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PHOTOGRAPH: QUALITY MEAT SCOTLAND

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£30m each year is spent on measures against sea lice – **page 2**

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460 ewes and **50** red deer are part of the mix for the optimal hill farm, according to SRUC – **page 8**

5 tonnes of carbon is released for every hectare of peat burned in the average moorland fire – **page 8**

24 per cent of the land surface of the northern hemisphere is permafrost, which currently acts as a significant carbon store – **page 9**

2014, Year of Family Farming

Family farms help ensure sustainable use of resources, says Prof Stuart Monro

THE INTERNATIONAL YEAR of Family Farming takes place in 2014. In both the developing and the developed world, the family has since time immemorial been the bedrock of the agricultural industry. Food, water, energy and shelter are the primary elements required to sustain life; finding food for the family unit was the main focus for early humanity.

In the 21st century, that aspect of the rural economy is still with us to some extent in this country. Farming properties are usually handed down from fathers to sons and daughters and the concept of the family business and investment over generations is still prominent. And investment is not only in the land and the technology, but also in the skills required to farm in a particular place, which can only be passed on by first-hand experience.

If this is the case in Scotland, how much more is it true of the developing world? The quest for sustainable food resources in places like sub-Saharan Africa, where climate change is affecting the availability of both food and water, is a particular challenge.

The International Year of Family Farming focuses attention on important socio-economic, environmental and cultural roles. The estimated 500 million family farms worldwide are the main producers of food consumed locally. Family farming is thus inextricably linked to world food security and preserving traditional food products; it plays a central role in the sustainable use of natural resources and helps safeguard the world's agro-biodiversity.

International Year of Family Farming:
www.familyfarmingcampaign.net

Above: the Neill family of Upper Nisbet Farm, near Jedburgh, won Scotch Beef Farm of the Year in 2012

About SCRR

THE SCOTTISH CONSORTIUM FOR RURAL RESEARCH – known until May 2012 as the Edinburgh Consortium – 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 on the back page.

Members' reports

Inverness College, UHI; Institute of Aquaculture, Stirling University

The surprising biodiversity of Scotland's lochs

DNA analysis reveals several distinct types of trout, explains Eric Verspoor of Inverness College, UHI

SCOTLAND'S 30,000 LOCHS are an iconic part of its landscape, and are vital to the wealth and health of its rural communities. These lochs contain complex, poorly understood ecosystems that underpin their socio-economic value, ecosystems that are hidden below the surface and increasingly threatened.

Even in respect of well-known parts of those systems, such as trout, it is generally assumed there are only two types: brown trout, which spend their entire lives in freshwater; and sea trout, which live in fresh water when young but go to sea to feed before returning to spawn. Yet work by the Rivers and Lochs Institute of UHI Inverness College has shown that Scottish trout are a diverse assemblage of genetically distinct types, each with its own unique biology, and that many types co-habit in one loch. Previously it was assumed that all lochs have one population and that the biology of all populations was the same.

DNA analysis of trout netted in different parts and depths of Loch Laidon, an 8km-long loch in central Scotland, has found three reproductively distinct populations. One is a pale, large-eyed, deepwater trout living below 20 metres, where little light penetrates, and is an ecological type never before seen.



Above: brown trout from Loch Laidon. Top left to bottom right – four typical loch trout from the shallow waters and two newly discovered deepwater trout

Right: Loch Laidon on Rannoch Moor, a typical Scottish highland loch



PHOTOGRAPHS: ERIK VERSPOOR

This work suggests other lochs might have multiple forms of trout. In addition, other aquatic species may also require identification if this important, largely hidden and unknown part of Scotland's lochs and its freshwater heritage is to be protected and conserved.

Wrasse, a proven weapon against sea lice

This successful project from the Institute of Aquaculture, Stirling University has been nominated for an award. Herve Migaud of the Institute describes how the project has developed over the past two years

THE INSTITUTE OF AQUACULTURE has always been closely involved in the fight against sea lice and early work has been instrumental in the establishment of an integrated and coordinated approach against the pest. Sea-lice counts at commercial sites have drastically reduced in the last decades but the cost of mitigation remains high (over £30 million per year in Scotland) and reliance on chemical compounds remains significant.

