 ha), coniferous forests decreased by 11% (1023.4 ha), and mixed forests increased by 92% (425.46 ha). Higher resolution land-cover data will enable more detailed assessments, but time series data are required for accounting purposes. Natural capital accounts can be used by decision-makers to make informed management choices for Irish forestry.

Dr Keith J. Kirby

Co-authors: None

Poster

Tree of the future to tree of the past: Ash Dieback in Wytham Woods

Long-term vegetation change in Wytham Woods (Oxfordshire) are being studied using results from permanent plots (1974-present) supported by more qualitative data from past descriptions and management plans. Ash *Fraxinus excelsior* increased in cover and importance from the 1950s onward; outgrowing sycamore *Acer pseudoplatanus*, oak *Quercus robur* and beech *Fagus sylvatica*. It was the most abundant species in the regeneration of trees and shrubs. Since 2017 its cover has been declining because of ash dieback. It is not clear yet whether (a) there will be significant emergence of tolerance/resistance amongst the population over the next few decades, (b) whether any that does emerge will escape being eaten by deer (unless protective measures are taken). The implications of reduction in cover of this distinctive tree species are starting to develop, notably in increased bramble!

Dr Kelly Gunnell

Co-authors: Prof. Mark Mulligan (King's College London)

Poster

Replacing forests lost in the last twenty years is not sufficient to eliminate flood risk in two Andean catchments

Flooding is a problem for many cities around the world and is becoming more severe due to both land use and climate change. The use of nature-based solutions (NbS), such as increasing or restoring forest cover, is increasingly advocated to mitigate these flood risks. We explored through modelling, how increasing water storage capacity in the form of canopy cover via reforestation can mitigate current flood risk. We spatially targeted reforestation within the catchments upstream of the cities of Bogotá in Colombia and Guayaquil in Ecuador. Four reforestation scenarios were created, which avoided biodiverse land, and/or avoided agricultural land, and/or targeted land on a slight slope. We found that reforestation of very small extents of the basins, via spatial targeting, does reduce flood risk at the basin scale to some degree. In particular, spatially targeting slopes is the more successful strategy per unit of tree cover increase. However, the reduction upstream of populated areas, and thus the benefit to downstream beneficiaries, is marginal. We conclude that reforestation scenarios need to be more ambitious than replacing what has been recently lost if the aim is to eliminate the negative impacts of flooding.

Ms Lena Lancaster

Co-authors: Dr Bonnie Waring, Imperial College London; Professor Thomas Bell, Imperial College London; Professor Martin Bidartondo, Imperial College London; Dr Elena Vanguelova, Forest Research

Poster

Assessing the impact of windthrow disturbance on soil properties in a UK forest: facilitating an archival approach

Extreme weather events have catastrophic effects on forest ecosystems. In 2021 and 2022, the UK saw record breaking wind speeds during winter storms Arwen, Eunice, and Franklin which caused substantial tree mortality. Although the effects on aboveground forest dynamics have been relatively well-documented, much less is known about the impacts of windthrow on plant roots and the soil microbial communities associated with them. We have undertaken fieldwork along 10 independent gradients of storm-related disturbance in Kielder Forest, comparing bulk and rhizosphere soil samples to quantify the impact extreme wind events have on soil properties. We found that soil carbon stocks were lowest in plots that had experienced the greatest degree of soil upheaval, consistent with an acceleration of carbon cycling due to physical disturbance and drying in these highly organic soils. Preliminary data also shows root biomass is smallest in these plots which is probable due to root upheaval in windthrown pits. Moreover, this study aims to create an archival 'BioBank' of microbial community data which will allow for future long-term studies investigating the recovery of such communities after extreme weather events; we will discuss how such sample archives can inform forest management in the future.

Professor Lindsey Gillson

Co-authors: M. Timm Hoffman, Plant Conservation Unit, University of Cape Town, South Africa; Peter Gell, Federation University, Australia; Anneli Ekblom, University of Uppsala, Sweden; William J. Bond, University of Cape Town, South Africa,

Talk - Culture, Heritage, and Histories of Trees

Trees, Carbon and the Psychology of Landscapes

Rampant afforestation threatens biodiversity and livelihoods, with questionable benefits to climate mitigation. Various guidelines assist in defining appropriate restoration targets that are cognisant of vegetation history, past forest extent and the interdependence of human management and biodiversity. However, the narrative of landscape degradation persists and is often applied without considering the history of landscapes and the antiquity of some open and mosaic landscapes. While some landscapes are undoubtedly degraded or deforested, others exist in open or mosaic states, and in these cases the assumption of degradation is the result of a cognitive bias. In psychology, a Fundamental Attribution Error is made when characteristics are attributed without consideration of context or circumstances. We apply this concept to Landscapes, explaining the over-application of the Degradation Narrative as a type of Attribution Error. We then propose a process that avoids such errors by first formally defining a null hypothesis regarding past landscape history, then testing such hypotheses using palaeoecology and other long-term data, before integrating these findings into a scenario-planning exercise that incorporates stakeholder perspectives. We contend that correct Landscape Attribution is an essential underpinning to restoration practice that is ecologically and locally appropriate as well adaptable to future conditions.

Mrs Louise Gathercole

Co-authors: RBG Kew, Forest Research, Defra

Poster

The Centre for Forest Protection - an overview

The new Centre for Forest Protection (CFP), jointly led by Forest Research and the Royal Botanic Gardens, Kew, was established with a £4.5m investment from Defra to provide a unique hub and collaborative platform for tree health expertise and research, supporting the England Tree Action Plan.

