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Scottish Consortium for Rural Research

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Our quest for evidence

Prof Sarah Skerratt, Scientific Director of SCRR, explains why she feels the consortium is well-placed to face Scotland's 'grand challenges'

'ABSENCE OF EVIDENCE is not evidence of absence,' as archaeologists are fond of pointing out. It is a compelling phrase, a call-to-arms to continue widening our understanding, deepen our knowledge-base, and challenge ourselves to remain discontented with our data – always questing. The Scottish Consortium for Rural Research is well-placed to address this absence.

We are facing societal 'grand challenges' including climate change (recently described in policy terms in Scotland as an 'emergency'), population growth (with the need to feed), systemic poverty... all the while maintaining biodiversity and the richness of our cultural and ecological systems. As the SCRR collective, we have the tools, the evidence and a track record of traceable impact in many of these critical research areas.

Specifically when focusing on our domain of 'rural', we know much data are absent, particularly in the policy sphere, not only in specific fields of investigation (such as lived-experience analyses), but also in how different elements of rural interact and are interdependent (such as how finite rural resources are traded off one with the other). As a collective, we have the capacity for 'systems thinking', so in vogue in the 1980s, and now being increasingly demanded by complex or wicked problems.

We need to be making the most of that collective. Hence my excitement about what the Scottish Consortium for Rural Research represents: the range of expertise, within, across and between disciplines, with new ideas creating previously undefined spaces.

From Stornoway to St Andrews, from Lerwick to Lockerbie, we have in-depth knowledge of our rural spaces, places, what is underfoot, the people who keep such communities alive, the challenges they face. We bring this to our analyses. To investigate the absent, we need to explore the further democratisation of science, through citizen-led approaches, through broadening our reach to a more inclusive approach embracing early-career researchers. Collectively, we will then generate new types of evidence, working with partners across industry, the third sector, government, the private sector – ensuring impact for public good.

As individual SCRR partners, we already have examples of leading the way: let's create more collaboration opportunities across rural Scotland to reduce the absence of evidence.

Pictured above: rural Scotland today, facing the challenges of climate change and food insecurity

This issue in species

Weissia wilsonii is a tiny moss species recently discovered growing in Cornwall – **page 2**

Scots pine (*Pinus sylvestris*) is the subject of a new guide to its properties and uses – **page 3**

Bere barley (*Hordeum vulgare*) shows the value of ancient crops in modern farming – **page 5**

Forester moth (*Adscita statices*) is a welcome new arrival to the west coast of Scotland – **page 7**

Gannets (*Morus bassanus*) have been incorporating plastic waste into their nests – **page 8**

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: details are on the back page.

Members' reports

Royal Botanic Garden Edinburgh

Saving species magnificent, new and on the brink of extinction

Ongoing work by Royal Botanic Garden Edinburgh, at home and in the field, has led to the identification of 65 new species in the past year

STUNNING GINGERS, exquisite begonias and one minuscule moss are in the incredible line-up of plant species described as new to science by leading experts at the Royal Botanic Garden Edinburgh (RBGE) over the past twelve months. As well as working around the globe, botanists have been cultivating specimens within specialist research facilities back home in Scotland and extracting data from preserved herbarium specimens, and they have formally recognised and described 65 new species of plants.

'A new native moss species was found in Cornwall and grows to just 5mm tall. It is known from a very few sites in England and Wales, and has undergone a long-term decline in distribution. It has been caught just in time'

In the week the Garden was announced as one of the first Botanic Gardens Conservation International (BGCI) Accredited Advanced Conservation Practitioners, RBGE is collating a list of new species from its last year of research from Indonesia, Madagascar, Vietnam, the Philippines, India, Democratic Republic of Congo, Nigeria, Thailand, Brazil, Colombia and Peru. Many have been grown on for months and often years in Edinburgh before being formally named.

Among the latest highlights are twelve species of amomum (from Zingiberaceae, the ginger family); eleven cyrtandra (part of Gesneriaceae, the African Violet family); five species of garcinia (mangosteens); and a whopping 19 species of begonia. RBGE's scientists and horticulturists are also awaiting confirmation on other recent collections from Borneo and Peru growing in the glasshouses, many almost certainly new to science.