The salmon industry's goal is to achieve effective chemical-free IPM (Integrated Pest Management) by the end of the decade to sustain its



environment, its expansion and the reputation of Scottish salmon. The cohabitation of cultured cleaner-wrasse species with salmon stocks is rapidly emerging as an effective and environmentally friendly IPM tool against sea lice.

Leading Scottish salmon producers – Marine Harvest (Scotland) Ltd (MHS) and Scottish Sea Farm (SSF) – teamed up with the Reproduction and Genetic group of the Institute of Aquaculture to develop the technologies to breed and grow commercially viable numbers of wrasse in tanks and deploy these successfully and sustainably in Atlantic

... and of saline lagoons in the Outer Hebrides

Fiona Ware, Curator of Invertebrate Biology at NMS, reports on a survey of species in a specialised habitat



PHOTOGRAPHS: MARK WOOMBS; BILL CRIGHTON, NMS

IN SEPTEMBER 2012, a team including marine biologists from National Museums Scotland was commissioned by Scottish Natural Heritage to survey the biodiversity of saline lagoons in the Uists. This survey revealed unusual and highly specialised species of plants and animals including the rare foxtail stonewort *Lamprothamnium papulosum* and the lagoon cockle *Cerastoderma glaucum*.

Saline lagoons are bodies of brackish water that have a restricted connection to the sea. The intrinsically variable salinity within lagoons, which may fluctuate with tidal cycles or in response to seasons and rainfall,

influences the structure of lagoon communities. Lagoon specialists, tolerant of environmental fluctuations, thrive in conditions that would cause intolerable stress in their saline or freshwater counterparts.

Internationally important examples of this habitat type, given Priority Status on Annex 1 of the EC Habitats Directive, occur in Scotland. Taxonomic confusion within a number of phyla has led to doubts in some existing species records and without access to historic specimens the records cannot be verified. By incorporating recent NMS research on the morphological and molecular identification of mud snails

Loch na Ciste, North Uist (above); the lagoon isopod, *Idotea chelipes*



(*Hydrobiidae*) and the morphological identification of lagoon isopods this survey has clarified the distribution of lagoon specialists in the Uists and will inform a monitoring strategy.

National Museums Scotland's collection of marine invertebrates is one of the largest collections of its kind in the UK and is estimated to contain nearly one million specimens. Botanical and zoological specimens from the survey have been incorporated into the collections of the Royal Botanic Garden Edinburgh and NMS; NMS guarantees to care for the material in perpetuity and to make it accessible to researchers through our loans scheme.



Opposite page: Ballan wrasse broodstock at Machrihanish Marine Farms

Left: farmed Ballan wrasse ready to be transferred

Right: wrasse hatchery at Machrihanish

salmon farms across Scotland. Co-funding of £2.1m from the Technology Strategy Board was awarded to support this strategic industry-academy collaboration over a three-year period from January 2012.

Due to its success, the project has since been nominated for the Scottish Enterprise Life Sciences Annual Awards 2014.



PHOTOGRAPHS: ERIC LECLERCO

Members' reports

SRUC; Forest Research, RBGE, the University of Edinburgh

Campaign highlights pre-natal care for livestock

Sarah Hunter-Argyle of SRUC on a project to educate farmers about stress among their animals

PHOTOGRAPH: MARIANNE FARISH

RESEARCHERS AT Scotland's Rural College are launching a new campaign – Mothers Matter – aimed at helping farmers understand how healthy, happy and productive livestock starts with healthy, happy mothers. The team are producing leaflets for cattle, pigs and sheep which explain animal welfare research in areas such as health, nutrition, handling and stock density, and ask farmers to think about their current management practices.

The campaign was inspired by a survey SRUC carried out with 1300 farms. They assessed the conditions and treatment of livestock, highlighting the key hazards that animals face at this critical time.

The first leaflet to be released, on ewes, highlights key concerns. Stocking density was one of these, with



18 per cent of farms visited keeping ewes at a higher density than Defra recommends before lambing. High stocking density leads to increased levels of aggression and so to stress

Blackface lambs: happy mothers have healthy offspring

which may affect the foetal lamb's development. Rough handling was also highlighted. Ewes that received aversive handling showed changes in the structure of neurones in those brain regions involved in emotional regulation and cognitive processing.

Dr Kenny Rutherford, who is leading the project, says: 'Stress, whether health, social, or environment related, is something that we humans try to avoid, and the same should be true for our animals. We hope this leaflet will encourage sheep farmers to make small changes that could make a big difference to their flock.'

