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scrr

Scottish Consortium
for Rural Research

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www.scrr.ac.uk

PICTURE: NATIONAL TRUST FOR SCOTLAND



This issue in numbers

Woodland represents **13.5%** of UK land area – **page 2**

Damaged peatland caused **15%** of Scotland's carbon emissions in 2022 – **page 3**

More than **400** specialist species thrive in woodland – **page 3**

There are currently **34** landscape restoration initiatives supported by UK CEH staff – **page 2**

About **72,000** species living in the UK and Ireland will have their genome sequenced – **page 7**

Things we can learn from the past

Dr Nick Fraser, Keeper of Natural Sciences, National Museums Scotland, describes a link between yesterday's countryside and the future

SITTING IN A FIELD on a warm summer's day, the air full of industrious insects active among and above the grasses, cowslips, clover and bird's foot trefoil – this is a fond memory I have as a child growing up in the countryside. In those days, a long summer drive in the family car was not complete without cleaning the front bumper, grill and bonnet of the plastered remains of unfortunate flying insects. But such memories seem to be just that – distant memories.

These days the impact of climate change and the biodiversity crisis point to a different 'normal'. Now my insect encounters are all too frequently painful rather than joyful. The clouds of insects I encounter in my field work today are more likely to be low in diversity

– midges in the western Highlands or assassin bugs and horse flies in a quarry in the eastern United States!

So on a recent late summer visit to the National Museum of Rural Life at Kitchside it was heartwarming to find myself transported back to my childhood. Sitting on a small promontory in Coronation Meadow towards the north side of the property, I experienced the charm of my childhood listening to the bees, wasps and flies constantly buzzing past my face as I watched the cattle grazing in the adjacent field.

The Museum is associated with a working farm, Wester Kitchside, and the property is a unique partnership between the National Trust for Scotland (NTS) and National Museums Scotland.

Above: meadow at Wester Kitchside, a farm attached to the National Museum of Rural Life

It is set in the gently undulating countryside of South Lanarkshire only 30 minutes from Glasgow. The farmhouse belonged to the Reid family for more than 400 years before it was left to the NTS by James Coats Reid and his wife Margaret. So why was I transported back to a time when flying insects were much more abundant?

Interestingly, the site captures farming practices from the 1950s and the land has not been subjected to

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About SCRR

THE SCOTTISH CONSORTIUM FOR RURAL RESEARCH exists to promote sharing of ideas and techniques among a group of organisations active in research into land, freshwater, coastal and marine resources, and their uses.

Our member organisations have bases throughout Scotland and are at work all over the world: further details can be found on the back page.

Members' reports

Forest Research

From page 1

modern agricultural methods. The evidence of ridge and furrow ploughing is still clearly visible in some of the fields towards the northern side of the property. It is up in this region that the Coronation Meadow is located, and it is one of the best examples of unimproved grassland in central Scotland.

If left unmanaged, a problem with any early successional stage habitat can be a build-up of soil nutrients. These extra nutrients will ultimately allow more aggressive invasive plant species to establish and thrive. To counteract this, from late September to March, Aberdeen Angus graze in the meadow. Their activities help to remove nutrients so that they aren't recycled back into the soil: sustainable farming alongside rich biodiversity. The result is an amazing gem of biodiversity that is rare in Scotland.

But there is so much more: the extensive hedgerows and dry-stone dykes offer habitat and overwintering sites for a variety of life. These features, along with the deciduous woodland behind the museum building, offer opportunities for training in traditional rural skills and land management

At the end of September 2024, a group of SCRR members visited and experienced various aspects of the site. With Vicky McClean (general manager) and Ritchie Young (farm manager) as our expert guides for the day, we had a remarkable visit.

The working farm is home to Ayrshire, Aberdeen Angus and Highland cattle, Tamworth pigs, sheep, hens and Clydesdale horses. The farmhouse kitchen garden and the milking byre were big hits with



PICTURE: VICKY MCCLEAN, NATIONAL MUSEUM OF RURAL LIFE

Extensive hedgerows provide habitat at Wester Kitchside

the group. In the museum itself, the visitor can discover 300 years of Scottish rural history and see Scotland's largest collection of tractors, combine harvesters and other farming machinery. It was quickly apparent that some members would have dallied here out of the blustery weather for much longer! But ultimately, the positive effect of the outdoors on mental health and wellbeing was readily apparent – we had the most uplifting day!

There is perhaps a unique opportunity for members of SCRR to work together in this rural community. These opportunities could include

training students in biodiversity monitoring and developing and managing the woodland habitat. Or perhaps training in traditional skills, such as building dry-stone dykes or hedges. But perhaps of overriding significance, there is a glorious opportunity to be able to engage directly with the public on matters of rural affairs.

Please get in touch with Vicky McClean (v.mcclean@nms.ac.uk), Lee Innes (innes@moredun.ac.uk) or Nick Fraser (nick.fraser@nms.ac.uk) if you would like to learn more

Forestry Facts and Figures 2024 is published

FORESTRY FACTS AND FIGURES 2024 is the latest edition of the annual summary of forestry statistics compiled by Forest Research on behalf of the forestry authorities in England, Wales, Scotland, and Northern Ireland.

It gives information on woodland area and cover, timber and wood products, imports and exports, economics, employment, woodland visits and the environment.

Key findings show:

- **There are now 3.28 million hectares of woodland in the UK (as of March 2024)**

- **Woodland area in the UK now represents 13.5% of total land area**
- **20,660 hectares of new woodland were created in the UK in 2023/24**
- **There was a 59% increase in new planting and 28% increase in restocking in the UK in 2023/24**
- **57% of softwood produced in 2023 came from private sector forests**
- **Around 21,000 full-time equivalent staff were employed by the forestry sector in the UK in 2022**

The UK Statistics Authority has designated these as Accredited Official Statistics in accordance with the Statistics and Registration Act 2007 and signifying compliance with the Code of Practice for Statistics.

