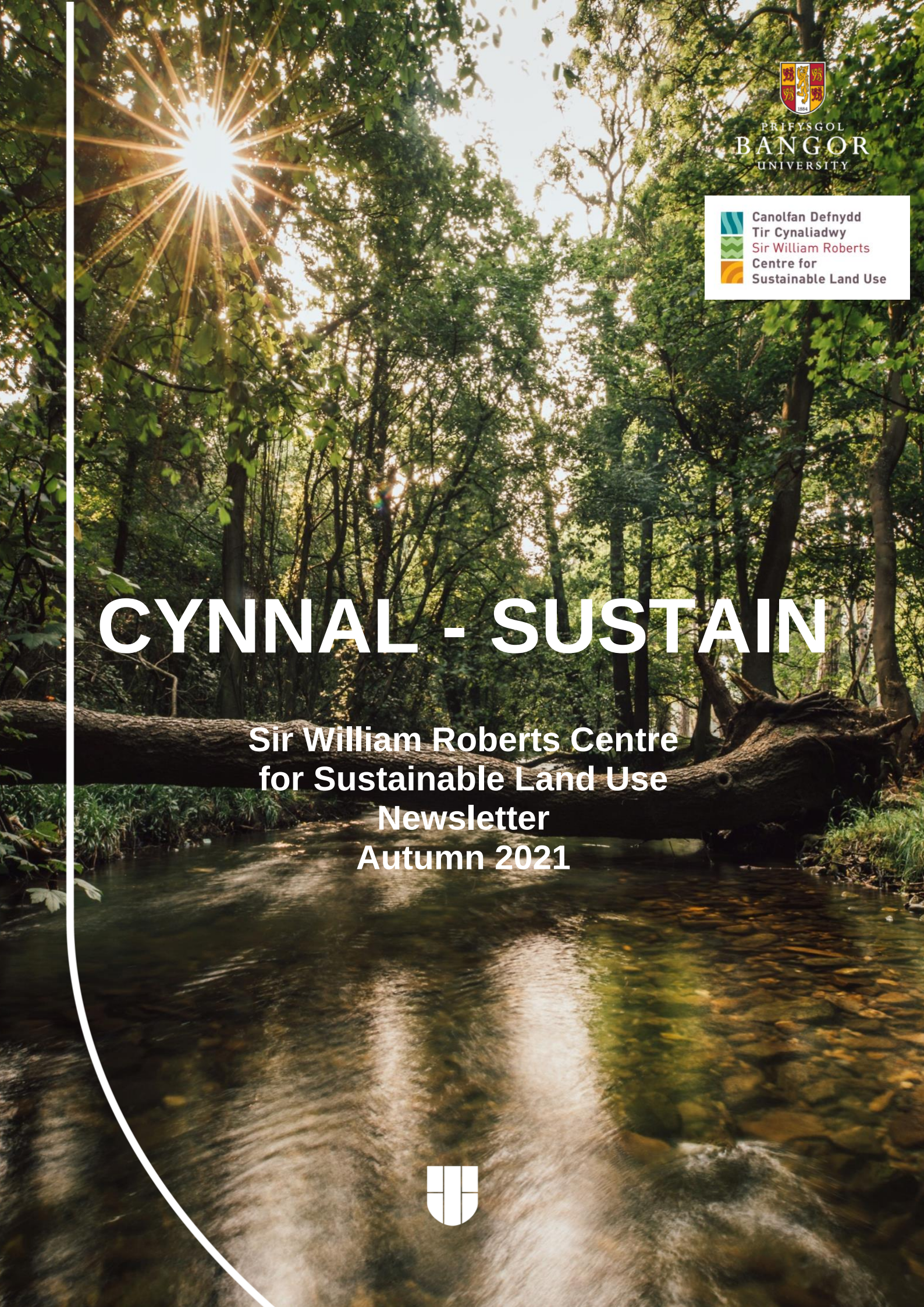


PRIFYSGOL BANGOR UNIVERSITY

Canolfan Defnydd Tir Cynaliadwy Sir William Roberts Centre for Sustainable Land Use

CYNNAL - SUSTAIN

Sir William Roberts Centre for Sustainable Land Use Newsletter Autumn 2021

WELCOME

Canolfan Defnydd Tir Cynaliadwy Sir William Roberts Centre for Sustainable Land Use

From Ashley Hardaker, Postdoctoral Research Officer in Land Use Sustainability Metrics

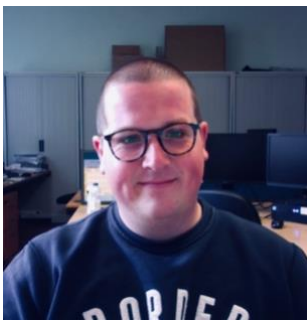
AUTUMN 2021
EDITION – NO 2

Following on from our first bulletin back at the beginning of 2021 and some very warm and positive feedback from our readers, we are pleased to present to you the Autumn edition of *Cynnal-Sustain*. We hope you enjoy the insights into the work of SWRC researchers and land-based research across the University more broadly during the last six months.