'Mothers Matter: Managing ewes during pregnancy to improve lamb health, welfare and performance' is online at www.sruc.ac.uk/earlylife

FOREST RESEARCH HAS recently been working together with students on the Professional Graduate Diploma in Education (PGDE) secondary school courses in design and technology, physics, chemistry, biology and geography to develop learning for sustainability. This has involved identifying what trees, woods and forests can offer to educators striving to deliver curriculum targets within the context of Curriculum for Excellence experiences and outcomes.

The students research and develop ideas for a unit of work, with related resources, for teaching and learning. These outputs aim to help build a resource of curriculum development ideas for educators of learners in early high school, making science, technology, engineering and maths subjects more rewarding for learners.

To strengthen experiences in working with external clients and developing resources, the design and technology students were tasked to deliver an event over two afternoons in the Real Life Science Lab (RLSL) at the RBGE. This event formed part of the Garden's events programme. Many SCRR member organisations contribute to this programme.

This year's event (December 7 and 8) attracted over 260 visitors into the RLSL. The overall theme revolved around the development and use of wood, and emphasised sustainability. Those activities that involved hands-on



PHOTOGRAPHS: STEVE PENNY

Forests and education – natural partners

Steve Penny of Forest Research describes a joint venture with RBGE and the School of Education at the University of Edinburgh

sawing and drilling of wood, and building with it, were most popular: designing and building bridges out of lollipop sticks and then loading them.

We would like to acknowledge additional support from: Forestry Engineering Group (IAgrE); Forestry

Pictured above: one of the popular 'Real Life Science Lab' events at RBGE

Commission Scotland; Ellen McArthur Foundation; and Our Dynamic Earth.

Outputs from 2013's project will be available after April 25, 2014; those from 2012 are at: www.itl.org.uk/resources/results.php?id=716

Members' reports

Royal Botanic Garden Edinburgh; Roslin Institute

Right: Viking prongwort, *Herbertus norenus*, from Lysefjord, Norway, a newly discovered species

SCOTLAND HAS A RICH and internationally important resource that is often overlooked – the mosses, liverworts, lichens and fungi, which add colour to our glens and woodlands and a disproportionate amount of Scottish biodiversity. An initiative to understand the diversity and distribution of these species links an historically rich legacy of specialist taxonomic expertise with DNA sequencing.

'DNA barcoding' is a way of translating expertly identified specimens into curated databases of standardised DNA sequences that can be used to distinguish among species. The DNA barcode library offers a way of making identification accessible to many more users, from forensics to conservation, and not just expert taxonomists. Another benefit is a more accurate picture of biodiversity – having DNA sequences gives us clear insights into evolutionary history and numbers of species.

Scientists at RBGE have been coordinating global efforts in DNA barcoding plants, and have also focused on the UK flora. As a result of barcoding British liverworts, several new species have been discovered. For instance, DNA barcoding led to the recent discovery of the Viking prongwort, known only from Shetland and Norway. RBGE also applied this approach to testing species limits on a set of difficult-to-identify conservation-priority mosses and liverworts, a DEFRA funded project. In about



PHOTOGRAPHS: DAVID LONG

Barcoding biodiverse Britain: discovering rarities under our feet

Rebecca Yahr of RBGE explains an ambitious effort to catalogue British flora



Left: the north-facing slope of Ronas Hill, Shetland, a typical habitat for Viking prongwort

20 per cent of the 30 species studied, unexpected diversity was uncovered, suggesting that the difficulty in identification is due to the presence of more than a single species. Several of these are likely to merit conservation once their boundaries have been more clearly defined.

Roslin team helps to solve historic elephant riddle

SCIENTISTS AT The Roslin institute have helped show that an Asian elephant foetus used to name the species is actually African.