The full 2024 publication, including details of the sources used and downloadable spreadsheets of data, can be found on the Statistics section of the Forest Research website at www.forestresearch.gov.uk/tools-and-resources/statistics/forestry-statistics/ and is also available from the UK Government site, www.gov.uk

New flux tower in southern Scotland joins network

Funded by NatureScot's Peatland ACTION programme, the tower will monitor carbon during peatland restoration

THE SOUTH OF SCOTLAND is joining a national network of flux towers that spans the country, with this unique project allowing greenhouse gases to be measured as the land changes from its current commercial forestry crops to restored peatland.

Peatlands are recognised as vital carbon stores and are the largest terrestrial store of carbon in the UK. However, according to the GHG Emissions Inventory, damaged peatlands were responsible for over 15% of Scotland's total carbon emissions in 2022. Understanding how Scotland's land stores or releases these gases is key to reducing carbon emissions.

Information from the flux tower, which has been funded by NatureScot Peatland ACTION, will help fill critical gaps in the understanding of greenhouse gas emissions from peatlands in different conditions. The data will also help inform the Peatland ACTION Programme on the

effectiveness of peatland restoration measures and evidencing how to best manage existing peatland carbon stores in the future – ultimately helping the nation reach its net zero ambitions.

The 14-metre flux tower sits within a commercial forestry crop planted upon deep peat soil 24 years ago. Critically, the tower will be the first to measure carbon dioxide and methane from the site as the trees grow, reach maturity, and are felled, to see how emissions change as the land is restored back to open peatland.

Data from the flux tower's instrumentation will be pooled with data from a national network of flux towers in Scotland (SCO2FLUX) and shared openly with key stakeholders in peatland restoration and forestry management through the UK CEH Environmental Information Data Centre.

Updates on the project will be shared on the Crichton Carbon Centre website at www.carboncentre.org/flux-tower



Instrumentation for the new tower is set up by researchers from the James Hutton Institute and Crichton Carbon Centre

PICTURE: CRICHTON CARBON CENTRE

PUBLISHED IN OCTOBER 2024, the Forest Research Rapid Review of Evidence on Biodiversity in Great Britain's Commercial Forests considers what is known about most common types of 'high forest' in Great Britain.

Nadia Barsoum, Senior Biodiversity Scientist at Forest Research explains: 'Forests where trees can attain their full canopy heights and reach mature stages of development are known as high forests.'

'In Great Britain, a significant proportion of these forests are managed in a commercial capacity for timber and wood-based products and comprise conifer, broadleaf or conifer-broadleaf mixtures. The review is needed to understand the contribution of these forest types to biodiversity and to identify gaps in understanding.'

The first part of the publication uses expert knowledge of the habitat requirements of more than 400 woodland specialist species to predict whether commercial high forest has the potential to offer suitable habitat for at least one stage of the lifecycle of each of those species.

The second part of the publication is a summary of published research

Biodiversity in Britain's 'high forests'

Forest Research's Rapid Review has been finding out whether mature forests can offer a habitat for 400 specialist woodland species



Blue fungus and moss on a pine

(from 1970 to 2020) reporting on biodiversity in commercial forests in Great Britain. The review concludes

that there may only be enough research evidence to answer specific research questions about biodiversity in commercial high forests for certain broad taxonomic groups (such as birds, ground vegetation, carabid beetles).

It also predicts, based on the findings related to habitat requirements and expert knowledge, that commercial forests can potentially accommodate many specialist woodland mammals, birds, amphibians and reptiles, some woodland specialist fungi and vascular plants, but few specialist invertebrates, lichens and bryophytes.

In addition, the review highlights gaps in evidence and provides some recommendations for future research areas to focus on and methodological approaches that might be used to fill those gaps.

The review was conducted by Forest Research and funded by the Forestry Commission.

Read the Rapid Review of Evidence on Biodiversity in Great Britain's Commercial Forests in full on the Forest Research website at www.forestresearch.gov.uk/publications/biodiversity-commercial-forests/

Members' reports

Forest Research, UK Centre for Ecology and Hydrology

Ways to mitigate the risk of wind damage within planted woodlands

ForestGALES from Forest Research is a decision support tool designed to help forest managers to make choices that will protect their trees in an increasingly unstable climate

WIND STORMS CAUSE major disturbance in both natural and managed forests. For the forest industry, wind damage results in a loss of income due to unanticipated and increased harvesting costs and the loss of timber. After catastrophic wind damage, the ability of forests to deliver important ecosystem services such as timber provision, carbon sequestration, slope stability, water quality and recreation is severely impaired.

These are particularly serious concerns because wind damage to forests in Britain and Europe has increased over the past century and climate change is expected to exacerbate this situation. However, management choices can mitigate the threat.

ForestGALES is a computer-based decision support tool developed by Forest Research to assist forest managers in making decisions about how to mitigate the risk of wind damage within planted forests. It provides estimates of the probability of wind damage for coniferous and broadleaf stands in Britain and compares the impact of different forest

management options on this risk. Since 2000, ForestGALES has been the recommended tool for assessing wind risk and is widely used in the forest industry across the UK.

The decision support tool has developed over the last 25 years by incorporating the latest scientific knowledge and real-world evidence of wind risk. Collaboration with partners from many different countries, including France, New Zealand, Sweden, Canada, Italy, Japan, Norway, and via the International Union of Forest Research Organisations (IUFRO), has been critical. This collaboration, and the adaptation of the tool for use in other countries, continues as the ForestGALES model evolves.

For further information on ForestGALES see the Forest Research website at www.forestresearch.gov.uk/tools-and-resources/fthr/forestgales/ or contact Dr Tom Locatelli, Senior Climate Change Scientist, Forest Research

Below: research work on tree damaged by wind in a specific type of location



How trees, woods and forests adapt to new conditions

A project involving Forest Research and the UK Centre for Ecology and Hydrology looks at whether species can cope with their changing environment

ARE SCOTLAND'S TREES, woods and forests capable of adapting fast enough to a changing environment? If not, and they need our help, how should we intervene when the future is uncertain? These questions are being explored by a multidisciplinary team of nine partners through the newLEAF project, led by Dr Stephen Cavers at the UK Centre for Ecology & Hydrology, using a combination of historical data, experimental work and modelling.