Productive land use systems including agriculture and forestry underpin the well-being of society through the goods and services they provide. Changes in policy direction and contemporary awareness of the environmental impact of these systems raises the pressure for them to transition towards sustainability. As part of this, metrics and tools can help farmers, foresters and land managers measure and track their performance across the multiple areas of sustainability (environmental, social, and economic). This can, in turn, identify potential pathways to improvement.

To build the SWRC's research capacity and solidify links between existing staff and partners in this arena of land use sustainability metrics, I joined the centre in June 2021 as a Postdoctoral Research Officer. Over the next year or so I will be working on several pieces of collaborative research looking at how existing sustainability tools, such as Life Cycle Assessment, can be developed to better capture broader impacts on ecosystem services. I will also be investigating how these tools can be integrated with metrics that assess social and economic impacts.

In its third year, funded by a generous endowment from Sir Williams Roberts the SWRC continues to provide a forum to collaborate and share land-based sustainability research. In this issue of *Cynnal-Sustain,* we would like to share with you the career path success of one of our doctoral researchers and some of the excellent KESS funded land-based research at Bangor looking at the well-being benefits of woodlands, innovative tree health assessments using remote sensing, and sustainability challenges in livestock production."



Ashley Hardaker, Postdoctoral Research Officer in Land Use Sustainability Metrics

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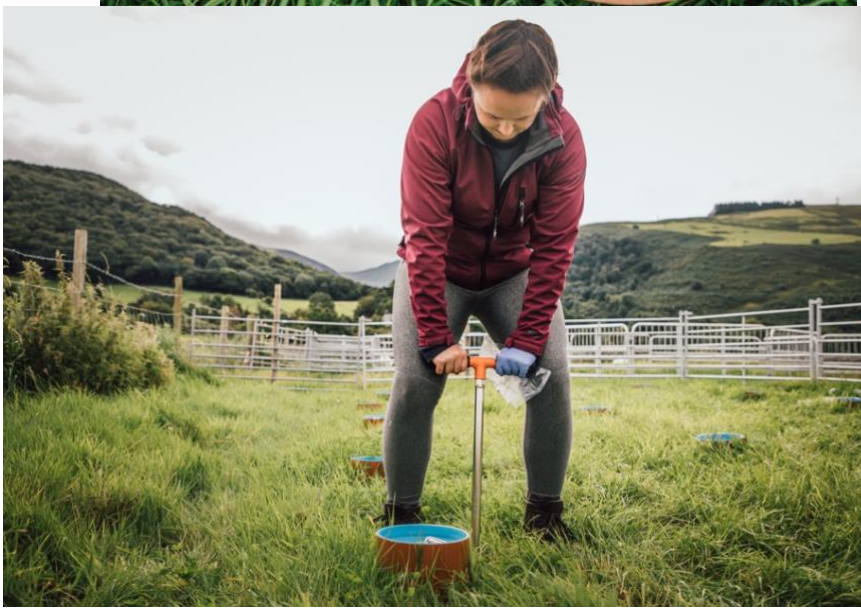
PLACEMENT LEADS TO EXCITING CAREER OPPORTUNITY



Hollie Riddell, a doctoral researcher with the Sir William Roberts Centre at Bangor University, recently completed a placement with Welsh Government. Here, Hollie has reflected on this placement in the civil service and how her doctoral research has set her up for her future policy making career.

“As a final year doctoral researcher, my thoughts have begun to turn to “What comes next?” – a bit of a terrifying prospect! Especially considering it feels like yesterday when I started my studentship with the SWRC. Working within the civil service is a career path that has always appeared desirable for me, even before beginning my doctoral studies. However, it was being a PhD student that allowed me to explore this route further. The Welsh Government, in collaboration with Environment Platform Wales, runs a placement scheme whereby PhD students take a 3-6 month hiatus from studies to work within a government department. In December 2020 I secured such a placement.