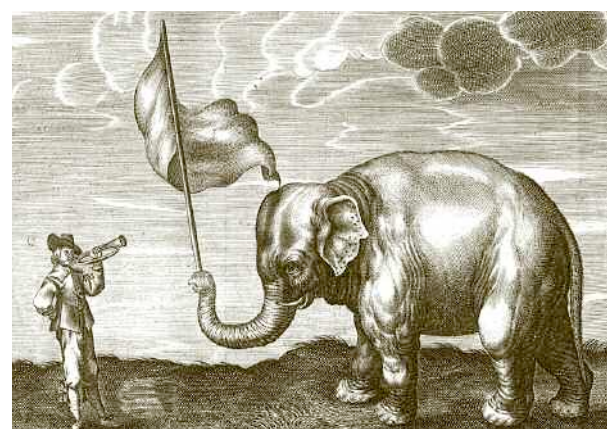
A recent study, published in the Zoological Journal of the Linnean Society with a host of international collaborators, has revealed that Carl Linnaeus unwittingly combined two different species of elephant when he created the first description of an Asian elephant in the 18th century.

Linnaeus had used a description by John Ray of a captive elephant and the 5cm-long pickled foetus belonging to Albertus Seba. The true identity of

the latter was detected genetically following comparison with DNA archived during an investigation of Elephant Endotheliotropic Herpesvirus.

The investigating team then tracked to the Museum of Natural History in Florence the skeleton of the captive elephant described by Ray – an animal named Hansken – and confirmed it as the true type specimen for the Asian elephant, *Elephas maximus*.

In c.1637 Rembrandt saw Hansken and drew the animal from life, and these images are now the iconotypes of this species. The image reproduced here, however, is by an unknown artist.



Members' reports

Heriot-Watt University and the University of Edinburgh

Predicting squirrelepox spread in Scotland

A disease that kills red squirrels is being carried northward by greys. Andy White of Heriot-Watt University and Peter Lurz of the University of Edinburgh run through the evidence

THE INVASION AND establishment of non-native species is a major international threat to native biodiversity (DEFRA – UK Biodiversity Action Plan, 2007) and it is now recognised that shared infectious disease is a key determinant of invasive success and spread. An important example of a disease-mediated threat to diversity is the invasion into the UK of grey squirrels, which have extensively replaced the native red squirrel.

Squirrelepox, carried by but avirulent to the greys, yet lethal to reds, is unequivocally linked to the rapid replacement of red squirrels. Recently squirrelepox has been reported in populations in southern Scotland and to assess the threat from squirrelepox, a partnership between Heriot-Watt University, Scottish Natural Heritage and the Scottish Wildlife Trust has undertaken 'A modelling assessment of control strategies to prevent/reduce squirrelepox spread'.

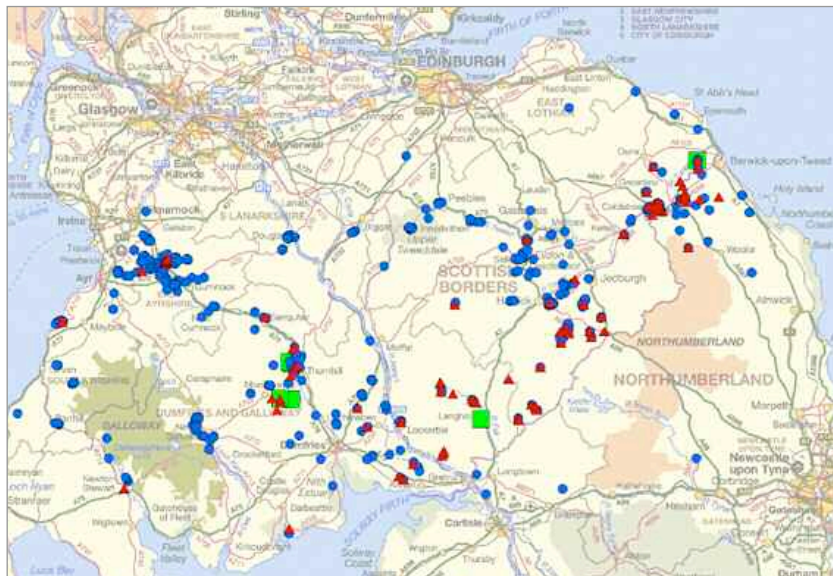
Key model findings are that squirrelepox can spread rapidly through established grey squirrel populations and is likely to spread from its current northern limit in southern Scotland to central Scotland. Spread from southern to central populations occurs through distinct corridors that connect high-density regions. The model identified several such potential corridors through forest and urban habitat, and all corridors would need to be targeted for control to prevent spread from southern to central grey squirrel populations.

The report findings are being used to inform proposed red squirrel conservation policy for Scotland.