The mission of the centre is to protect the future of our forests, woodlands and trees from environmental and socioeconomic threats, through innovative science, interdisciplinary research, expert advice and training.

Research is focusing on strengthening our forests and woodlands to withstand pests and diseases, while also limiting the entrance and spread of new pests and diseases and reducing the impacts of other pressures such as climate change. We have a range of projects outlined in this talk, many of which see the lead partners working in collaboration, using the complementary strengths of the two organisations and our partners and collaborators.

We are developing an education and training programme to build capacity and capability in forest protection. We will also develop a knowledge hub, of use to scientists, policy makers and practitioners, to promote the outcomes of our work and to gather information from other organisations in the field of forest protection.

Ms Lucy Jenkins

Co-authors: None

Poster

Nature brings people together

This talk looks at native woodlands and trees in the urban landscape - where they play a crucial role overlapping culture, heritage, ecosystems and climate resilience.

The talk will draw on my research into nature connectedness, including how children and young people relate to nature, and the importance of nature to recovery in physical and mental health. I will refer to my (25 years') landscape architecture practice, including projects placing emphasis on trees, habitat connectivity and climate resilience in the urban context.

There is widespread impetus to integrate climate resilient measures to cope with heat and flooding. Native trees form a critical piece in this green infrastructure. Their role cannot be discounted in favour of technologies.

Native trees can define character in towns and cities (changing seasonal colours, scents, fruits, bringing wildlife and culture. Sensing joy at natural phenomena is one of the most inclusive and unconditional experiences humans can have. Being a small part of nature ourselves, nature is unpredictable and reassuring. Our connection to native trees can be intensely personal (a hawthorn on a street corner full of sparrows) or shared as a community (hornbeam woodland, climbed by generations of children knowing a park as their very own).

Professor Martin Dallimer

Co-authors: Maximilian Nawrath; Katherine N. Irvine; Jessica C. Fisher; Rob Fish; Gail E. Austen; Peter King; Zoe G. Davies

Poster

Quantifying the change of the value of forest cultural ecosystem services – a global meta-analysis

The world's forests, and the biodiversity that they contain, provide multiple cultural ecosystem services that are essential to people's wellbeing. The last four decades have been characterised by huge societal, environmental and technological change. Consequently, people's preferences for, and values associated with, these services may have altered. To examine whether this is the case, we conducted a scoping review and meta-analysis, assessing 343 economic valuation studies. Our findings reveal that the value people place on physical interactions with forests, such as recreation, has significantly decreased over the last four decades. Further, while a diversity of cultural ecosystem services, forest types and biodiversity attributes have been studied, the existing evidence-base is biased towards high-income countries, and certain dimensions of value, such as spiritual and symbolic interactions with forests remain understudied. This is likely to mean that the contribution that forests make to cultural ecosystem services globally has been undervalued. Redressing this knowledge and evidence gap should be a priority to ensure that the full benefits of current efforts to restore rehabilitate and re-establish forest ecosystems is acknowledged and incorporated into policy and decision-making.

Dr Matt Guy

Co-authors: Elena Vangelova, Forest Research; Ruben Manso, Forest Research; Frank Ashwood, Forest Research; Joshua Bauld, University of Stirling; Samuel Hughes, University of Leeds; Kevin Watts, Forest Research/University of Stirling

Talk - 30x30 Landscape Restoration

Assessing the use of natural colonisation to create new forests within temperate agriculturally dominated landscapes

There is a global drive to increase forest cover to protect biodiversity and help combat climate change. Tree planting is widely used to increase forest cover, although there is growing interest in using natural processes. However, predicting the outcome of natural colonisation or 'Passive restoration' is challenging as it is a highly variable process and evidence is sparse, especially in temperate landscapes. We will present work from two complementary studies that aim to evaluate the spatial and temporal scale over which natural colonisation may be an effective approach to create new forests within temperate agriculturally dominated landscapes. First, using LiDAR point-cloud data from 90 sites in the UK, we demonstrate that natural colonisation in temperate agricultural landscapes has the potential to create new forests within 70-140 metres of an existing seed source after 20 years. Secondly, using detailed field data from a sub selection of these sites, we examine the spatial process of colonisation from mature 'sources' woodlands and how this drives species composition, aboveground biomass accumulation and below ground carbon stocks. These results on species, biomass and carbon are compared against adjacent mature woodlands and nearby forests, of similar ages, created by active tree planting.

Dr Matthew Struebig

Co-authors: Dominic Muenzel, DICE University of Kent; Lindsay F. Banin, UK-CEH; Sugeng Budiharta, BRIN Indonesia; Joseph Hutabarat, FFI Indonesia Programme; Courtney Morgans, DICE University of Kent; Sonny Mumbunan, World Resources Institute, Jakarta; Emmy Primadona, KKWarsi, Indonesia; Hastina Purnama, KKWarsi, Indonesia; Elizabeth H. Raine, UK-CEH; Truly Santika, NRI University of Greenwich; Maria Voigt, DICE-University of Kent; Nurul Winarni, Universitas Indonesia; Jatna Supriatna, Universitas Indonesia; Zoe Davies, DICE University of Kent; Bob Smith, DICE University of Kent

Talk - 30x30 and Landscape Restoration

Delivering on conservation, restoration and poverty alleviation goals in Indonesia's community forests

Land-use change and resource extraction continue to negatively impact tropical forests. The UN Decade on Restoration seeks positive outcomes in these degraded ecosystems for biodiversity, climate change and people. One way to achieve this 'triple win' is to ensure the rapid uptake of sustainable forest management through social forestry.