My PhD project covers creation of a more accurate carbon footprint for lamb production, attempting to differentiate emissions across the different altitudes that production occurs (lowland, upland, and hill). My placement was within the chemicals team and involved working on new responsibilities that had come to the team as a result of Brexit. These included prioritising future chemical restrictions and assessing applications for authorisation from businesses requesting to use a particular chemical in their production processes. While these are not obviously related, I found a lot of skills built within my PhD, and background knowledge, enabled me to develop better processes within my placement tasks and improve the quality of my outputs.

Completing a PhD requires a variety of core skills: project management, critical thinking, written and verbal communication, teamwork and leadership. It requires you to take responsibility for your own work, meet deadlines and make decisions based on evaluating relevant information. Within my own experience, running field trials in remote locations using novel equipment has come with many of its own frustrations.

However, “making things work” has led me to build tenacity and problem-solving skills. I am less bothered by things going wrong and more confident in my ability to overcome setbacks. Use of these skills were paramount in completing tasks in my placement. I had to read and analyse technical information, meet deadlines, create summaries for team managers and present/discuss information in meetings both formal and informal. All familiar activities for a doctoral researcher!

If you were to look at a job advert for any civil service position, or indeed any other industry, you would most probably find some, or all, of the above qualities listed within the desirable skills. I finished my placement in July 2021 and have since been offered a job within the Welsh Government for the future. While my career path seems to be wandering away from academia, I am confident that undertaking the PhD (and completing it – eventually!) has aided me in opening the door for a civil service career. It has also built career skills and networks that I will benefit from indefinitely. Not only that, but the wider experiences from being within the student community and the lifelong friendships I have built, have made the experience, while challenging at times, ultimately fulfilling and worthwhile.”

NEWS IN BRIEF

The 2021 Drapers' scholarship recipients have been announced and include Alex Ioannou undertaking the project *Reframing the Welsh landscape: The role of collective subjectivity in a time which calls for landscape change.* Alex's doctoral research will be supervised by SWRC Director Dr Norman Dandy and Dr Shaun Evans, Director of the Institute for the Study of Welsh Estates. This interdisciplinary doctoral project will generate a richer understanding of the 'story' of landscape in Wales since c.1500 with a view to reframing perceptions towards land and landscape.

Dr Andy Smith, School of Natural Sciences will contribute to a major new study funded through the UKRI Future of UK Treescapes Programme. The MEMBRA project (Understanding Memory of UK Treescapes for Better Resilience and Adaptation) aims to fill the gaps in our understanding of how past experiences of increased carbon dioxide, drought, and disease impact trees' adaption to different environmental stresses. The MEMBRA project is led by the University of Birmingham, and will use Bangor University's tree diversity experiment, BangorDiverse.

The School of Natural Sciences has recently made several new appointments for lectureships spanning zoology, conservation, and natural resource management. The new staff bring a range of fresh expertise to bolster the research capacity and teaching provision of the school.

The Sir William Roberts Centre webpages have grown to provide more information about our researchers and the areas of work being carried out. We have also created a page dedicated to Sir William's legacy and for past recipients of Scholarships and other support funded by Sir William's endowment. If you were a beneficiary of support from Sir William at any time, please get in touch with us and tell us about it.

A new collaborative cross-school research group has emerged at Bangor University called Places of Climate Change ('PloCC'). Initially sparked by a WISERD research day, the group has emerged to jointly address sense-of-place notions in relation to climate change. from sociological, psychological, geographic, financial, and linguistic perspectives. A monthly seminar series has been started to stimulate interdisciplinary discussion in this area.

NATURE BENEFITS WELLBEING – BUT WHOSE?

The positive impacts of spending time in nature on human health and wellbeing are well established. Indeed, the coronavirus pandemic saw an upward trend in outdoor exercise and a renewed appreciation of the solace that time there can provide. However, engagement is unequal and therefore so is access to the related wellbeing benefits. This is a persistent pattern over time with certain groups under-represented and *"especially disconnected"* in visitor figures for natural landscapes. Low income, ethnic minority and older age groups are all less likely to visit frequently, inequalities that have likely been exacerbated by the Covid pandemic. This matters because these same groups often have worse health and have been shown to benefit disproportionately from access to nature.