The three-year project is funded primarily by the UKRI's 'Future of UK Treescapes' programme. Geneticists, social scientists and pathologists from Forest Research are contributing to most of the project's work packages, and also leading novel historical research into the sources of British

Above: trees in a southern English pine wood, adapted to a warmer climate



PICTURE: ELLIS GARNEY VIA UNSPLASH

EARLY CAREER RESEARCHERS

Our trees and the places where they live

Krisztian Nemeth is a research associate at the UK Centre for Ecology & Hydrology investigating genetic diversity and resistance to disease in plants, especially trees, as well as working at a larger scale on landscapes and habitats



UNDERSTANDING GENETIC DIVERSITY and the adaptive potential of plant populations has become increasingly critical as threats from climate change, pathogens, and anthropogenic pressures intensify.

Before my current role as an ecological geneticist research associate at the UK Centre for Ecology & Hydrology, I conducted my MSci research project at the Gregor Mendel Institute of Molecular Plant Biology (GMI) under the guidance of Dr. Kelly Swarts. My study focused on genetic diversity in maize landraces across the Americas and examined the levels of adaptive introgression from wild maize populations into high-elevation landraces.

In my current position, I investigate genetic diversity, gene flow and adaptation in plant species, particularly European temperate trees such as Scots Pine and Oak spp.

Additionally, I study various endemic plant species from St Helena, aiming to enhance our understanding of genetic diversity within fragmented and endangered populations.

I assist in projects collaborating with Natural England and Trees for Life to identify native pine woods beyond the Caledonian pine woods. This work involves sample collection, DNA extraction, genotyping and analysis to determine whether these populations are genetically distinct or have historical connections to Caledonian pinewood sources.

Moreover, I am involved in projects assessing the health of Scots pine and its resistance to pathogens such as *Dothistroma septosporum*. We conduct bioassays using tissue collected from multisite provenance trials to characterise the disease ecology and ascertain if resistance is genetically determined.

As a field botanist, I contribute to the Countryside Survey Project, a long-running national monitoring scheme that evaluates changes in vegetation

communities and soil chemistry across fixed plots in the UK.

Recently, I joined two Defra projects. The first aims to evaluate methods for assessing the risk of invasion from novel tree species planted at scale, supporting decision-making and risk management. The second project assists 34 landscape restoration initiatives, with a team of seven or eight UKCEH staff members, ensuring rigorous baseline monitoring and evaluation across various habitats, species and environmental attributes.

The work involved in these projects is distinct from my previous experiences and I am eager to acquire new skills while collaborating closely with stakeholders and policymakers.

Below: Krisztian Nemeth is assessing native pine woods outside Scotland



tree seed over the last 100 years to understand the implications for the resilience of British treescapes. The wider context of decision-making under uncertainty is explored through a new 'verbatim theatre' play, *Three Words for Forest*, directed by Dr Rachel Clive at Glasgow University and co-designed with social and natural scientists and forestry stakeholders.

As the research nears an end, early results indicate that some tree species do have the capacity to adapt fast – in the space of a single generation – to new environments. This finding supports the case for working with nature, for example by encouraging natural regeneration, so that the woods themselves can respond in the most appropriate way to optimise their survival.

The team is now finalising data and applying models to explore adaptive potential in more tree species and under a wider range of changing environments, and preparing guidance to support forestry policy and practice.

To learn more about the project, please visit the project's page on the UK Treescapes website at www.uktreescapes.org/projects/newleaf/ or contact Stephen Cavers, scav@ceh.ac.uk or David Edwards@forestresearch.gov.uk

Members' reports

Society of Antiquaries of Scotland



PICTURES: © TOM OVENDEN

Left and above: extracting a tree-core from a Scots pine (*Pinus sylvestris*) in an experimental forest in Scotland

New archaeological research framework shows potential of trees for more than dating

Dr Helen Spencer, head of research at the Society of Antiquaries of Scotland, describes the Society's new dendrochronology research framework, which goes beyond the familiar ring-width dating to reveal insights into past forests

A NEW THEMATIC research framework has been launched by The Society of Antiquaries of Scotland as part of their Scottish Archaeological Research Framework project.

The Dendrochronology Research Framework for Scotland is a collaborative project created in association with AOC Archaeology Group, Dendrochronicle, Forest Research, the University of St Andrews and Swansea University.

Dendrochronology has many applications both within and beyond cultural heritage, not just as a method of dating wood, and this Research Framework embraces the wider applications of tree-ring science to include sections on dendroclimatology, dendroecology and dendro-isotopes as well as sections on dendrochronology in archaeology, standing buildings and landscape history.

A wide range of clients and researchers can benefit from the application of dendrochronology in their projects, whether in cultural

heritage or environmental fields of interest. Dendrochronology provides date, source and species information that contributes to the better understanding of individual heritage structures. Conventional ring-width dendrochronology can even sometimes provide a felling date of a tree used in a

Below: ceiling at 302 Lawnmarket, Edinburgh, with beams made of Norwegian pine felled in AD 1591



building to a specific year, while timber provenancing can tell us where the timber came from and therefore more about the history of the trade of wood. Knowing the original source of timber is also important to inform like-for-like timber replacement in conservation repair work.

Newer dendrochronological methodologies first developed for climate-based applications – for example, using stable oxygen isotopes or blue intensity parameters – now offer complementary approaches. Dendroecology has helped to reshape our understanding of how trees and forests function and ecological systems they are part of develop and change through time.

Understanding how these ecosystems have responded to stressful events in the past, in turn will allow us to plan more effectively to meet these challenges in the future.