We provide a spatial optimization framework to help prioritise resource allocations at scale across Indonesia's community-managed forests. Indonesia committed to allocate 12.7 million hectares to social forestry to improve village welfare and avoid deforestation, but uptake and outcomes have been uneven across the country to date.

Our multicriteria decision-support tool uses freely-available data on conservation features, forest biomass and multidimensional poverty to help identify the land parcels eligible for social forestry with greatest potential to achieve conservation, restoration and development goals. We explicitly account for provincial-level planning, allowing for a more even allocation of social forestry across Indonesia's many islands.

The tool can identify where conservation versus restoration and development goals can be best met, helping guide resource allocations to best help communities achieve positive outcomes through social forestry. Our work shows how 'Other Effective Conservation Measures' such as social forestry can help deliver 30x30 commitments.

Dr Melissa Minter

Co-authors: Joshua Copping; Alix Zelly; Susan Baker; Natasha Constant; Euan Bowditch; Tom Finch

Talk - 30x30 and Landscape Restoration

Scenarios of treescape expansion for a net-zero land sector: how achievable are top-down scenarios at a local scale?

Nature-based solutions offer part of the solution to the nature and climate crises, and treescape expansion plays a key role the UK Government's Net Zero Strategy. However, national targets rarely map neatly on to actions at lower spatial scales, and these 'top-down' approaches could risk alienating local actors and stakeholders. 'Bottom-up' approaches, however, may not meet the ambition needed to address grand challenges. We simulate thousands of UK land use scenarios,

combining treescape expansion with other land use changes, and predict the outcomes of each on net greenhouse gas emissions, bird habitat availability and food production. We find that whilst many scenarios can reduce net greenhouse gas emissions from the land sector, often with positive changes to bird habitat availability, but only a small fraction of scenarios reach net zero with only a modest impact on food production. We present the implications of these ‘food-efficient’ net zero scenarios for land use in the UK and in two upland case study landscapes, Yorkshire Dales and North Pennines (England) and Elenydd-Mallaen (Wales). Future work will involve participatory scenario planning with local stakeholders in these landscapes to co-produce landscape-scale scenarios and understand how achievable the top-down net zero scenarios are at a local scale.

Ms Naomi C Housego

Co-authors: Thomas C Parker (The James Hutton Institute); Lorna E Street (The University of Edinburgh); Elena I Vanguelova (Forest Research); Ruth J Mitchell (The James Hutton Institute)

Poster

Natural regeneration of Scots pine and birch onto Scottish heather moorland drives net ecosystem carbon losses at the decadal timescale relevant to net zero

Woodlands are proposed to address the joint biodiversity and climate crises. However, woodland establishment onto Scotland’s carbon-rich organic soils can drive soil carbon losses, via ground preparation and tree-soil interactions. To better understand tree-soil interactions in the absence of ground preparation, and to contextualise soil carbon losses within ecosystems, we investigated the ecosystem carbon stock changes that follow natural regeneration. In the Cairngorms, Scotland, we identified sites of 25-30-year-old Scots pine and birch natural regeneration onto heather moorland. We measured tree, vegetation, and soil carbon stocks at intervals along an eight metre transect from single naturally regenerated trees into uncolonised heather moorland. Soil carbon stocks were lower in the rooting zone of the trees, compared to eight metres away in open moorland. This suggests the role of tree-soil interactions in driving soil carbon losses, given the absence of ground preparation. At the ecosystem scale, soil carbon losses exceeded tree carbon gains, while vegetation carbon stocks did not vary, resulting in net ecosystem carbon losses following natural regeneration onto Scotland’s carbon-rich heather moorlands. Thus, when establishing woodland for climate change mitigation, potential soil carbon losses should be considered relative to tree carbon gains.

Mr Nicholas Allen

Co-authors: Rachel Gaulton, Newcastle University; Naomi Jones, Fera

Poster

Remote sensing of Hawthorn hedgerow biomass

Hedgerows provide a range of ecosystem services including storing carbon and harbouring biodiversity, yet are increasingly diminished and degraded.

Whilst a woodland carbon code exists to standardise and regulate woodland creation and carbon accounting, no equivalent exists for hedgerows, precluding them from sources of finance for restoration and planting. Remote sensing tools offer quick, scalable and repeatable ways of

collecting data to evaluate hedgerow carbon storage. Yet a key shortfall is the difficulty of ground truthing biomass estimates which requires labour intensive coppicing, drying and weighing.

In this work we propose a method to estimate hawthorn hedgerow biomass from high density Terrestrial Laser Scanning (TLS).

Using TLS data of three leaf off hedgerows across an age gradient we were able to correlate volumetric biomass estimates with coppice weight from these hedgerows. Pre-processed TLS data was segmented into stems and branches in the Forest Structural Complexity Tool (FSCT) and cylinders fit to estimate volume.

The successful and novel application of TLS forestry methods to hedgerows provides an important non-destructive ground truthing method which will allow the development and validation of landscape scale methods such as Airborne LiDAR. These methods can inform payments for hedgerow restoration in both a public agri-environmental and private finance context.