Heli Gittins worked closely with Coed Lleol/Small Woods to ascertain whether taking part in a woodland activity programme could address these challenges, exploring how it impacted participants' wellbeing and use of woodlands over time. This research was undertaken as part of Heli's doctoral project funded by the Knowledge Economy Skills Scholarships (KESS) programme, in partnership also with the Woodland Trust. Coed Lleol's 'Actif Woods Wales' project have been running programmes for adults across Wales for over ten years. Activities range from bushcraft and woodland walks to conservation, foraging, campfire cooking, and outdoor mindfulness. By partnering health and social care organisations with woodland project officers, the programme reaches people with a wide range of health conditions and support needs and importantly, those who may not already be regular greenspace visitors.

Heli's mixed methods research found that independent woodland use increased following the participation. Findings clearly showed how programmes could break down barriers to access and so provide lasting wellbeing benefits. Focus group data gave good insight into how taking part in a supported programme impacted woodland use beyond addressing barriers. Having a positive experience such as this in nature could act as a 'greenspace turning or *re*-turning point', giving

"It's given me a lot more confidence in an environment that I wasn't confident in before"

confidence to new users and re-connecting those who had lost touch with the habit of visiting through mental or physical ill health or a lack of time.

Findings showed significant positive changes for mental wellbeing and all other physical and psychological measures of wellbeing at programme end. Furthermore, these positive benefits had *held* at the follow up point months after the programme had finished, meeting a key research gap on longer term impacts and wider lifestyle changes of such programmes.

Actif Woods have continued to measure pre and post woodland use since the study in recognition of the importance of promoting independent access. Structured interventions such as this clearly act as a bridge to increased and self-sustaining visits which can have a profound effect on the health and wellbeing of some of the most vulnerable members of society. On a broader scale, this makes financial sense – in fact a Social Return on Investment report in partnership with Bangor University's Centre for Health Economics which used the study data found good social value for investment ratios. However, whilst attention on nature-based interventions has gathered pace and terms such as green health and natural prescriptions are becoming common parlance, projects such as Actif Woods Wales are far from secure in terms of funding and sustainable support. Regional collaborations such as the Let's Get Moving North Wales group are a good start, bringing together key players from health and environmental sectors group to share information and inspiration. The broader challenge though is structural, to establish secure funding streams at strategic level to properly embed natural solutions in the health care system.

IMPROVING THE SUSTAINABILITY OF WELSH LIVESTOCK PRODUCTION

Agriculture is the overwhelmingly dominant land use by area in the UK. For example, over 80% of Wales' land is under some form of agricultural management. Given its climate and landscape, much of Wales has favourable conditions for growing grass and less so for crops, meaning that livestock systems are ubiquitous. The Welsh Government '*Aggregate Agricultural Output and Income'* report shows the total value of national agricultural output in Wales for 2020 is projected to stand at £1.7billion. At a local level, agriculture is often a principal component of the rural economy, with strong linked social, cultural, and heritage values. Its significance in the Welsh landscape and to its people is therefore palpable.

However, the industry is facing times of potentially unprecedented change. Post-Brexit agri-policy is likely to take a very different direction to the Common Agricultural Policy, which has heavily influenced the sector for decades. In the future, farmers will be rewarded for the delivery of 'public goods' such as clear air and water, enhancing biodiversity, and storing carbon. Indeed, the agriculture industry is under more pressure than ever to play its part in tackling the major environmental issues of our time, such as climate change and biodiversity loss. Within the School of Natural Sciences, we have many projects that are investigating ways to reduce the environmental impacts of agriculture and livestock production. Two such PhD projects are outlined below, and both are co-funded between the KESS2 programme and Hybu Cig Cymru – Meat Promotion Wales (HCC).

Louise McNicol is a graduate of the University of Glasgow and started her PhD in August 2020. Her work aims to investigate strategies to reach zero carbon beef and sheep production on Welsh farms - a target set by the Welsh Government by 2050. The first part of her project has been to determine the carbon footprints of different farming systems (hill, upland lowland) across Wales investigating how these farms can reduce their emissions through implanting measures to increasing efficiency, e.g., optimising nutrition, grassland management, genetic merit, and animal health.

Overall, these measures aim at increasing productivity, decreasing the land required to maintain the current level of output, which will leave more land available for sequestration through agroforestry or woodland creation. The project also plans to explore the barriers of implementation of these mitigation options and consider farmers' attitudes towards net zero at farm scale. Finally, this project will also look beyond the farm level and look at national level modelling in the agriculture and forestry sectors in Wales to determine what meeting net zero targets could look like in terms of the national balance of land use and animal numbers.