Closer to home, a new native moss species, *Weissia wilsonii*, was found in Cornwall and grows to just 5mm tall. It is known from a very few sites in England and Wales and RBGE research tells us it has seen a long-term decline in distribution: it has been caught just in time.

Dr Mark Hughes, a tropical diversity scientist, explained why Edinburgh was particularly significant in the identification of new species. 'We have a living collection containing some of the world's rarest plants, many of which arrive here unidentified and hence potentially new to science. Our job is to make sure all the parts of the jigsaw which makes up our green planet get the recognition and protection they deserve, which means formally identifying them as new to science and, also, ensuring each gets a conservation assessment according to IUCN (International Union for Conservation of Nature) guidelines.'

The data also highlights the global significance of the Royal Botanic Garden Edinburgh's glasshouses and plant health facilities at the point where it is embarking on the £70m Edinburgh Biomes initiative to protect its unique and world-leading plant collection.

For more information contact Shauna Hay, s.hay@rbge.org.uk

Maintaining healthy blackcurrant crops in a changing climate

Dr Katharine Preedy of Biomathematics and Statistics Scotland describes how novel statistical modelling techniques can help fruit farmers

IN COMMON WITH a number of fruit crops and woody plants, blackcurrants require a period of chilling before they start to grow in spring. This reduces the risk of frost damage to new buds, ensuring that buds burst rapidly in the spring and that they flower together. Insufficient chilling may cause crops to flower later in the year, to produce fewer fruit and, over repeated years, to have a reduced plant lifespan.

Blackcurrants have a particularly high chilling requirement. We are already seeing the effects of milder winters, but the mechanisms are not well understood and commercial growers currently use a model where they simply count up the number of hours the plant experiences below 7C during the winter.

In a collaboration funded jointly by the Scottish Government and Innovate UK, BioSS researchers have worked with scientists at the James Hutton Institute and growers from across the UK to develop statistical models which explore the relationship between chilling period and buds opening in the spring.

The chilling effect was seen to be much stronger as the temperature dropped, and there was an optimal chilling range which differed by variety: some varieties had high chill requirements, while others were more susceptible to over-chilling. The model also highlighted considerable variation

PHOTOGRAPH © JAMES HUTTON INSTITUTE

in the resilience to changing temperatures with some varieties able to accumulate sufficient chilling even at warmer temperatures, if chilled for long enough.

The research will enable breeders to select cultivars resilient to the increasingly variable winters expected as the climate changes, and help growers decide when to intervene to support insufficiently chilled plants. The model also provides a framework to apply to genomic data to find markers for such resilience which may also be relevant to other woody plants. So, in addition to their economic importance, blackcurrants can act as something of a 'canary in the mine'; if we can understand how blackcurrants react to a changing climate, we can apply the knowledge to similar fruit crops such as raspberries, blueberries, cherries, apples and plums.

For more information contact Dr Katharine Preedy, katharine.preedy@bioss.ac.uk

Wood properties and uses of Scots pine

Paul McLean of Forest Research on a new report that reflects the popularity of a much-loved native tree

SCOTS PINE IS a much-loved tree in the Scottish landscape with important landscaping and biodiversity benefits. Sustainably managed, it provides a valuable timber resource and there is increasing interest in how to make best use of the home-grown material. Forest Research has recently published a comprehensive report that responds to this interest by collating and synthesising research into the production and use of Scots pine timber across Great Britain.

The natural distribution of Scots pine covers a large area spanning Europe and Asia. It was once the dominant tree species in northern Great Britain covering around 20 per cent of Scotland and six per cent of Great Britain. While only a small fraction of these natural forests remain, thanks to a century of reafforestation

Forestry office at Smithton, Inverness clad in Scots pine

Scots pine now covers around one per cent of Great Britain. It is the second most abundant conifer growing in the UK and the only native conifer species grown for timber. It remains an important timber species in areas that are too dry for the faster-growing Sitka spruce and is therefore of considerable regional significance, particularly in northern and eastern Scotland.

The new report draws on sources from the European continent, where Scots pine is better characterised and used in a wider range of applications. It is written for those who are seeking to determine the potential end uses of Scots pine including engineers, wood processors and forest scientists. It is divided into three parts: one, distribution of Scots pine; two, wood properties and uses; and three, suitability for different end products.