Mr Nick Rowles

Co-authors: None

Poster

Thinking outside the woods

‘Thinking outside the woods’ how increasing agroforestry can help create a more biodiverse and climate resilient landscape – a presentation of findings from an HM Government funded Trees Outside Woodlands (TOW) project.

We need to plant more trees in the landscape, but also produce enough food from farmland. There is only so much low-grade agricultural land that can be planted with woodlands, so we need to ‘think outside the woods’ and plant more Trees Outside Woodlands.

The agroforestry and orchards pilot is testing how to encourage the uptake of tree planting to improve biodiversity, soil health and pollination, and benefit farm businesses.

This presentation will cover:

- An introduction to agroforestry and its benefits to both farmers and the landscape
- A description of identified current barriers to agroforestry uptake including attitudes and understanding
- Outcomes from practical approaches trialled:
 - o The impact of grant funding schemes to increase participation
 - o Strategies for information sharing and upskilling. For example, different kinds of support for landowners, including one-to-one on-farm advice, talks and a webinar, and a learning voucher.
- Evidence of the cost effectiveness of the different approaches to increasing the uptake of agroforestry and analysis of experience of participation in the various schemes.
- Other findings.

Ms Nikki Cotterill

Co-authors: Nadia Barsoum, Forest Research; James Borrell, Kew Gardens; Guillermo Friis, Kew Gardens; Emily Parkinson, Forest Research

Poster

Understanding cultivation methodologies employed by UK nurseries with a focus on silver birch (*Betula pendula*) and English oak (*Quercus robur*)

Creation of new woodlands represents a key strategy in the UK government's plan for achieving net zero greenhouse gas by 2050. Other initiatives, such as the England Trees Action Plan, encourages landowners to plant native broadleaves like *Quercus robur* and *Betula pendula*, driving their demand. Due to the limited scope for natural colonisation and regeneration to reach afforestation targets alone, many of the trees for woodland creation are likely to be nursery-raised. However, little attention has been given in both scientific literature and recent policy to the processes involved in nursery cultivation of seedlings. This study details the results of a recent questionnaire designed to probe methods currently employed by nurseries in the cultivation of birch and oak, finding huge disparities in approaches. Findings indicate nurseries struggle to meet demands, either due to poor harvest or uncertainty on future requirements. Limitations in seed collection and mortality rates through afforestation pipelines might result in reduced genetic diversity in afforested woodlands, with unpredictable effects on resilience to environmental change, pests and diseases. However, we do know genetic diversity underpins the future adaptive potential of our tree populations, and maintaining that diversity is an essential goal of the UK Forest Genetic Resources strategy.

Mr Paul Bellamy

Co-authors: Gareth Fisher, RSPB

Poster

Managing woods to maintain resilience of protected sites to the effects of climate change

Site management and history have a strong influence on biodiversity value of woodlands, with managed ancient woods having higher diversity for many taxa than recent and unmanaged woods. Declines in the diversity of taxa within woodlands have been attributed to a range of factors related to changes in land management within woods and surrounding farmland over the past century. Bringing woods into management has been a policy aim for both conservation and the forestry industry. Recent research suggests that management can improve bird populations, and structural complexity influences bird populations in woods under grant funded management.

Future climate change is likely to add further pressure to woodland particularly in southern Britain. RSPB is implementing site specific management techniques to improve resilience of important woodland sites. Hydrological management to hold wetness within woods has been implemented in coppice woods with short-term improvement in bird populations. Other management techniques being employed to ensure long-term succession of deadwood and veteran trees and buffering woodland sites with natural colonisation of adjacent land. Site history, local edaphic and climate conditions as well as current management and priorities are important in identifying suitable interventions to improve resilience.

Dr Peter King

Co-authors: Martin Dallimer (University of Leeds); Thomas Lundhede (University of Copenhagen); Gail E. Austen (University of Kent); Katherine N. Irvine (James Hutton Institute); Jessica C. Fisher (University of Kent); Robert D. Fish (University of Kent); Zoe G. Davies (University of Kent)

Poster

Effect of subjective wellbeing on preferences for attributes of forest biodiversity

People generally hold multiple, often positive, values for forests and the biodiversity they contain. Further, the benefits of forests extend to improvements in diverse aspects of human health and wellbeing. Despite varied methods for capturing monetary and non-monetary values, effectively measuring multiple benefits and values is challenging. Indeed, it remains unclear how these measures are related. Addressing this is important to accurately value forest biodiversity to inform policy. Using a self-reported wellbeing scale (BIO-WELL) and a choice experiment, we investigated how wellbeing and willingness to pay (WTP) are related. We administered an online survey to >7000 members of the British public and recovered wellbeing derived from forest biodiversity, and WTP for different attributes of forest biodiversity (colours, smells, sounds, the ecological function of deadwood for decomposition). Using structural equation models to control for socioeconomic, spatial, and temporal factors, we found that participants who derive higher wellbeing from biodiversity were more likely to choose alternatives in the choice experiment that increase forest biodiversity attributes. However, WTP and wellbeing were only weakly correlated. Relying solely on monetary methods risks masking other, equally powerful, arguments for forest biodiversity conservation so policy should adequately represent a plurality of values to improve public support.