The framework summaries this wide range of applications of dendrochronology in Scotland, highlighting recent developments, areas of good practice and some recent case studies. There is also a series of key research questions and recommendations that should help guide the development and application of dendrochronology in the future.

The project was funded by Forestry and Land Scotland and Historic Environment Scotland.

The framework is available online at scarf.scot/thematic/dendrochronology/ and also as a free booklet by contacting the Society of Antiquaries of Scotland

PICTURE: © AOC ARCHAEOLOGY GROUP

Unlocking the secrets of Scotland's favourite plants

Researchers from RBGE are gathering data from the country's most interesting and important specimens



SCIENTISTS ARE UNLOCKING the genetic secrets of some of Scotland's favourite plant species – a breakthrough that will bring a greater understanding of biodiversity across Britain and Ireland – thanks to experts at the Royal Botanic Garden Edinburgh and partners in the Darwin Tree of Life (DTOL) project.

The ground-breaking initiative aims to sequence the genomes of all 72,000 plants, animals, fungi and other living organisms across the UK and Ireland.

The team in Edinburgh is tasked with identifying and collecting material from native species including Scottish beardmoss, rowan and wych elm. Specimens are then coded by colleagues in the project led by the Wellcome Sanger Institute.

The complex process is now gathering pace, with data being made freely available to other researchers.

Earlier this year, scientists at the Scottish research institute collected samples for sequencing from an apparently disease resilient elm in

the Borders that had survived the devastating impact of Dutch elm disease. Known informally as the Jedburgh Giant, geneticists at RBGE are currently propagating the tree with other mature elms with the hope that they can rear 'super survivors'.

The Jedburgh Giant is just one plant with a colourful tale to tell whose genetic history the team at the Royal Botanic Garden Edinburgh have been helping to unravel.

The Scottish beardmoss (*Bryoeithrophyllum caledonicum*) was unknown to science until 1982, when the organisation's Dr David Long named it *caledonicum* in homage to the nation. Native only to Scotland, it is found largely in the highlands and islands.

A lonely rowan (*Sorbus aucuparia*) in the Scottish Borders survived predation by sheep and became known as The Survivor Tree of Carrifran. Awarded Scotland's Tree of the Year 2020, and a finalist for Europe's Tree of the Year 2021, it is now surrounded by its progeny and by thousands of other

native trees, thanks to the Borders Forest Trust.

David Bell, sample coordinator for the Darwin Tree of Life at the Royal Botanic Garden Edinburgh, said: 'Compared to humans, many plants have surprisingly large amounts

'As an open resource for the scientific community, the knowledge we are gaining of how plants adapt in the face of environmental change will have practical applications right across society – including how we manage threats to our agricultural crops'

of DNA, making their sequencing extremely complex. At a time when so many species are under threat from climate change, pests and diseases, the DTOL programme has never been more important.

'As an open resource for the whole scientific community, the knowledge we are gaining of how plants adapt in the face of environmental change will have practical applications right across society – including how we manage threats to our agricultural and commercial crops.'

Professor Mark Blaxter, programme lead for the DTOL at the Wellcome Sanger Institute, commented: 'It is great to see high-quality genome sequences released for these plant species. The beardmoss is an iconic Scottish endemic, and the elm and the rowan we sequenced are famous individual trees with a rich history and public following.

'The Darwin project has allowed us to shine a light on these species, and provide data that will be important for conservation and ecology. The British and Irish flora is rapidly becoming the best studied in the world in terms of genome data.'

For more on this story from RBGE, see www.rbge.org.uk/news/articles/unlocking-the-secrets-of-scotland-s-native-plant-species/ and for details of the Darwin Tree of Life project from the Wellcome Sanger Institute, see www.sanger.ac.uk/collaboration/darwin-tree-of-life-project/

Andy Griffiths takes a sample from *Sorbus aucuparia* at Carrifran in the Scottish Borders

Members' reports

Roslin, University of Edinburgh

EARLY CAREER RESEARCHERS

Data and modelling as ways to protect animals from disease

Dr Chris Banks is a core scientist and research fellow at the Roslin Institute working on machine learning models to support animal health and reduce disease transmission

I AM A COMPUTER SCIENTIST and computational/mathematical modeller and currently a core scientist and research fellow at the Roslin Institute, University of Edinburgh. I work within the group of Prof Rowland Kao. Over my career, my research has focused on the computational modelling of systems to help improve the understanding of the natural and synthetic world.



and how the creation of new woodland may be bringing wild deer populations closer to cattle herds.

We use an economic model to determine which areas of land are likely to be forested, then a species distribution model to decide where wild deer populations

are likely to grow and how these new populations come into contact with agricultural holdings. In a test area of Dumfries and Galloway we find that contact risk between deer and cattle could be increased by over 25%.

I also work on a number of smaller projects within animal health and bioscience including: deep learning for diagnosing disease in small animal CT scans; using deep learning to identify and time developmental stages in chicken embryos; using models to quantify the effect of climate or land use changes on disease transmission and genetics; and various applications of large models of bovine TB transmission in the UK and avian influenza in US cattle.

Prior research on COVID-19 transmission modelling contributed to the response to the pandemic.

More information is available from Chris Banks's website, banks.ac/

My current research focuses on developing veterinary epidemiological models for UK agricultural disease. This includes computational modelling of disease transmission based on real-world scenarios, as well as analysis for understanding risk factors and the mitigation of disease spread.

I am currently working on two larger projects. One project is on machine learning models for improving disease diagnostics. Here we incorporate information on epidemiological and environmental risk factors into the interpretation of diagnostic tests using machine learning models. This has two benefits: improved herd-level accuracy of test and the ability to identify the risk factors that have greatest impact.

This has been applied to bovine TB skin testing, where we have shown around a 12% increase in herd-level test sensitivity on historical data.

I am working on further applications, including diseases where there are fewer regulations around testing, like BVD. In these situations, I hope that the use of machine learning augmented testing could be trialled in the field.