Download the report at www.forestresearch.gov.uk/research/wood-properties-and-uses-scots-pine-britain/

Members' reports

Forest Research, Centre for Ecology & Hydrology

Using 'big data' to help manage global natural assets

Dr Chloe Bellamy of Forest Research describes how data from a major woodland survey can be analysed

RESEARCH CARRIED OUT by the University of Southampton and Forest Research is helping to tackle one of our biggest sustainability challenges, looking after and nurturing the natural resources in the world around us.

The study outlines a new approach for using environmental 'big data' to understand where different approaches to managing our natural capital – such as forests, lakes, soils – are most effective, so that the environment continues to provide us with the food, water, recreation and timber on which we all depend.

The work has been carried out with co-authors from Forest Research and the Centre for Ecology & Hydrology (CEH). The data used in the study is collected by both organisations, through the UK-wide Countryside Survey (CEH) and National Forest Inventory (Forest Research). The study is part of SCALEFORES, a €1.5m project funded

by the European Research Council (ERC), with findings published in the journal Nature Sustainability.

The 15,000 woodland squares surveyed for the National Forest Inventory provide a detailed picture of the British wooded landscape. But to truly harness the power of 'big data', we need new approaches to sort through the complexity. The methods developed in this study are providing a deeper understanding of our natural environment, informing national-scale strategies to protect and enhance the benefits that woodlands and other ecosystems provide to society.

More details at www.forestresearch.gov.uk/news/using-big-data-help-manage-global-natural-assets/

Countryside Survey – countrysidesurvey.org.uk

National Forest Inventory – www.forestresearch.gov.uk/tools-and-resources/national-forest-inventory/

Nature Sustainability – www.nature.com/natsustain/

Better forestry to protect the water environment

Dr Tom Nisbet of Forest Research describes a new guide covering an important environmental issue

THE ENVIRONMENTAL BENEFITS of forests and woodlands are increasingly recognised and valued by society. Benefits for the water environment include the ability to protect aquatic habitats and species, preserve the quality of drinking water, alleviate flooding, and guard against erosion, landslides and the loss of soil.

The provision of such benefits is central to public funding for woodland creation and management. It is vital that we manage our forests, woodlands and trees sustainably to protect these environmental goods and services.

Forest management practices can harm the water environment by disturbing soil and vegetation, or by altering pathways of water movement. Poor management can diminish or reverse the benefits of forests and woodlands, contribute to local flooding and risk severe water pollution.

This new practice guide provides advice to forest managers, practitioners, planners and supervisors on how forest operations should be

Managed properly, forests can protect the quality and ecology of waters

planned and managed to protect the water environment. Applying this guidance will help ensure that forest operations comply with the UK Forestry Standard Guidelines on Forests and Water, which are the primary source of information on the legal and good practice requirements. The Guide is supported by a fold-out 'cab card' for operators which illustrates key points of good practice. Five copies of the card are supplied with each printed copy of the guide.

Download the guide free of charge at www.forestresearch.gov.uk/research/managing-forest-operations-protect-water-environment/

Bere, an ancient crop that could increase agricultural sustainability

Experimental planting by the James Hutton Institute, University of Copenhagen and University of the Highlands and Islands has proven the advantages of traditional varieties of this ancient form of barley

SCIENTISTS AT James Hutton Institute, the University of Copenhagen and the Agronomy Institute of the University of the Highlands and Islands (UHI) are investigating the remarkable ability of some strains of Scottish bere barley to grow on soils deficient in trace elements.

Before the 1900s, most farmers grew local strains of crops which had evolved in their locality over centuries of growing. In particularly challenging environments, some strains developed unique characteristics which are potentially of great value to modern agriculture.

Bere is an ancient type of Scottish barley with strong historic links to the Western Isles, Orkney and Shetland.

'Soils deficient in trace elements are common in many parts of the world and can usually only support crops if foliar applications of trace elements are made. The ability of strains of bere barley to cope with these conditions is therefore potentially of global significance'

In the three island groups, sandy agricultural soils deficient in trace elements (especially manganese, copper and zinc) are common along the coast, and introduced crops often fail on these soils.

A dramatic demonstration of this was seen in a recent trial on sandy soil in Orkney, which included both modern barley varieties and different strains of bere. Within a few weeks of emerging, the modern varieties already appeared yellow and grew poorly, producing no grain at harvest. In contrast, three strains of bere which originated from island locations with sandy soils grew healthily and produced good yields of grain. Leaf samples confirmed that the modern varieties were very deficient in manganese, zinc and copper while levels were normal in the beres.