Dr Petra Guy

Co-authors: Brian Pickles, Mark Tibbett

Poster

Identifying communities and drivers of rare and common species of ectomycorrhizal fungi in British oak woodlands

Ectomycorrhizal fungi (EMF) are fundamental to woodland ecosystem function, they provide trees with the majority of their nutrient needs and increase drought and disease resistance. Oaks form the largest single species component to standing volume in British broadleaved woodlands, and therefore knowledge of their EMF community and its filters is of particular importance. In general, information regarding EMF communities and their drivers is essential for landscape restoration in order to ensure we understand the role of organisms fundamental to woodland ecosystem function and services, such as tree health and resilience. In general, EMF community studies consider only drivers of rare species. In this work we use multisite generalised dissimilarity modelling, which differentiates drivers between low and high occupancy taxa. Our analyses indicate that atmospheric pollutants, in particular, oxidised nitrogen deposition, are major filters of EMF community structure. Further, soil carbon to nitrogen ratio was an important filter only for the lowest occupancy taxa whilst non-marine sulphur deposition was important only for the most widespread species. In addition, we estimate that the alpha diversity the oak EMF community may be as high as 250 species, providing a vital indicator for expected EMF diversity of this important tree species.

Dr Phil Wilkes

Co-authors: Mathias Disney, UCL and NCEO

Poster

Connectivity, configuration and natural capital of London's urban forest

Urban forests are ubiquitous in the urban matrix and provide a myriad of ecosystem services. Yet urban trees and forests are often neglected and maligned. Our research decouples urban forest from land-use type and therefore allows us to map urban forest across London, revealing the extent, connectivity and value of the capital's urban trees. Combining terrestrial LiDAR, open access airborne LiDAR and Sentinel 2 earth observation data we identify pockets of high value urban forests where, for example, carbon densities are comparable to tropical forests. This analysis also reveals the configuration of London's urban forest where residential back gardens play an important role in a network of green corridors that connect forest patches from the green belt to the inner city. Further, we identify threats and inequalities of access to the capital's urban forest. Our work aims to shed new light on urban forests, valuing them for their socio-economic value as well as for their utility.

Ms Rebecca Gosling

Co-authors: Fritha West (Woodland Trust); Peter Crow (Forest Research); Matt Parratt (Forest Research); Lucy Turner (Forest Research); Charles Lane (Fera Science Ltd), Ana Perez-Sierra (Forest Research); Observatree volunteers (Woodland Trust)

Talk - Tree Health

Observatree: 10 years of early warning citizen science

Observatree is a successful collaboration between Governmental agencies and NGOs. The project utilises citizen science to act as an early warning for tree pests (including pathogens). Now entering its tenth year, what data has the project generated? Can volunteers submit accurate surveys for early warning and monitoring? By the end of 2022 over 18,000 reports had been submitted by a network of 200 highly trained volunteers. The volunteers reported on 23 priority pests, alongside reporting other worrying symptoms and, importantly, negative findings. The network has submitted 1900 new findings of the priority pests, contributing greatly to the known distribution of ash dieback, elm zig-zag sawfly and Oriental chestnut gall wasp. Analysis from 2019 reported 85% of the pest or pathogen findings were correct in identification, demonstrating the potential for volunteers in this space. Observatree also has a network of over 600 sentinel trees, consisting of over 30 species, distributed across the UK. The health of this network is showing decline. Over 50% of the monitored ash and horse chestnut species exhibit a damaging pest or pathogen. This data is vital for monitoring the state of the nations trees, aiding statutory action, research, and policy.

Dr Richard Ferris

Co-authors: Hugh. Smith; Nadia. Barsoum; Francis. Ashwood; Russell. Anderson; Ben. Ditchburn

Poster

Monitoring to support the enhancement, restoration and expansion of wooded habitats

“How can we improve what we have until we know what we’ve got?”

A key challenge facing the restoration of woodlands and habitats with significant tree features in England is that high quality, geographically representative, systematically routine data for assessing woodland ecological condition are lacking.

To expand and enhance woodlands effectively we must have baselines from which to detect trends and make valid comparisons of ecological condition over time. These data baselines must be underpinned by consistent and robust environmental monitoring.

There has been significant policy interest in improving ecological condition of woodlands, because it is intrinsically linked to the resilience and quality of natural capital and therefore provisioning services, such as carbon storage and sequestration.

The Natural Capital Ecosystem Assessment (NCEA) includes a Trees and Woodlands portfolio of work that will provide the evidence to support the current key policy asks whilst also ensuring its products have wider applicability.

Case studies of NCEA monitoring illustrating the innovation and breadth of disciplines supporting woodland enhancement, expansion and restoration:

- eDNA and DNA metabarcoding in woodlands
- Passive acoustic monitoring devices
- Soil mesofauna analysis
- Trees Outside Woodland (TOW) National Map

Ms Robyn Wrigley

Co-authors: Professor Dominick Spracklen (University of Leeds); Dr Cat Scott (University of Leeds), George Porton (University of Leeds)

Poster

Landscape-scale nature recovery in a UK upland landscape

Uplands across the UK have been influenced by people for thousands of years, and today, hill farming is the predominant land use. Agricultural intensification in the uplands has led to clearing of trees and draining of peat, replacing these ecosystems with low productivity grasslands of low conservation value. This has left isolated fragments of natural habitat requiring landscape scale restoration efforts to deliver nature recovery.