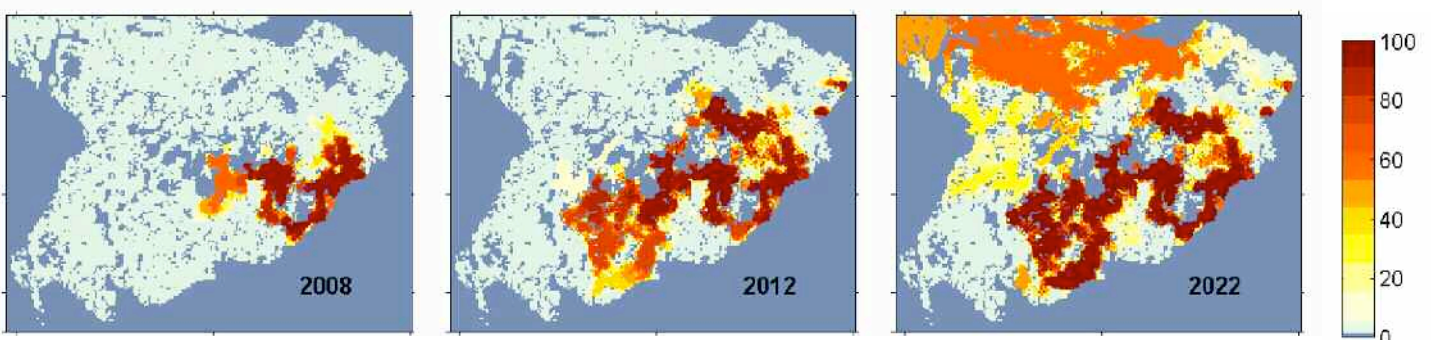
Below: model predictions indicating the percentage occurrence of seroprevalence in grey squirrels: 2008, 2012 and 2022



PHOTOGRAPH: © LORNE GILL/SNH



Squirrelepox test results 2011. Red triangles are seropositive grey squirrels, blue circles are seronegative. Compared to 2007 figures, this map shows a spread of the disease north-east towards Berwick and north-west towards Kilmarnock, from an initial locus north of Carlisle. Data from Scottish Wildlife Trust.



Cairngorms National Park: the UK's first 'LTSER' platform

Hamish Trench of the National Park explains its exciting new role in Long-Term Social and Economic Research, described as 'a place-based approach to the sustainable management of an area'

MORE THAN FORTY representatives of Scottish academic and research organisations, volunteer groups, government agencies and NGOs gathered for the launch of the Cairngorms National Park as the UK's first Long-term Social-Ecological Research (LTSER) platform in November 2013, the event supported the Beltane network.

So far five organisations, the Cairngorms National Park Authority, Centre for Ecology and Hydrology, University of the Highlands and Islands, James Hutton Institute and Scottish Natural Heritage have formally signed the MoU. This is a commitment to work together to enhance the knowledge on social, economic and ecological aspects relevant to the sustainable management of the Park in a truly interdisciplinary fashion.

The ethos of the LTSER platforms in Europe (under the auspices of the LTER-Europe network) combines the data legacy and infrastructure of traditional long-term ecological research (LTER) sites with social and economic research in a place-based approach to sustainable management of an area.

Hamish Trench, Director of Conservation and Visitor Experience at the Cairngorms National Park Authority said: "Being an LTSER is a key part of our strategy to champion the



PHOTOGRAPH: STEWART GRANT

Cairngorms National Park as a 'Learning Landscape' – promoting cross discipline collaboration and knowledge exchange. We need grounded and timely research to meet the management challenges in the Park, and the Cairngorms can contribute to many international research agendas."

A Cairngorms Research web hub now provides a practical focus for collaboration, providing an accessible way to connect research ideas and data. CNPA is currently developing the research strategy for the Park.

For more information, follow links to research at www.cairngorms.co.uk

New tools for organisations coping with climate change

Anne Marte of Sniffer has details of a range of new web-based adaptation tools

MAKING CHANGES to account for Scotland's changing climate has become an important agenda for many local authorities, enterprises and communities. Through the Adaptation Scotland Programme, Sniffer is launching early in 2014 a set of comprehensive tools for each sector. The tools will help with: assessing climate risks and impacts; and identifying what actions to take.

A template for adaptation planning for businesses is already up on the

Adaptation Scotland website. It helps businesses answer two key questions. How could climate change affect our business continuity and efficiency? And what can we do to increase resilience, enhance efficiency, add value and save money?