Above and below: traditional bere varieties show healthier growth

Further research in different environments has confirmed the ability of some strains of bere to grow on similarly deficient soils and since the trait does not occur in all bere, it probably arose through deliberate selection by island farmers.

Soils deficient in trace elements are common in many parts of the world and can usually only support crops if several foliar applications of trace elements are made. The ability of strains of bere to cope with these conditions is therefore potentially of global significance and research is also investigating the genes and physiological mechanisms behind this trait, so that it can be incorporated into modern varieties. The research demonstrates very clearly that some ancient crops contain important traits which may help to develop a more sustainable agriculture, and underlines the importance of conserving genetic diversity within these crops as a future agricultural resource.

For more information, contact Tim George (tim.george@hutton.ac.uk) or Joanne Russell (Joanne.Russell@hutton.ac.uk) at James Hutton Institute, or Peter Martin (Peter.Martin@uhi.ac.uk) at the Agronomy Institute, UHI

Ecological Sciences, James Hutton Institute – www.hutton.ac.uk/research/groups/ecological%20sciences

Agronomy Institute, University of the Highlands and Islands – www.uhi.ac.uk/en/research-enterprise/centres/agronomy/

Members' reports

University of Glasgow, Forest Research

Crop plants that need less water to grow

Researchers at the University of Glasgow have been able to increase the uptake of carbon doxide

GLASGOW SCIENTISTS HAVE developed a new, sustainable way for plants to increase carbon dioxide (CO_2) uptake for photosynthesis while reducing water usage.

The breakthrough was led by a team of plant scientists at the University of Glasgow. The researchers used a new, synthetic light-activated ion channel, engineered from plant and algal virus proteins, to speed up the opening and closing of the stomata – pores in the leaves of plants through which carbon dioxide enters for photosynthesis. The modified plants grew as normal and substantially better under light conditions typical of the field, fixing more CO_2 while losing less water to the atmosphere.

Crop irrigation accounts for roughly 70 per cent of fresh water use on the planet and its use has expanded at unsustainable rates over the past three decades. Scientists have been trying to find ways to make plants grow with less water. Until now, much of the research has reduced water consumption, but at a potential cost in reduced CO_2 uptake and plant growth. This is not a satisfactory approach overall, given the growing demands on agricultural food production. This new research now offers a different approach that can successfully improve growth without compromising water use efficiency.

The researchers studied the plant arabidopsis, a member of the mustard family. Using the light-activated ion channel, called BLINK, the plant's stomatal responses were accelerated and better synchronised when grown under fluctuating light – conditions that are typical of the natural environment, where, for example, shade can be provided by clouds passing overhead or neighbouring plants.

Above: plants grown with (right) and without (left) the new synthetic system to improve uptake of CO_2

The engineered plants showed improved growth and biomass production while conserving water. The research also adopted a well-established approach from neuroscience, called optogenetics, to better equip stomata that are essential in balancing CO_2 uptake and water loss. The paper, 'Optogenetic manipulation of stomatal kinetics improves carbon assimilation, water use, and growth', is published in Science. The work was funded by the Biotechnology and Biological Sciences Research Council (BBSRC).

'Crop irrigation accounts for roughly 70 per cent of fresh water use on the planet and its use has expanded at unsustainable rates over the past three decades'

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New head of IFOS announced at Forest Research

NICOL SINCLAIR has been announced as the new Head of Inventory, Forecasting and Operational Support (IFOS) within Forest Research. He takes over from Peter Weston, who has retired after a long and distinguished career in the Forestry Commission.

In accepting his new role, Nicol said: 'This is an important time for Forest Research as both the demands from and threats to our forests have never been greater.

'I am excited to join Forest Research as Head of IFOS at such a pivotal time and look forward to working with the team, customers and stakeholders to continue to develop

our management platforms, data offer and highlight the benefits of forestry.' Nicol is a member of the Institute of Chartered Foresters and has worked in the Forestry Commission since 1990. He started his career in Llandovery, followed by a variety of roles in the public forest estate in Scotland including in his native Argyll, Newton Stewart, and Inverness.