My second larger project is on combining land use statistics, economic models of land use change, and species distributions to estimate infectious disease risks due to land use and climate change. Here we are looking at the change in land use due to the provision of forestry subsidies,



Benchmarking su free-range laying

Well-bred hens seem to be the key, Agriculture and Food Systems, Univ

CONSIDERING THE NEED to nourish a growing human population while tackling multiple environmental and social challenges, it is important to evaluate the relative performance farming systems based on an array of sustainability objectives.

Researchers from the Global Academy of Agriculture and

'Differences among farms with similar production systems were likely due to laying hen breed and unmeasured human factors ... breeds with balanced genetic merit will play an important role'

Food Systems benchmarked the sustainability performance of 80 UK free-range laying hen flocks. They used the linear programming technique 'Data Envelope Analysis' to assign multi-criteria scores to the flocks, based on environmental, animal welfare, antimicrobial use, and production metrics.

Below: deer can come into closer contact with cattle when land is forested



PICTURE: CHARLES J SHARP VIA WIKIMEDIA



PICTURE: THEGREENU VIA WIKIMEDIA

Sustainability in hen flocks

reports the Global Academy of
University of Edinburgh

Some flocks achieved superior performance across multiple sustainability objectives. Differences in scores among farms with similar production systems were likely due to laying hen breed and unmeasured human factors.

The authors conclude that breeds with balanced genetic merit will play an important role in food systems seeking to mitigate externalities of production.

In addition, they demonstrate use of this methodology in deriving balanced sustainability metrics for farming systems including the neglected measures of animal welfare and antimicrobial use.

They propose that this method could be used to incentivise best practice within supply chains or government schemes.

Higham, L.E., Handel, I., Boden, L., and Moran, D. (2024) Benchmarking sustainability performance in UK free-range laying hen flocks. *Agricultural Systems* 221: 104103. doi.org/10.1016/j.agsy.2024.104103

Sustainability performance was assessed within 80 UK laying hen flocks

EARLY CAREER RESEARCHERS

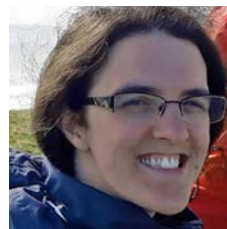
Resistance to treatments for worms and mites in sheep

Jennifer McIntyre is a research associate at the University of Glasgow working on the genetic basis of resistance to ivermectin and moxidectin in parasites of sheep

RESISTANCE TO IVERMECTIN and moxidectin is a problem with parasites of sheep – particularly the worms *Teladorsagia circumcincta* and *Haemonchus contortus*, and the sheep scab mite, *Psoroptes ovis*.

Anthelmintic and acaricide resistance are challenging issues for small ruminant farmers today and threaten sustainable sheep production. The macrocyclic lactones, which include the broad spectrum endectocides, ivermectin and moxidectin, are particularly useful, but resistance is steadily developing and they need to be carefully used.

Working with Steve Doyle at the Wellcome Sanger Institute, Jennifer has made a new chromosomal genome assembly for *T. circumcincta*, a major step in identifying the genetic basis of anthelmintic resistance. They then explored three different analyses, finding a locus on chromosome 5 to be under selection by ivermectin.



Working with Roz Laing at the University of Glasgow, Jennifer researches the genetic basis of macrocyclic lactone resistance in *H. contortus*, looking particularly at sub-optimal treatment selection pressures.

Finally, in a collaboration led by Stew Burgess at the Moredun Research Institute and involving both Glasgow and the SRUC, Jennifer is starting work on the genetic basis of macrocyclic lactone resistance (particularly moxidectin) in *P. ovis*.

‘The macrocyclic lactones, which include the broad spectrum endectocides, ivermectin and moxidectin, are particularly useful, but resistance is steadily developing and they need to be carefully used’



PICTURE: KREUZSCHNABEL VIA WIKIMEDIA

Resistance to common treatments for parasites is a problem for sheep farmers

Members' reports

University of Edinburgh



PICTURE: KAMCASEDL VIA WIKIMEDIA

What are the implications for sustainability of feeding pets?

Is meat in pet food a problem for sustainability?

John Harvey and Dr Peter Alexander of the University of Edinburgh are researching the complex topic of animal by-products in pet food and its environmental implications

PETS EATING MEAT that would otherwise be destined for human consumption increases the overall demand for meat and therefore has a substantial environmental footprint. However, if pets eat parts of meat carcasses not consumed by humans, is this also an environmental challenge?

Studies of the diets of dogs going back to the bronze age have shown that what man's best friend eats is closely entwined with human diet. The nutritional requirements of dogs have adapted to what parts of animals, fish or plants are available – often as scraps or potential waste material.

This continues today, as modern production of pet food relies heavily on animal by-products (ABPs), which are the parts of the animal carcass less used in the human food systems, such as offal, trimmings, and fat.

The historic integration of the food system for dogs with the human food system was due to resource availability. Now, this integration is critical in understanding and hopefully reducing the climate and ecological impacts of feeding pets. Given the environmental impacts associated with meat production, it is essential that all parts of the produced animals are best utilised so that livestock production can be minimised.

To fully understand the environmental implications of using ABPs in pet food, it is important to consider what would happen if they were not used in pet food. This involves examining the potential changes in the food system and the environmental impacts of alternative uses.

For instance, if ABPs would otherwise be incinerated as waste, with minimal effect on the number of animals raised for meat, their use in pet food could be beneficial. Conversely, if the use of ABPs in pet food supports increased meat production, the environmental impacts could be increased. However, due to the wide-ranging potential uses of ABPs, we do not yet have assessments of the consequences of different use patterns.

It is also important to understand how emissions for different animal products are calculated. Traditionally, the 'gold standard' Life Cycle Assessment approach assigns environmental impacts to different carcass portions based on their relative economic value, assigning a lower environmental impact to ABPs than higher value meats. This recognises that all cuts contribute to the value of farming, but that higher-value products tend to drive the industry. Some studies however may allocate emissions

differently – for example, by mass, where the impacts of 1kg of prime steak and 1kg of intestines are judged as equal, whereas it seems unlikely the demand for intestines drives livestock production. The difference between estimates using these two different approaches can be tenfold.