Users identify vulnerable assets, processes, people and supply chains to consider how they are already affected by severe weather, and how this might change in future. They then explore ways to manage their risks by reducing threats and capitalising on opportunities.



The template for businesses will be followed shortly by 'Five steps to managing your climate risks', a process particularly aimed at helping public sector organisations fulfil their Public Bodies Climate Change Duties. It will provide guidance for a series of community workshops on local climate impacts and possible actions.

The development of these tools has been a process involving a range of public sector organisations, members of the 2020 Climate Group and communities that are already working on reducing their carbon footprint.

More from adaptationscotland.org.uk

Members' reports

SRUC and University of Edinburgh; University of Glasgow and CEH



Labour on Scottish hill farms – a barrier or an opportunity?

Claire Morgan-Davies of SRUC, Ron Wilson of the University of Edinburgh and Tony Waterhouse of SRUC outline their research on the commercial viability of hill farms

WITH RECENT CHANGES in agricultural policies and declining livestock numbers in extensive marginal lands, it is becoming more difficult to justify farm labour.

This study used an optimisation model to investigate the effects of changing the enterprise mix on labour requirements and its implications for economic viability of hill farms. The initial model, based on a case study hill farm with 1970 ha hill ground and 230 ha lower ground, indicated the following enterprise mix as being financially optimal; 460 ewes, no cattle, 50 wild red deer and 214 ha of new grant-

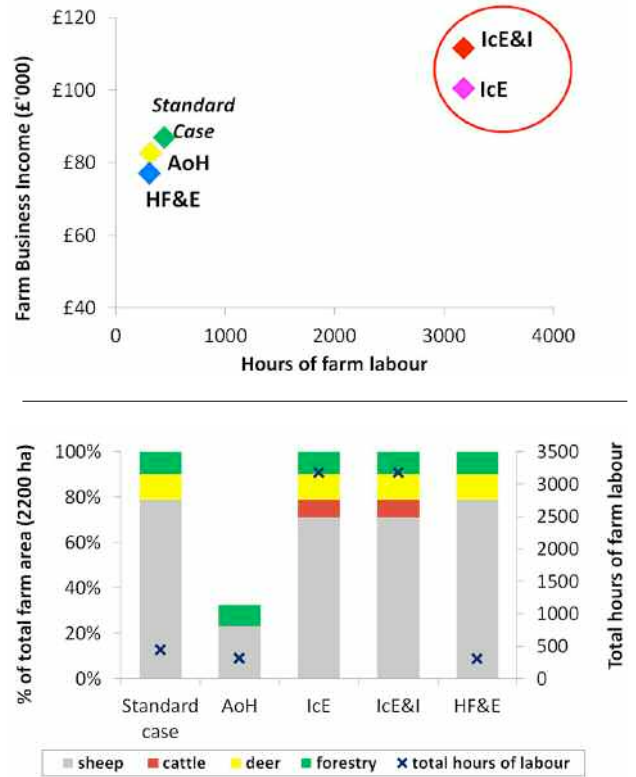
Pictured above: case study farm in western Scotland

eligible woodland. This will be referred to as the standard case. Subsequently four scenarios were run through the model and the effects on enterprise mix and labour requirements noted. The scenarios were:

1. Abandonment of hill ground, more intensive use of the lower ground (AoH)
2. Increase livestock production efficiency alone (IcE)
3. Increase livestock production efficiency with financial incentives (IcE&I)
4. Increase energy and fuel prices (HF&E).

Only scenarios that increased livestock efficiency created enough income and work to justify one permanent labour unit (Figure 1). However, the corollary was that insufficient labour availability meant that many enterprise activities were severely restricted (Figure 2).

Unless farm productivity increased or costs decreased, it was difficult to justify employing permanent labour. Despite the potentially rewarding opportunities of changing the farm enterprise mix, the disparity between labour requirements and costs could be a barrier to uptake by farmers.