Joe Jones is a University College Dublin graduate and started his PhD at Bangor University in August 2020. Joe's work focuses on beef and sheep grazing management systems. Wales has the climate for growing grass, however, it is known that much of the growth is not efficiently utilised through traditional 'set-stocking' systems, where livestock are given access to whole fields for long durations. The aim of Joe's work is to assist with the improvement of the economic and environmental sustainability of livestock farming through moves towards improved grazing systems, such as 'mob' grazing. Mob grazed systems involve livestock being grouped together and grazing smaller areas of fields before being moved on to fresh grass on a monthly rotation.

Joe's project is undertaking an online survey and follow-up interviews to better understand the current baseline, i.e., why do livestock farmers choose the grazing systems they have, and what are the barriers to adapting these. Joe is also involved in fieldwork at a site at Coleg Glynllifon, a land-based college south of Caernarfon. This field experiment focuses on two grazing systems (set-stocking and mob grazing) with both cattle and sheep. A wide range of data is being collected from the site to compare the impacts of both grazing systems on grass yield and quality, livestock performance, soil quality, and GHG emissions.

Both Louise and Joe have already interacted and disseminated their results with stakeholders through talks and discussions with HCC, as well as with farmers' unions.

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TECHNOLOGICAL ADVANCES IN FOREST PEST SURVEILLANCE

Now more than ever, keeping vigilant of pests and diseases is an important aspect of a forest manager's role. Expanding ranges of endemic pathogen species and a growing list of novel threats from overseas cast doubt on the future of some of our most commercially, culturally, and ecologically valuable tree species; the widespread decimation of our native ash probably being the most conspicuous contemporary example.

Surveillance of forest pest and disease disturbances has in the past relied on costly visual aerial mapping which is often constrained by human interpretation, or labour intensive and time-consuming ground surveys. Recently however, remote sensing technology has shown considerable promise in its ability to detect and accurately map outbreaks at a range of scales from individual trees to whole forested landscapes, permitting more informed management responses.

Postgraduate researchers at Bangor University have been investigating the potential for high resolution spectral data to detect and monitor one particularly destructive forest disease; Ramorum disease, sometime known as 'sudden larch death' (image right). During the past decade, foresters have witnessed landscape scale decline of larch plantations across the country, the culprit being the fungus-like organism, *Phytophthora ramorum.* The potential for such data to accurately map these outbreaks, assess severity, and even detect infection in visually asymptomatic trees is being explored by Bangor researcher Rob Taylor. The goal is to make a valuable contribution to improving the toolbox available for foresters and researchers to better monitor, manage and study present and future forest diseases in Wales.

Above: The aggressive pathogen *Phytophthora ramorum* has decimated larch plantations throughout Wales since 2010 Photo: Robert Taylor

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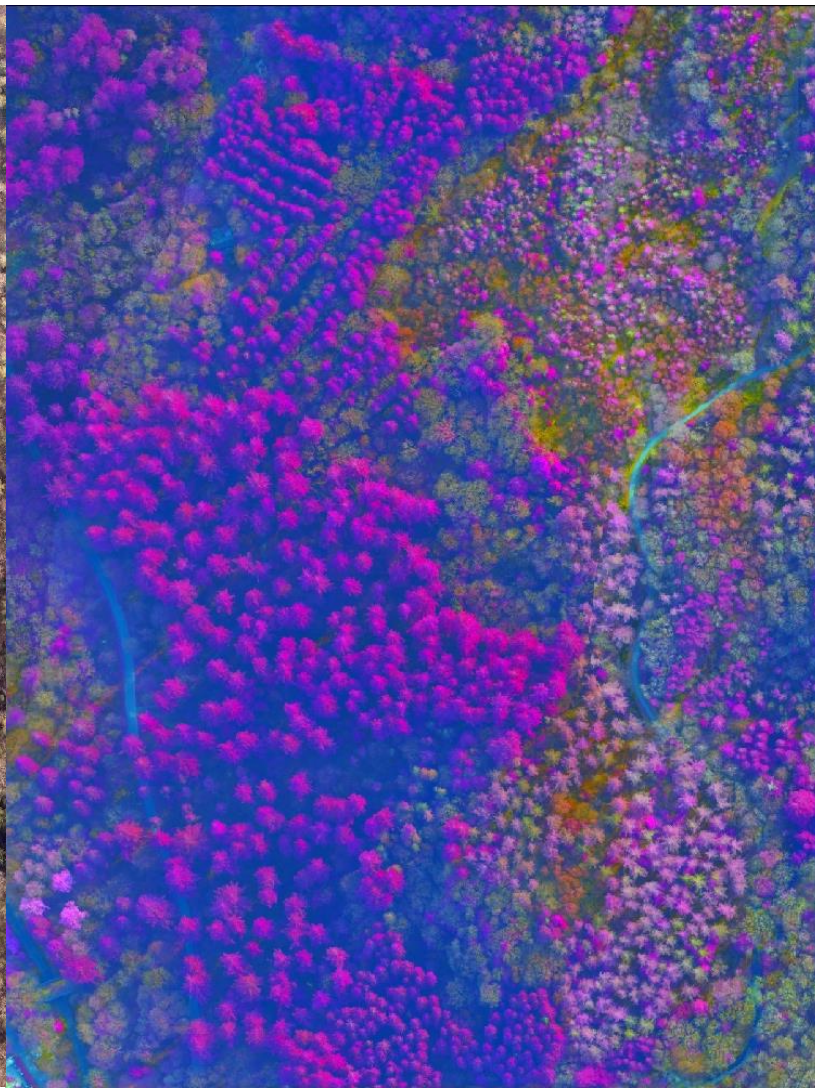