His roles have included establishing the first Forestry Apprenticeship Scheme in Scotland; rethinking timber transport; and introducing the first National Strategic Plan for the public forest estate. As part of this , he worked very closely with the IFOS team and helped to develop Forester – Forest Research's spatial planning system.

Survey reveals that moths are getting fewer and further between

A new report for Scottish Natural Heritage shows that moth numbers have declined over the past 25 years, but their distribution has increased

TRENDS OF MOTHS in Scotland 2019 is a new report by Scottish Natural Heritage (SNH) and partners. It finds that moth abundance has fallen by almost 50 per cent over the period, with more species classed as 'significantly decreasing' than 'increasing'. Eight of the 20 species in most rapid decline are associated with moorland, suggesting that the insects may be disproportionately struggling in this habitat.

Of the top 20 most rapidly increasing species, 16 are associated with woodland habitats, suggesting that common woodland moths may be doing well in Scotland.

'Moths can give us vital clues about the health of our environment, because they are found in so many different habitats and have a high sensitivity to environmental changes... there are clear signals that climate change and loss of habitat are driving the overall population decline'

The research also shows that over the same time period, moth 'occupancy' – the distribution of the insects across Scotland – has increased by about 16 per cent.

Climate change is likely to be an important factor behind the trends, driving the range of some species northward with corresponding increases in occupancy. At the same time, warmer and wetter winters driven by climate change have been shown to negatively impact some moths, while other species are suffering population declines as a result of detrimental land management and habitat changes.

SNH is working with Butterfly Conservation, landowners and volunteers on conservation programmes for 21 priority species, with some encouraging signs. In 2018, monitoring at the single site on the remote west coast where the New Forest Burnet moth survives resulted in the highest count since 2013, following efforts to protect its habitat from over-grazing.

Elsewhere the feeding signs of Forester Moth caterpillars were discovered at two sites in Kilmartin. This is the first time they have been found in the wild in Scotland, following a training day held by Butterfly Conservation and part-funded by SNH.

The research used a huge dataset of some five million records compiled by thousands of volunteers to show for the first time how moths in Scotland are faring.

Simon Foster, SNH trends and indicators analyst, said: 'Moths are an important part of our biodiversity and can give us vital clues about the health of our environment, because they are found in so many different habitats and have a high sensitivity to environmental changes.

'The evidence is that some populations have undergone large declines or range changes, with clear signals that climate change and loss of habitat are driving the overall population decline.'

Download the report at www.nature.scot/trend-notes-scottish-moths

Butterfly Conservation in Scotland – butterfly-conservation.org/in-your-area/scottish-office

Right: New Forest burnet moth. Below: forester moth

PHOTOGRAPH: IAIN LEACH, BUTTERFLY CONSERVATION

Members' reports

University of the Highlands and Islands; Scottish Association for Marine Science

Monitoring the incorporation of plastic into the nests of UK seabirds

Nina O'Hanlon, seabird ecologist, Environmental Research Institute (UHI), reports on a project to assess the extent of this environmental problem

Left: gannet nests incorporating netting and a red balloon

PLASTIC POLLUTION is an increasing, and global, environmental issue which poses a major threat to marine biodiversity. The production of plastic continues to rise with millions of tons entering the oceans each year. It is therefore not surprising that seabirds come into contact with it. Seabirds can ingest plastic or become entangled in it, which may have negative consequences on their survival.

Several seabird species are known to incorporate plastic into their nests, particularly those that build substantial surface nests such as gannets and shags. However, to date the majority of evidence concerning nest incorporation of plastic by seabirds is anecdotal.

In a recent report assessing the impact of marine plastic on seabirds in the northeastern Atlantic , we only found quantitative, published data on nest incorporation of plastic for just two seabird species – gannets on Grassholm (Pembrokeshire, Wales) and kittiwakes in Denmark. Therefore there is a need to obtain current information on the extent of this issue.

Last summer, we carried out fieldwork across Scotland to collect data on plastic incorporated into gannet nests. Nest incorporation of plastic debris was recorded in all eight gannetries visited. The majority of items were netting and rope; however packaging straps, plastic bags and balloons were also noted.

This data will be collated with data on other seabird species collected from across the UK by some fantastic seabird researchers and by volunteers with Seabirds Count, as part of the current national breeding seabird census. So far we have data from a range of species including shags, large gulls and kittiwakes. This data will help us find out where marine plastic pollution is having the greatest impact on our seabirds, and which species are most vulnerable. If you would like to get involved in collecting data this year then please get in touch.