Effects of severe wildfires on moorland ecosystems

A report from G. Matt Davies of the Solway Centre, University of Glasgow; Alan Gray of the Centre for Ecology and Hydrology; and Rut Domenech Jordi of the Solway Centre, University of Glasgow

UNUSUALLY WARM, dry weather in the spring of 2011 and again in 2012 resulted in wildfires on peatlands across the UK, causing substantial environmental damage. Our NERC-funded project aims to understand the impacts of wildfire severity on peatland vegetation and carbon dynamics, contribute to improving the restoration of severely-burnt moorlands, and assist forecasting the potential for



damaging wildfires. Six fire sites were investigated, covering a range of conditions from dry moorlands in the Peak District and the North Yorkshire Moors, wet heathland in south-west Scotland to forest-edge sites in the Scottish Highlands.

Data recording focused on assessing fire severity using an adapted version of Composite Burn Index (CBI), estimating fuel

Vulnerability of carbon in permafrost soils to global warming and hydrological change

Phil Wookey at Heriot-Watt University on a large-scale joint research project in the Canadian Arctic

EXPERTISE FROM a largely Scottish-based team is being applied to understanding a key unknown in the global carbon cycle; the vulnerability of carbon in permafrost soils to global warming and hydrological change.

Like Scotland, vast areas of the circumpolar north have carbon-rich soils due to conditions unfavourable for the decomposition of soil organic matter; unlike Scotland, however, the presence of permafrost is a key factor. Around 18.7 million square kilometres (~24 per cent) of the Northern Hemisphere land surface is underlain by permafrost, and the soils in these regions are currently estimated to contain somewhere between 1400 and 1850 billion tonnes of organic carbon. If conditions improve for decomposer organisms, through warming and permafrost thawing, then the carbon budget for these regions may shift, producing more of the biogenic greenhouse gases carbon dioxide and methane, and potentially accelerating the existing 'Arctic Amplification' of climate change.

The team – involving participants from Heriot-Watt University, the University of Aberdeen, University of Stirling, Centre for Ecology and Hydrology, Scottish Universities Environmental Research Centre and the University of Durham – is working with Canadian partners to understand the complex interplay between permafrost, hydrology and carbon fluxes, and the

Right: home from home – midnight at Trail Valley Creek, Northwest Territories, Canada

Below: Jens Subke injects a stable isotope 'labelled' carbon dioxide into a chamber to measure the fate of photosynthetically-assimilated carbon



PHOTOGRAPHS: PHIL WOOKEY



research is based in a region undergoing climate change much more rapidly than the global average; the Mackenzie Uplands area of Arctic Canada, in the Northwest Territories. The UK Natural Environment Research Council (NERC) has funded the work for 3.5 years, and the project has relevance for upland management and carbon budgeting in Scotland.

Further information from Phil Wookey, p.a.wookey@hw.ac.uk

consumption, collecting data on soil CO₂ and CH₄ fluxes and assessing vegetation regeneration.

Initial results point to substantial differences in fire severity within and between different wildfires. Fuel consumption across all the fires varied more than five-fold and the proportion of fuel consumed ranged from 71 per cent to 96 per cent.

Carbon released by the fires averaged 5 tonnes of carbon per hectare burned.

Data from studies of sub-surface fire-induced soil hydrophobicity, altered peat moisture content and a modified microclimate are expected to shed light on rates of peat decomposition.

Opposite: Rut Domenech Jordi and Sophie Philbrick collecting samples from a gas flux chamber to determine soil CO₂ and CH₄ flux rates.

Right: an area of moorland burnt by a severe wildfire in the spring of 2011. Bare eroding peat can be seen in the foreground. Channels cut by surface run-off separate areas of the original ground surface where limited vegetation regeneration can be found. Carbon emissions from such peatlands are likely to be high due to erosion of the peat, increased fluxes of dissolved organic carbon and altered rates of gaseous carbon emissions due to peat decomposition. Severe post-fire erosion such as this can continue for decades and prevent vegetation regeneration.



PHOTOGRAPHS: UNIVERSITY OF GLASGOW

Members' reports

Forest Research, University of Glasgow

Artists in residence at Forest Research

FOREST RESEARCH are delighted to be hosting two visiting researchers / artists-in-residence - Tim Collins and Reiko Goto - in early 2014. Tim and Reiko are Glasgow-based artists who focus on environmental issues, combining art and science in thought-provoking ways; find out more from their website (see below).