The project, funded by the KESS2 East Scheme in collaboration with the Welsh Government and Forest Research, has had the good fortune of collaborating with 2Excel Aviation on data collection. For 2Excel's remote sensing team, spring is often a time for pilot training and instrument calibration and so they were able to use these test flights to generously supply the very high-quality aerial imagery used within Rob's project. A single flight campaign over a 420-hectare section of Gwydir Forest near Betws y Coed in Snowdonia National Park yielded hyperspectral imagery containing hundreds of spectral bands across the visible and infrared regions (images above). In combination with field surveys which gathered reference samples of affected trees, the data is being analysed using the latest machine learning models to accurately and comprehensively map disease severity across the study area. The research is also attempting to calculate the spectral reflectance of stress in larch trees which could aid future studies of forest pathology and demonstrate how land managers can potentially obtain valuable overviews of the health of their forests.

With today's rapid and worrying rates of environmental change, we believe that exploiting advances in technology is vital if effective and truly sustainable natural resource management is to be realised. Although it could be argued that it is forms of our technology that is driving environmental decline, if such tools are used to form a more detailed understanding of landscape scale disturbances, then more targeted and nuanced responses can channel resources to where they can be most effective.

Above left: Airborne hyperspectral imagery can provide detailed spectral information on individual canopy trees. Photo: Robert Taylor

Above right: Spectral bands can be combined to highlight areas of interest within the forest. Photo: Robert Taylor

@Henfaes

The beginning of a 4-year Global Challenges Research Fund project @soilplastics started this year at Henfaes. The project is looking at the effect of agricultural plastic legacy on soil health and food security. Currently, a field trail is running at henfaes to compare the nitrogen use efficiency of maize grown on synthetic and biodegradable plastic films.

Dr David Shaw (Sarvari Research Trust) and Dr Katherine Steele (School of Natural Sciences) continue to collaborate on the breeding of blight and virus resistant potatoes that can be grown without fungicides. New disease resistant hybrids have been field-trialled at Henfaes since 2018, taking advantage of the Henfaes climate that favours severe outbreaks of late blight of potato each summer. The best resistant clones from the field at this time of year are commercialised in partnership with the Sarvari Research Trust with new varieties continually in the pipeline.

Henfaes continues to provide Zoology undergraduates with the opportunity to gain experience in animal husbandry. We have just welcomed three pedigree Zwartbles sheep to our teaching collection alongside the alpacas, and look forward to expanding our flock next spring. Henfaes will be central to the delivery of the new Zoology with Animal Management degree in 2022, and we are currently developing some exciting practical sessions to encompass many elements of livestock management and transferable husbandry practices.

Moving into Autumn we have recently completed the early September gathering of the hill flock and have selected the ewe lambs to be retained as replacements. The remaining lambs are being sold as store lambs, which have been achieving a good price recently. The intention is to gather the mountain later in October to clear the Aber & Llanfairfechan Common, in accordance with the management agreement the graziers have with Natural Resources Wales. Our 2021 wool clip has just been collected, though renumeration for the 2020 clip (payment is provided one year in arrears) is somewhat disappointing, an issue common to all in the sheep sector. The value of 2200 kg of fleece was nowhere near enough to offset shearing and haulage costs. Gone are the days where the wool clip would provide the lion's share of a farm's