This is critical, because the assumption that alternative protein sources – for example, plants, insects, or lab grown meat – are more environmentally friendly will often differ between the different allocation approaches. It will also alter the difference in impacts between pet food formats: dry food typically contains more animal by-products, whereas many wet foods, grain-free foods and approaches such as raw feeding may include more meat of types that humans would consume.

Many models that assess likely future human diet scenarios anticipate ongoing increases in meat production. However, this does not guarantee availability of ABPs for pet food as competing demands, such as biofuels, are already causing challenges for manufacturers. This seems a concerning practice.

EU and other organisations have developed 'hierarchy' approaches to managing potential waste for best environmental outcomes. These approaches consider that the preferred

'EU and other organisations have developed 'hierarchy' approaches which consider that the preferred option for animal by-products would be as human food, followed by animal food – energy recovery is the least preferred option'

option for ABPs would be as human food, followed by animal food; energy recovery is the least preferred option except for disposal.

The waste hierarchy approach does raise one important preferred option: could humans be encouraged to eat more of the 'non-prime' meat cuts?

The above discussion highlights a range of ongoing debates in what is a relatively under-researched area.

An area of little disagreement is that use of meat in pet food should not compete with human food. Regardless of the allocation approach taken, use of prime meat that would otherwise be eaten by humans is likely to have very high environmental impacts.

As societies globally aim to adjust to the challenges of rapidly reducing emissions, wider discussion of what type of meat should be eaten by pets must not be avoided.

EARLY CAREER RESEARCHERS

Natural antimicrobials in dairy farming

Xinyi Huang is a postdoctoral researcher at Moredun working on a project to reduce the use of antibiotics in dairy cattle by adding treatments based on natural extracts from wine industry by-products

MY BACKGROUND IS in veterinary medicine and I came to Scotland five years ago to study for my PhD at the University of Glasgow. I studied the pathogenesis of acute virus infection, Bluetongue virus and SARS-CoV-2, using experimental infection animal models. My scientific interest involves host-pathogen interactions and the pathogenesis of animal diseases.

Scotland holds a special place in my heart: I am deeply impressed by its stunning landscapes and admire its dedicated efforts to preserve its natural beauty. I am particularly passionate about Scottish farming industry; hence I currently work as a postdoctoral research scientist at Moredun Research Institute, surrounded by scenery of the Pentland hills.



Xinyi Huang is currently working on pathogens in dairy cattle



At Moredun, I am working on a project with practical applications. The EU Horizon 2020-funded project NeoGiANT aims to develop and validate economically and environmentally sustainable natural formulations using wine-making by-products rich in polyphenols. These have the potential to reduce the dependence on antibiotics in the farming industry, a significant step towards sustainable farming.

We have already made progress, having performed a challenge trial to validate a formulation for intramammary treatment against major bovine mastitis pathogens *Streptococcus uberis* in dairy cattle, and a feeding trial to assess the in-feed performance of the formulation in calves.

SCOTTISH SHEEP FARMERS have reported growing concerns about the potential role of badgers in killing lambs. However, attacks are rarely witnessed and interventions to reduce future predation risk must be evidence-based.

Science and Advice for Scottish Agriculture (SASA) led research to assess the perceived role of badgers in lamb predation in partnership with NatureScot, National Farmers Union Scotland and Scottish Land and Estates. The project was supported by the veterinary services of Scotland's Rural College (SRUC) and the Royal Veterinary College, London.

Twenty-seven farms across Scotland volunteered to take part and all participants suspected they had previously lost lambs to badger predation. The study used a questionnaire to better understand why farmers suspected that badgers were the culprit.

Most stated that they associated particular wound patterns with badger predation, including stripped carcasses and head removal. Others suspected that badgers may be to blame if there were badger signs nearby, such as sett entrance, footprints or hair.

Post-mortem examinations (PME) confirmed if predation was the cause

Collaborative approach solves lamb mystery

A joint project led by SASA investigated reports of lamb predation on Scottish farms that were thought to involve badgers



Lambs are at risk of predation with foxes the main culprit

of death or if the carcass had been scavenged after death. We also categorised wounds most associated with predation versus scavenging. Predation was confirmed in 48 per cent of lambs. Thirty-one percent were

scavenged after death and predation could not be ruled out for the remaining 21 per cent. Puncture wounds to the head, neck or throat were associated with a predation incident, while other wounds, including a stripped carcass and organ, head or limb removal, occurred after death during scavenging activity.

DNA analysis then determined which species had been in contact with the carcasses. Fox DNA was present on 87 per cent of the lambs, including all of the lambs exhibiting evidence of predation. Badger DNA was detected on 5 per cent of lambs but not on any for which predation was confirmed.

We did not attempt to quantify the contribution of predation to overall lamb losses, but average losses due to predation are considered to be low. However, where lamb predation does occur, the results of this study suggest that foxes are the most likely culprit. The study highlights the value of a collaborative and inter-disciplinary approach to confirm predation events and to identify predator species, informing livestock managers and their management decisions.

Read more here: doi.org/10.1002/2688-8319.12370

Members' reports

National Museums Scotland

EARLY CAREER RESEARCHERS

What is the role of farming in 21st century Scotland?

Erik Crnkovich is a PhD student in social anthropology at Durham University. He is conducting fieldwork in lowland Scotland to understand how farm diversification is reshaping farmer identity, or 'what it means to be a farmer'

HOW WE ENVISION farming drives at the role of the countryside in society; it encapsulates our relationship with the environment, food, heritage, health, rural and urban populations. Getting the future of agriculture right, therefore, depends on a flexible and people-friendly approach to sustainability.