For details contact Nina O'Hanlon, nina.ohanlon@uhi.ac.uk Seabirds Count – jncc.defra.gov.uk/page-7413 Environmental Research Institute – www.uhi.ac.uk/en/research-enterprise/centres/eri/

SAMS scientists advise on seaweed biosecurity

The Scottish Association for Marine Science (SAMS) is taking a leading role in efforts to improve the sustainability of a fast-growing global industry

GOVERNMENTS FROM around the world are considering how best to safeguard the rapidly expanding global seaweed industry, following advice from researchers at the Scottish Association for Marine Science (SAMS).

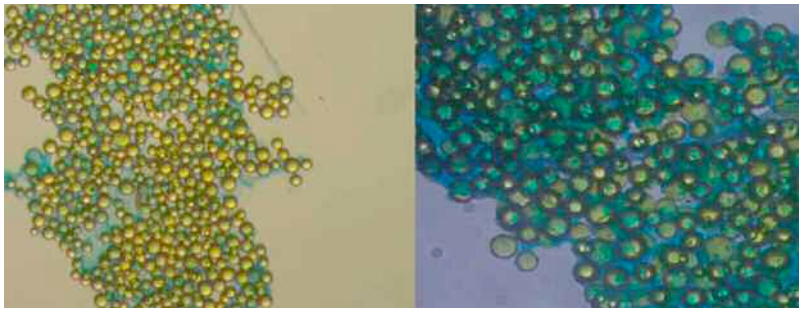
Worth around five billion dollars annually, the seaweed industry is largely based in south-east Asia, China and west Africa, sustaining coastal communities in many developing countries. Seaweed production more than doubled in size globally in the course of 20 years, from 13.5 million tonnes in 1995 to 30 million tonnes in 2016.

As a food, seaweed is a rich source of micronutrients (iron, calcium, iodine, potassium and selenium), vitamins and Omega-3 fatty acids.

Dr Valeria Montalescot in the Philippines

The Food and Agriculture Organisation (FAO) now intends to include seaweed alongside marine animals, such as finfish and shrimp, in producing advice on biosecurity, which aims to prevent the spread of disease and pest species. Seaweed had not been included in the initial biosecurity planning until a presentation made at a recent FAO-led meeting in Paris by SAMS scientist Prof Elizabeth Cottier-Cook, the leader of the GlobalSeaweedSTAR project, a UK-funded research effort to improve the sustainability of the global seaweed growing industry.

Seaweed aquaculture biosecurity is now the subject of a side-meeting at the FAO's sub-committee on aquaculture (COFI/AQ) in Trondheim from August 22 to 26, 2019. From this meeting, Prof Cottier-Cook and her team are hoping to produce a technical document on seaweed biosecurity for FAO approval.



Left: plastic particles are 'glued' together by biopolymers excreted by bacteria

Natural biopolymers create plastic agglomerates in Scottish waters

Tony Gutierrez, microbial ecologist at Heriot-Watt University, describes the outcome of recent laboratory experiments

SCIENTISTS AT Heriot Watt University have discovered that biopolymers excreted by bacteria are gluing micro and nano plastics together so that they form larger masses in our oceans. The biopolymers are common across all freshwater and marine environments, but until now scientists did not know what effects these sticky, glue-like materials had on the nano and microplastics that are now ubiquitous in all our waters.

As part of RealRiskNano, a £1.1 million project funded by the Natural Environment Research Council (NERC), scientists used water collected from the Faroe-Shetland Channel and the Firth of Forth in various experiments aimed at understanding the behaviour of micro- and nano-plastics in the marine environment.

The scientists added plastics to seawater and incubated them in conditions that simulated the ocean surface. Within minutes, they grouped together with bacteria, algae and other organic particles. The team was surprised to find that large masses of biopolymers – glue-like substances produced and excreted by microorganisms – formed the bulk of these plastic agglomerates. The nano-plastics, which are 100-200 times smaller than a bacterial cell, are incorporated into the agglomerates, which are visible to the naked eye and therefore might be mistaken for a food source by small marine animals.