Wild Ingleborough is a multi-partner landscape-scale nature recovery project in the Yorkshire Dales. The project began in 2021, building on decades of work by Natural England and Yorkshire Wildlife Trust, to aid nature recovery of this upland area. Native tree planting and changes to grazing management have been used to connect fragments of ancient woodland and allow species-rich grasslands to recover. Monitoring is a vital part of the project. Here we compare how different grazing strategies (sheep grazed, low-intensity cattle grazing, ungrazed) impact species diversity across limestone, organo-mineral and peat soils.

Sharing initial findings from the project can provide others with an insight into what can be achieved in upland conservation and may inspire a conversation of shared ideas on this topic.

Dr Roi Maor

Co-authors: Jakub Truszkowski, University of Gothenburg; Jade Saunders, World Forest ID; Victor Deklerck, RBG Kew; Caspar Chater, RBG Kew

Poster

Tracing the geographical origins of products for deforestation-free supply chains

Agriculture is driving alarming rates of tropical deforestation, impacting livelihoods, biodiversity and ecosystem-level processes. To address this, world-leading economies are banning trade and importation of deforestation-linked timber and agricultural products (forest-risk commodities—FRCs). However, such bans are currently un-enforceable due to provenance verification shortfalls. Chemical analysis of the agricultural product itself may help identifying geographic origin, as stable isotopes and trace elements within the plant tissue reflect the environmental conditions under which it grew. However, matching a sample to a geographical location is impossible without a reference library of geolocated samples and corresponding chemical signatures. Here, we present a complete pipeline for establishing the provenance of FRCs, from field collection of reference samples through chemical analysis to Machine Learning-based inference of geographic origin. We are collating the first reference database of geolocated chemical signatures of pantropical soy and cocoa, and have developed a Machine Learning workflow to infer the origin of a sample from its elemental similarity to reference records. By using an unbroken chain-of-sample-custody from field to data, this pipeline increases the precision of origin estimates. This tool facilitates supply-chain transparency and traceability, which will enable authorities to act quickly and effectively to stop trade in deforestation-linked commodities.

Mr Ross J. Barnett

Co-authors: Emily Waddell; Elisa Fuentes-Montemayor; Kirsty Park; Sam Rogerson (University of Stirling); Matt Guy; Kevin Watts (Forest Research); Tom Bradfer-Lawrence (Royal Society for the Protection of Birds); James M. Bullock; Maico Geert Weites; Ben A. Woodcock (UK Centre for Ecology and Hydrology); Rosie S. Hails; Ben McCarthy (National Trust); Oscar Aguinaga Vargas; Ron Corstanje; Alexey Larionov; Mark Pawlett; Daniel Simms; Jim Harris (Cranfield University)

Talk - 30x30 and Landscape Restoration

The sound of restoration: How site and landscape factors affect soundscape complexity in restored woodland

There is an urgent need to increase habitat restoration to meet 30 by 30 targets. Restoration efforts frequently aim to recreate reference communities, or evaluate their success against a list of target species. The Restoring Resilient Ecosystems (RestREco) project aims to deliver a step change in restoration science, by considering ecosystem complexity, multi-functionality, and resilience as fundamental aims for restoration projects. This presentation will provide an outline of the key aims and methods of RestREco, before focussing on work relating to ecoacoustics. Acoustic indices have been utilised more frequently in recent years as indicators for biodiversity, habitat quality and disturbance, however there is currently little research on how terrestrial woodland soundscapes might change following restoration efforts. Focussing on acoustic recordings taken from 60

woodlands in Scotland and England, we will investigate the link between site factors (e.g. age, former land use, habitat complexity) and acoustic indices in restored woodland sites.

Dr Ruth Mitchell

Co-authors: None

Talk - Tree Health

How resilient are our native woodlands to multiple pests and pathogens?

The impact of tree diseases on associated biodiversity is rarely considered and the cumulative impact of diseases affecting different tree species has not previously been considered.

We studied the co-occurring tree species *Fraxinus excelsior* ash and *Quercus petraea/robur* oak affected by ash dieback and acute oak decline respectively. The number of associated species impacted by a decline in ash and oak was 38% greater than the sum of the number of associated species affected by either disease individually. In addition, 472 species were identified as using ash and oak and other tree species. These species would be resilient to a decline in ash and oak if the other tree species that support them are present at the site. However, studies of 24 mixed ash/oak woodlands in the UK showed a lack of functional redundancy; tree species that would host biodiversity currently supported by ash and oak were absent. Those woodlands with greater tree species diversity were more resilient. At many sites the soils and climate were suitable to establish additional tree species which would increase resilience. The results support current guides to sustainable forestry, that species diversity of multipurpose and conservation woodlands should be increased to enhance their resilience.

Ms Sally Westaway

Co-authors: Jo Smith, MV Agroecology Research Centre; Laurence Smith, University of Reading; Ian Grange, Royal Agricultural University

Poster

Meeting tree planting targets on the UK's path to Net-Zero: a review of lessons learnt from 100 years of land use policies

The UK government aims to achieve net-zero greenhouse gas emissions by 2050, to achieve this goal, targets have been set to plant nearly a million hectares of new woodland by 2050. However, more than 70% of the UK's land is used for agricultural production, so meeting these targets creates a potential conflict between land for food production and land for carbon sequestration. We review the role of policy in determining the presence of trees in the UK's agricultural landscape over the past 100 years and evaluate the drivers behind the current extent of trees, woodland, and agroforestry on UK farms. Our review found that the effectiveness of financial incentives to influence tree planting is dependent on the pre-existing interest and values of the landowner, grants alone may not be sufficient to encourage farmers to plant trees. Scheme complexity, bureaucracy, and insufficient payment rates are barriers to the success of woodland grants and agri-environment schemes. Key to future progress will be scheme flexibility to enable farmers to choose to plant trees where it best suits local conditions, aligning of policy tools with farmer values, and ensuring that farmers have the knowledge and support to make decisions.