Erik Crnkovich's project aims to diversify our understanding of what a sustainable farm looks like by showing how the values that different farmers bring to their businesses are creating new models of sustainability.

This question is being brought to the fore by Scotland's 'just transition' to net zero and ensuing agricultural policy shifts. A just transition aims to use green economic growth to improve the relationship between farming, the environment, and society. This means



a new subsidy framework rewarding both small changes to equipment, feed and practice, as well as wholesale transformations such as wetland restoration.

While diversification is by no means new, what the farmer's role in society should be – a businessperson, or a steward of the environment or cultural heritage – is increasingly being rethought. As a policy issue, Erik will evaluate the just transition as an instance of sustainable development or neoliberal conservation. Here, existing literature shows that green capitalisation can reproduce the very issues it is intended to alleviate.

As an anthropologist, Erik is interested in the issue of identity. Here, his research explores how an individual's identity relates to their vision of the good life, and further



Below: a farmer's role can be as a businessperson or as a steward of the environment

how they pursue that vision through everyday value-informed practices.

He therefore approaches the farm landscape as a tool for those who live and work there to pursue their aspirations – it is a materialisation of identity, and changes to one entail response from the other.

His PhD is funded by the Economic and Social Research Council. Prior to Durham, he conducted anthropological fieldwork in Fife for an MA (University of St Andrews) and MRes (University of Cambridge) in social anthropology.

In addition to research, he is interested in opportunities to write and present for popular audiences, as well as work with charities and the private sector. He is the director of a community archaeology project at Pittarhie Castle, Fife.

Erik can be contacted at erik.crnkovich@durham.ac.uk



PICTURE: SCOTTISH GOVERNMENT VIA ELICKER

NMS at forefront of 'museomics'

New technology for large-scale, rapid genomic sequencing is up and running, explains Martin Stervander of National Museums Scotland

A LARGE GRANT was recently awarded from the Biotechnology and Biological Sciences Research Council (BBSRC) to build the infrastructure for inexpensive and efficient genetic characterisation based on small tissue samples from historical museum specimens. The new equipment will be installed with the main applicant, the Natural History Museum in London.

National Museums Scotland offered its support in the application as a project partner, which means that we will soon be able to reap the benefits of this technological advance.

At the core, three new pieces of equipment allow the efficient and

automated handling of laboratory reactions at the scale of nanolitres – that is, a billionth of a litre! – and the high-throughput sequencing of DNA.

The approach is to sequence genomic DNA 'randomly' at a scale that produces on average one read at every point in the large nuclear genome. However, the actual target is instead the much smaller genome of the mitochondrion, the powerhouse of animal cells. Luckily, while there are only two copies of the

nuclear genome per cell, there are typically several tens up to a thousand copies of the mitochondrial genome.

All DNA reads that match the mitochondrion can then be 'fished out' and assembled to characterise the whole mitochondrial genome, mapping out which genes are where, and so on. Mitochondrial genes also happen to be the most commonly used genetic markers for molecular identification and play an important part in taxonomy.

NMS will contribute samples from across the animal kingdom and the classical elements to address identification and taxonomic distinctions: for example, field mice from St Kilda, Dupont's larks from north-west Africa, and sea squirts and fungus-gnats from across the Holarctic.



NMS headquarters in Edinburgh

PICTURE: DR OSAMA S MAMIN VIA WIKIMEDIA

Antimicrobial resistance in Scotland's wild swimmers

Improved health is the aim of this project from the Global Academy for Agriculture and Food Systems

AN INTERDISCIPLINARY PROJECT looking into the risks of antimicrobial resistance (AMR) in Scotland's inland wild swimmers is currently under way led by Dr Jess Mitchell of the Global Academy for Agriculture and Food Systems at the University of Edinburgh.

Supported by seed funding from the University of Edinburgh and Moredun Research Institute, the project brings together social scientists, microbiologists, vets and zoologists who have a shared interest in both AMR and the natural world.

Recognising the lack of research and engagement with AMR as a One Health problem, this team wanted to engage communities who frequently spend time in the natural or 'non-domestic' environment as co-producers of new data around environmental AMR. This led us to consider the wild or open water swimming community, particularly those who swim in lochs, rivers and other inland waterways.

Numbers of inland swimmers have increased steadily since the pandemic. However, this is against the backdrop of rising levels of pollution from sewage discharges and agricultural run-off.



Our team are interested to know how wild swimmers perceive these risks and weigh them against the perceived benefits of wild swimming. We also want to collect data regarding popular swimming destinations and etiquette such as kit used and the social dynamics of swimming groups. Swimmers will also identify locations for water sampling and microbiological analyses, which will allow us to explore what AMR microbes are living in popular swimming locations.

Dr Jess Mitchell (left) and fellow open water swimmers

Jess is leading the social science component of this research which includes a survey and focus group discussions to explore how swimmers perceive the risks and benefits of wild swimming in terms of their own health and that of the wider environment and non-human species including wildlife.

Data are currently being analysed but it is interesting to note that many of the common risks include physical rather than microbiological threats, while benefits include a 'connection to nature', even though many swimmers believe swimming could actually be disruptive for nature, especially bird life.

Our focus groups will now unpack the reasons behind such answers and discuss potential links between water pollution, infections and AMR.

After our sampling phase we will share all findings back to our swimming community and discuss the best way to communicate this information *en masse*. We want to be able to share information that is usable and allows informed decision-making without prompting fear. Our ultimate aim is to ensure inland wild or outdoor swimming can be as safe as possible from a One Health perspective.

RESEARCHERS FROM THE University of Edinburgh came together in October 2024 to celebrate the University's Africa Research Day.

The event featured a keynote address by HE Mbelwa Brighton Kairuki, High Commissioner for the United Republic of Tanzania to the UK, who spoke on 'Celebrating Julius Nyerere: A Legacy Built on a Vision of Transformative Education'. The former Tanzanian president is one of the University's most distinguished alumni.