The researchers have raised concerns about the potential impacts of this agglomeration on the deep sea and geochemical cycles, such as the flow of food from surface to sea floor. The agglomerates form in something similar to 'marine snow', the shower of organic detritus that carries carbon and nutrients from the surface to the ocean floor and feeds deep-sea ecosystems.

Heavier plastics could drive marine snow to fall at a faster rate to the sea floor; while the opposite could happen if lighter forms of plastic make it more buoyant, in which case deep-sea ecosystems could become starved of food.

To understand this scenario the researchers have identified the need for more data on how abundant these invisible plastics are in the ocean.

The NERC RealRiskNano project involves researchers from Heriot-Watt University and Plymouth University, and the research was published in the Marine Pollution Bulletin.

See epaquatic.org/realrisknano/

Feather formation in the egg could help birds stay cool

Denis Headon of Roslin Institute, University of Edinburgh explains a significant new finding

THE FORMATION OF feathers has been studied for over 50 years as a way to understand how simple tissues interact to produce organs. With advances in technology, scientists can now watch the process of organ development as it happens, giving deeper insights into how the embryonic body produces a complex anatomy through cells both moving and signalling to one another.

Scientists have discovered how bird feathers form in a wave-like motion, creating a regular pattern in the skin. Researchers have identified chemical signals that are switched on and off in a bird's skin as feathers are arranged sequentially. The findings could help design strategies to reduce feather density in farmed birds, which can be prone to overheating – a major welfare concern in tropical climates.

The Roslin team used high-powered microscopes to analyse the earliest stages of feather development in various bird species, and studied chicken embryos to track individual cells during the process.

In ducks and chickens, feather development swept across the skin like a wave, forming a regular hexagonal pattern. This wave motion was driven by two components: a genetic signal called EDA, and increasing cell numbers.

In flightless birds such as ostriches and emus, the wave does not occur and feathers are arranged haphazardly. Lack of flight over many generations may have allowed their feather arrangements to deteriorate.

Depth of plumage affects a bird's heat tolerance. Most commercial breeds of chicken have too many feathers to cope with heat. This is important for agriculture in low- and middle-income countries, with tropical climates and high demand for poultry. Experts may be able to develop breeds that are more heat resistant.

The study is published in PLOS Biology and the Roslin Institute receives strategic funding from the Biotechnology and Biological Sciences Research Council (BBSRC).

For more contact Denis Headon, denis.headon@ roslin.ed.ac.uk

News and events from Roslin Institute – www.ed.ac.uk/roslin/news-events

Members' reports

Moredun Research Institute, Centre for Ecology & Hydrology

Deer health project finds low levels of *E. coli*

Dr Tom McNeilly from the Moredun Research Institute explains the findings of a new survey on the presence of *E. coli* O157, an important food-borne pathogen, in wild deer

A PROJECT UNDERTAKEN by the Moredun Research Institute and the University of Edinburgh to investigate the prevalence of harmful *E. coli* O157 bacteria in Scotland's wild deer has established that these bacteria have a low prevalence in deer of less than 0.3 per cent of the population.

The study, funded by the Scottish Government and Food Standards Scotland, was carried out following the outbreak of E. coli O157 infection in people linked to the consumption of venison products in 2015. The bacteria, which is shed in animal faeces, causes disease due to the production of Shiga toxin and is most severe in very young or elderly people. The research set out to determine the levels of E. coli O157 in wild deer in Scotland and how the bacteria might be transferred to meat during the production of venison.

The research was based on the collection and testing of faecal samples from all species of wild deer in Scotland (red, roe, sika and fallow) and covered all of Scotland's regions where wild deer are present. Through working alongside the Association of Deer Managers Groups and Forest Enterprise Scotland, a total of 1087 samples were received of which E. coli O157 was found to be present in three. Two positive samples came from red deer and one from a sika deer.

'A total of 1087 samples were received and E. coli O157 was found to be present in three. Two positive samples came from red deer and one from a sika deer'

Despite these low numbers, deer managers and processors are being urged to continue to do everything within their control, from the point of cull to the end product reaching the consumer, to minimise the risk of faecal contamination of the carcass. Partners in the Scottish Deer Health Survey include: Association of Deer Management Groups; Lowland Deer Network Scotland; Scottish Venison Partnership; Scottish Quality Wild Venison.