Ms Sophie Jane Tudge

Co-authors: Zoe Harris (University of Surrey); Richard Murphy (University of Surrey); Adriana De Palma (NHM); Andy Purvis (NHM)

Poster

Biodiversity change in tree plantations

Tree plantations have been expanding in area over recent decades. Conversion of primary vegetation to plantations has negative effects on biodiversity, but biodiversity within plantations can change over time. The maintenance of biodiversity within plantations is essential for the provision of ecosystem services, the conservation of wild species and, for agricultural tree crops, crop yield. However, we do not have a good understanding of how biodiversity is affected by land-use change to different types of tree plantation, and how biodiversity within plantations changes over time. My research calculates the average effects of conversion of primary vegetation to tree plantations on biodiversity in tropical and temperate regions. I also show how biodiversity changes over a 30-year period within tree plantations on a global level, and highlight differences per geographic region. My results give the relative ecological value of plantations of different ages, indicating which taxonomic groups respond best to plantation age, and which may need further encouragement. My results could have consequences for plantation management, helping managers to understand and maximise biodiversity within their plantations, for guiding the placement of new plantations with long-term ecological changes in mind, and for improving large-scale projections of biodiversity change.

Ms Tarja Rannisto

Co-authors: None

Talk - Culture, Heritage, and Histories of Trees

Aesthetics of urban treescapes as a way to people's better wellbeing

This paper discusses how far incorporating aesthetic preferences into planning strategies around urban treescapes can have positive effect on people's wellbeing.

Despite the fact that the health effects of nature have been scientifically proven, they have not been sufficiently included in urban planning. A significant reason for that is lack of scientific data of people's relationship with green spaces in cities, where they increasingly live and spend their time.

The available research data is limited, and it includes gaps mostly in incorporating aesthetic values in urban planning equally to other cultural and natural values.

This discussion paper proposes to fill this gap by paying enough attention to people's preferences of treescapes. By investing in their aesthetic quality in the planning phase, cities can attract more people to nature experiences in their everyday environment.

Such well-maintained urban treescapes offer local people opportunities for improving their wellbeing through positive emotional attachment and sense of identity by interacting with nature.

This presentation is part of a PhD research and focuses on the preliminary research results of people's preferences on trees in two urban woodlands in Sheffield.

Dr Thomas Sloan

Co-authors: Dr Cat Scott, University of Leeds; Stephen Denison, University of Leeds; Anna Gugan, Leeds City Council; Dr Robin Hayward, University of Leeds

Poster

Gair Wood: A new University of Leeds research woodland

In 2023 the University of Leeds created Gair Wood, a 36 hectare native, broadleaf-dominated woodland at the edge of the city of Leeds. Around fifteen hectares have been planted at varying densities with mixed species assemblages to create a varied canopy structure. Five hectares have been planted as scrub, and a further two hectares have been left to naturally regenerate using recruitment from seed sources in adjoining woodlands. The remaining areas will be maintained as rides and breaks, but will be managed to improve the diversity of ground flora.

This site design will improve the biodiversity, which is a key aim of the project. Other aims include creating a publicly accessible resource that will link several local green spaces, capturing carbon as part of the University's net zero efforts, and providing a venue for research and teaching. This final goal has involved a baseline monitoring campaign of pre-planting conditions and a wide range of student projects. The site also hosts a large tree species diversity experiment that aims to assess the impacts of species richness on woodland development. The project team are keen to hear from potential collaborators who are interested in using the site for research.

Dr Vasthi Alonso Chavez

Co-authors: Rothamsted Research; Forest Research; Warwick; University of York; Salford University

Talk - Tree Health

Integrating Epidemiology and Stakeholder behaviour in ash treescapes

We investigate how individuals and stakeholder groups can influence the successful detection and management of multiple risks to tree health focusing on ash trees.

With forests, hedgerows and other amenity trees (collectively treescapes), it is not always possible to prevent pests and diseases from arriving, therefore, early detection and successful management are key areas where science can deliver.

Management guidance is often threat-specific but decisions are often made regarding host tree species that may face multiple threats. The value of our project is that it investigates the interaction between multiple threats and the impact of land managers on successful surveillance.

We developed a spatially explicit model of the spread of Ash Dieback and Emerald Ash Borer at the UK scale suitable to assess the impact of large-scale surveillance. We also carried out social research on multi-stakeholder values, actions and acceptability of EAB management options in order to develop an agent-based model of stakeholder behaviours. We have identified optimal surveillance strategies and discovered motivations and disincentives for surveillance.

Ms Vicky Vale

Co-authors: Richard Ferris (Defra); Hugh Smith (Defra); Rebecca McIlhiney (Defra)

Poster

Evidence to support the expansion of tree cover in England – the role of the Natural Capital and Ecosystem Assessment programme

The Dasgupta Review and the Natural Capital Committee Final Report state a failure to recognise that our economies are embedded within nature, also highlighting the lack of fit-for-purpose data to make robust assessments of environmental condition. The UK Government has world-leading ambition on protecting natural assets, internationally and domestically. These goals can only be achieved by the provision of systematic and robust evidence.