The University's Easter Bush campus had a strong presence, with engaging talks under the theme 'African Research Highlights' delivered jointly by Miss Susan Njambi-Szapka, a PhD student at the Global Academy for Agriculture and Food Systems and the Jameel Observatory for Food Security Early Action, and Dr Musa Hassan, group leader at the Roslin Institute and the Centre for Tropical Livestock Genetics and Health (CTLGH). The session concluded with a dynamic panel discussion.

Africa Research Day

The University of Edinburgh celebrates its efforts to support research work in Africa



A diverse and impressive selection of research posters was showcased during the event. Highlights included Getinet Tarekegn's presentation on 'Africa GENetic Evaluation Service (AGENES): A Pipeline for Routine

The day finished with a panel discussion

Genetic Evaluation', Nishmeet Singh's work on 'Drivers of Food Choice for Fruits and Vegetables in Tanzania', Rebecca Doyle's insights into 'Animal Welfare Priorities in Key Value Chains in Uganda, Ethiopia, and Mali', Erhan Yalcindag's innovative 'Haemobiome: A High-Throughput Diagnostic Tool for Detecting Economically Important Livestock Haemopathogens', Fiona Allan's 'Reproductive Performance of Cattle in Africa – A Systematic Map of Recent Evidence', and a collaborative initiative by SEBI-Livestock, Royal (Dick) School of Veterinary Studies, and University of Edinburgh to support investment in livestock development.

The day was filled with enriching discussions and a delicious Ghanaian lunch, providing valuable networking opportunities for colleagues working on African-focused research. Participants left with a deeper understanding of the University of Edinburgh's ongoing efforts to support and advance research in Africa. We look forward to next year's gathering.

Members' reports

National Museums Scotland

The insect biodiversity of Northern Peru

Vladimir Blagoderov, principal curator of invertebrates at National Museums Scotland, describes a recent expedition to a biodiversity hotspot

NORTHERN PERU, together with southern parts of Ecuador and Colombia, is the richest biodiversity hotspot in the world. Yet very little is known about the insect fauna of the area. For years, collecting efforts concentrated on Southern and Central Peru and the Peruvian Amazon, specifically in the regions of Madre de Dios, Cusco, Lima, and Iquitos.

The biological diversity of Northern Peru is influenced by the historical geology and geography of the area. The vast landscapes in the Amotape-Huancabamba depression serve as a transition zone between the northern and central Andes, as well as between coastal regions of Peru and the Amazon. This area includes seven out of nine forest ecoregions found in Peru.

It is also one of the most densely populated areas in the country. The fertile land in secluded valleys has attracted human settlers for thousands

'More than 25,000 specimens of insects were collected, including dozens of new species'

of years. Recently, with a significant increase in migration out of higher Andean regions, deforestation and biodiversity loss have become the most pressing issues.

In March-May 2024, an expedition was organized by National Museums Scotland in cooperation with the Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, and led by Vladimir Blagoderov, principal curator of invertebrates at NMS. The expedition conducted 90 collecting events across the departments of Amazonas, Cajamarca, Loreto, and San Martín.

Insects were collected in five different ecoregions: Eastern montane Cordillera Real, Marañón dry forests, Peruvian Yungas, Ucayali humid forests, and Iquitos-V-rzea.

Particular attention was paid to Private Conservation Areas (ACP) and local communities, explaining the importance of insect monitoring in biodiversity conservation projects.



More than 25,000 specimens of insects were collected, including dozens of new species. For example, fungus gnats (*Diptera: Sciaroidea*) in the material from the area include at least three new genera. An international team of taxonomic experts will study these insects in the coming months and describe new taxa.

A significant number of specimens will be used for DNA barcoding, which will accelerate taxonomic descriptions and contribute to creating a barcode library for Peru.

Preliminary investigations have already posed many exciting questions. *Coelosynapha*, a recently described genus previously known only from Canada, Fennoscandia, and northeast Asia, has been found in the tropics of the Peruvian Amazon. An undescribed genus from Peru seems to be more closely related to *Dianepsia*, a group known only from Baltic amber (about 35 million years old) than to any other group of fungus gnats.

The next step of the project will involve working with selected ACPs and communities to establish a long-term collecting program for species discovery and ecological monitoring. This effort will facilitate biodiversity conservation and sustainable development. The project will significantly enhance NMS and MUSM collections, create a baseline for biodiversity monitoring in the area, and lay the foundations for further research on human impact on the environment and climate change.

Above:
collecting
insects in the
Peruvian forest

Photography special

During 2024, SCRR commissioned Tina Leahy, a talented photographer who recently graduated from Edinburgh College, to visit several of our members and undertake a project to capture a varied selection of images showcasing the range of work we represent right across rural research in Scotland. SCRR plans to make use of this image bank in various ways next year, but for now here is a small selection of Tina's images for you to enjoy.

Photography special
Tina Leahy



SCRR member organisations

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Roslin Institute	www.roslin.ed.ac.uk
Royal (Dick) School of Veterinary Studies	www.ed.ac.uk/schools-departments/vet
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School of Engineering	www.see.ed.ac.uk
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Biomathematics and Statistics Scotland	www.bioss.ac.uk
British Geological Survey, Edinburgh	www.bgs.ac.uk
Forest Research, Northern Research Station	www.forestry.gov.uk/forestresearch
Heriot Watt University, School of Life Sciences	www.sls.hw.ac.uk
James Hutton Institute	www.hutton.ac.uk
Moredun Research Institute	www.moredun.ac.uk
National Museums of Scotland	www.nms.ac.uk
NatureScot	www.nature.scot
Royal Botanic Garden Edinburgh	www.rbge.org.uk
Royal Society for the Protection of Birds - Scotland	www.rspb.org.uk/scotland
Science & Advice for Scottish Agriculture	www.sasa.gov.uk
Scotland's Rural College	www.sruc.ac.uk
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Contributions to the SCRR newsletter are welcomed. All contributions, comments and suggestions should be emailed to the Secretary/Treasurer as above.

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