News from Moredun Research Institute – www.moredun.org.uk/news

Protection of a u a big step for UK

The Centre for Ecology & Hydrology important milestone for the conserv explains Dr Stephen Cavers

A SCOTS PINE forest on a remote north-facing hillside in north-western Scotland has been named as the UK's first 'genetic conservation unit' (GCU). The designation by Scottish Natural Heritage (SNH) means the trees growing here will be protected as a unique part of the overall genetic diversity of this particular tree species.

The site, at Beinn Eighe in Wester Ross, is managed by SNH and was Britain's first National Nature Reserve, so it is fitting that it is now also the site of another first for the UK. It is hoped that the establishment of the Beinn Eighe GCU will also act to stimulate the creation of GCUs across the UK for all of our native trees.

Biodiversity underpins our ecosystem services and provides the capability for ecosystems to adapt to challenges such as environmental change or new pests and diseases. Genetic diversity is a key component of biodiversity and is essential for species-level responses to change.

Nationally, under the Aichi Targets of the Convention on Biological Diversity, the UK is committed to prevent the loss of genetic diversity in our native species and must find ways to characterise, secure and manage its native genetic resources. This needs to include a capability to document and

PHOTOGRAPH: LORNE GILL/SNH

nique forest is biodiversity

has played a key role in an ation of native trees in Britain,

monitor the status of genetic diversity. In tree species, a Europe-wide framework (EUFGIS) has been created to manage genetic resources, which provides a focus for the collation of knowledge about genetic diversity and for identification and conservation of a representative proportion of that variation as dynamically managed gene conservation units.

Some specimens at Beinn Eighe are more than 350 years old and the genetic composition of the pinewood has been shown to be unique. The genetic conservation unit for Scots pine at the site is a significant first step towards the UK securing this important national resource.

As well as providing the research that forms the scientific basis for recognising Beinn Eighe's distinctiveness, CEH has played a leading role in developing the new strategy for the UK's Forest Genetic Resources, which will form the framework for protecting the genetic diversity in all of the UK's native trees.

Forest Genetic Resources strategy, www.ceh.ac.uk/our-science/projects/uk-forest-genetic-resources-strategy

EUFGIS, www.eufgis.org/

Peter Wilson Lecture 2019 – International Leadership for the Environment

May 30, 2019 • Royal Society of Edinburgh • Francesca Osowska, chief executive, Scottish Natural Heritage

IN HER Peter Wilson Lecture given at the RSE on May 30, 2019, Francesca Osowska set out some challenges on how nature should be at the heart of decision-taking in rural Scotland. She informed an attentive audience that the world had barely a decade to shift to a low-carbon economy before the effects of global heating were irreversible and catastrophic. There were very clear threats facing Scotland, and by implication the rest of the UK, unless radical action was taken by 2030.

Ms Osowska said current levels of greenhouse gases in the atmosphere meant global heating of 1.5C was almost inevitable, requiring adaptation in the way people lived.

To prevent even more heating, there had to be sweeping changes to the way land and seas were exploited for food, towards much more sustainable food production; a marked shift towards sustainable transport; increased green spaces in urban areas; and significant reform of the economy to promote greater equality.

'Net zero emissions by 2050 would require converting 20 per cent of agricultural land to forestry, a switch to electrically powered transport and increasing renewable energy production by 50 per cent'

She cited goals set out in a recent report from the Committee on Climate Change (CCC), a government body that advises the UK and devolved governments on climate policy, which has called on the UK to adopt a target of net zero emissions by 2050. The UK government has so far failed to endorse that.

That required converting 20 per cent of agricultural land to forestry, biomass for energy, or expanding carbon-rich peatlands; a switch to electrically powered transport; increasing renewable energy production by 50 per cent; and heavy investment in carbon capture and storage, to pipe the CO_2 still being produced underground.

Her final message to the audience was to consider the imperative: 'Ask not what nature can do for you but what can you do for nature.'

Following the lecture there was a panel discussion and audience questions. The event continued afterwards with a reception and poster viewing in the RSE upper rooms.

The annual Peter Wilson Lecture is a joint production by the Scottish Consortium for Rural Research and the Royal Society of Edinburgh.

Details of the event can be found on the Royal Society of Edinburgh website at www.rse.org.uk/event/international-leadership-for-the-environment/ and a transcript and recording of the lecture will shortly be available.

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