In response, DEFRA is investing £140 million over three years towards delivering the Natural Capital and Ecosystem Assessment (NCEA) programme. NCEA is a science innovation and transformation programme spanning land and water environments, established to collect data on the extent, condition and change over time of England's ecosystems and natural capital. The programme will integrate data and address critical evidence gaps, informing ambitious, proactive, and sustainable policy decisions.

Woodland currently covers ~13% of the UK's land surface. DEFRA have set a target to increase tree canopy and woodland cover of England to 16.5% by 2050. The England Trees Action Plan has also committed to treble tree planting rates in England by the end of this Parliament. Delivery of targets such as these will be supported by NCEA outputs and are key for the UK's Net Zero strategy.

Dr Virginia Morera-Pujol

Co-authors: Colin Brock, School of Biology and Environmental Sciences, University College Dublin; Adam F. Smith, School of Biology and Environmental Sciences, University College Dublin; Kilian J. Murphy, School of Biology and Environmental Sciences, University College Dublin; Tancredi Caruso, School of Biology and Environmental Sciences, University College Dublin; Simone Ciuti, School of Biology and Environmental Sciences, University College Dublin

Poster

Deer impact on biodiversity: linking soil, trees, and vertebrates

Deer populations have reached extreme densities throughout Ireland, resulting in serious financial and environmental damage to forests and agriculture. Although deer are considered ecosystem engineers with beneficial effects on biodiversity, when they occur as non-native species at unsustainably high densities deer may have multi-faceted ill effects on biodiversity due to selective vegetation browsing and grazing, soil and vegetation trampling, and modification of soil chemical composition via waste. This can directly and indirectly affect vegetation, aboveground and belowground organisms, including soil invertebrates, mammals, and birds. We have deployed camera traps and sound recorders in a sika deer hotspot (Co. Wicklow, Ireland) in high deer-density areas and areas protected by fences. We gather quantitative data on mammal and bird richness, and vegetation and soil samples, to estimate understory vegetation richness, soil fungi/bacteria ratio (indicator of the microbial response to aboveground dynamics), microbial biomass and invertebrate

fauna diversity. This integrated and novel approach will inform policy makers on the actual effects that deer likely have on biodiversity with the long-term goal of creating a monitoring platform of terrestrial Irish biodiversity. This project will steer management actions aimed at controlling deer populations and restoring the ecological conditions needed for Irish biodiversity to flourish.

Mr Will Hayes

Co-authors: Jake Bicknell - University of Kent; Zoe Davies - University of Kent; Maria Voigt - University of Kent; Michelle Kalamandeen - McMaster University; Kerry Anne Cort - Conservation International; Isable Rosa; Nic Kotlinksy - Colorado State Forest Service

Poster

Predicting forest loss from gold mining: the case of Guyana

With accelerating deforestation in the southern Amazonia, the Guiana Shield represents an increasing share of closed forest cover and could play a key role in climate change mitigation and biodiversity conservation. However, recently, human activities, particularly mining for gold, have been driving deforestation in the region. Using a spatio-temporal modelling approach, we identify regions of Guyana with the highest probabilities of deforestation over the next 25 years. Our model projected a 9% net decrease in total forest cover by 2043. Forest in protected areas were found to have a lower probability of deforestation. We therefore evaluated how the proposed expansion of the protected area network would impact aboveground carbon biomass losses and habitat loss for the country's most threatened forest vertebrates compared to the current network. Our results show that establishing the proposed protected areas can buffer predicted threatened species range losses and reduce potential aboveground carbon emissions. Guyana has committed to 30x30, but is far behind schedule in achieving the Aichi target of 17% (currently on 8.5%). The model predicts that the proposed PA network (17%) will reduce forest loss from a 9% net decrease to a 7.4% net decrease, highlighting the need to identify further areas for protected area status to meet the 30x30 target.

Mr William Hagan Brown

Co-authors: Sophie Fauset (University of Plymouth); Ralph Fyfe (University of Plymouth); Rob MacKenzie (University of Birmingham); Manuel Gloor (University of Leeds).

Poster

Impact of Climate Change on Mature Oak Canopy Temperature

Results from crop systems have reported reduced stomatal conductance under high CO₂ concentrations resulting in higher leaf temperatures. However, there is limited data on the effect of increased CO₂ in natural ecosystems such as forests. Emerging Thermal Infrared (TIR) camera techniques to measure surface temperature has recently proven useful for continuously monitoring the surface temperature of natural ecosystems. In this current study, a TIR camera was utilised to measure the canopy temperature of a mature (>175 years) oak woodland at the Birmingham Institute of Forest Research Free Air Carbon Enrichment (BIFoR-FACE) facility at Staffordshire,

Central England, during the summer of 2021 and 2022. Over the growing season, the daytime (9:00 – 15:00 hours) canopy temperature of oaks under ambient (aCO₂) and elevated (eCO₂) was higher than the air temperature. The canopy temperature of oaks under eCO₂ was higher than those under aCO₂. The observed canopy temperature was mainly driven by microclimatic factors and enhanced by elevated CO₂. Measurement of leaf heat tolerance of oak leaves showed enhanced tolerance of oaks, both eCO₂ and aCO₂. Results from this study will provide information on the tolerance of oaks under high CO₂ for policy and plantation management.