The two artists are working with Forest Research staff on a project to explore the cultural values associated with the Caledonian pine forest, in particular the Black Wood of Rannoch. More details from Dr David Edwards, david.edwards@forestry.gsi.gov.uk

Tim Collins and Reiko Goto:
<http://collinsandgoto.com/>

Right: the Black Wood of Rannoch is one of the few remaining patches of original Caledonian pine wood. It contains important communities of species characteristic of old pine woods – lichens, fungi and a number of rare vascular plant species – as well as splendid pines, hundreds of years old.



PHOTOGRAPH: FORESTRY COMMISSION

February deadline for Rural Development Programme consultation

THE SCOTTISH GOVERNMENT is currently running a consultation on the new Scotland Rural Development Programme (SRDP) for 2014-2020. Detailed proposals have been set out by Richard Lochhead, rural affairs secretary. They include plans to protect rural development support for farmers, including the Less Favoured Area Support Scheme (LFASS), and to increase funding for agri-environmental schemes.

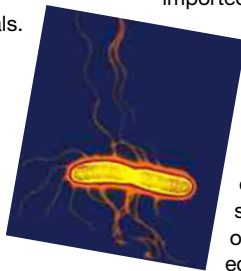
The consultation period runs until February 28, 2014. A summary of the proposals is available to download: both it and the consultation document are at www.ruralgateway.org.uk/en/node/8431.

Salmonella and resistance to antimicrobials are global issues

Dan Haydon of the University of Glasgow on research that suggests bacteria can be surprisingly well-travelled

PEAKING IN THE MID-1990S, an epidemic of the bacterium *Salmonella typhimurium* DT104 occurred in both humans and animals around the world. In addition to being a concern due to its prevalence, the epidemic was important because of the high frequency of resistance to commonly used antimicrobials.

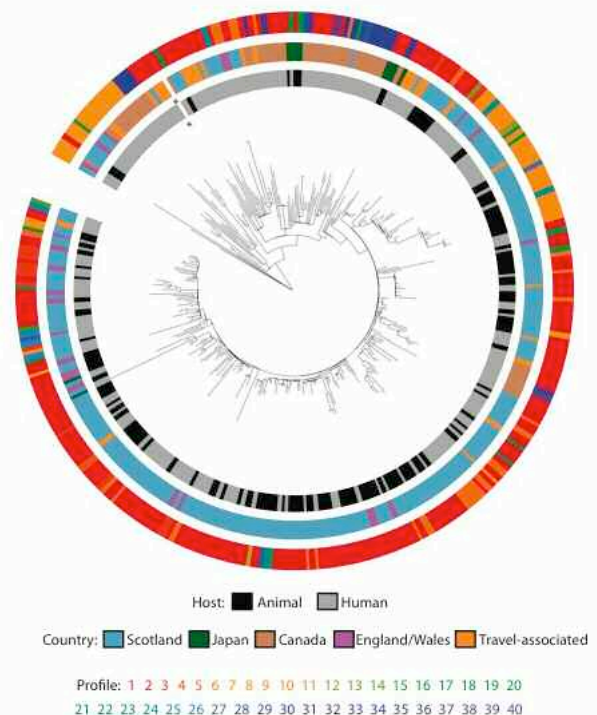
Using an unprecedented collection of Scottish salmonella isolates covering 22 years [1], recent international research described the use of whole genome sequencing to study genetic variation in the bacteria and drug resistance genes between different host populations. This genetic study confirmed previous analyses based on patterns of antimicrobial resistance (AMR) revealing that, in Scotland, the DT104 bacteria from local animals and humans were more different than expected; local animals were unlikely to be the main source of DT104 infections in humans. In addition, there was more



varied drug resistance in the human-infecting bacteria.

This suggests that the DT104 found in the human population is derived from a much greater number of sources than local animals, which could include international travel and imported foods. The Scottish DT104 bacteria were genetically similar to DT104 from other countries. Further research investigating the generality of these conclusions to other organisms, and other settings, will help transform our understanding of the ecology of AMR and zoonotic pathogens. The results highlight that Salmonella and AMR are global, rather than local, issues. We need stronger linkage of research across the veterinary and public health sectors if we are to manage antimicrobial resistance effectively.

[1] Mather et al, Science 2013, 341, 1514-7.



First environmental art festival held in south-west

Mike Bonaventura of the Crichton Carbon Centre reports on an inaugural event in Dumfries and Galloway

THE INAUGURAL Environmental Art Festival took place in September 2013 in Dumfries and Galloway. Could public engagement in the sustainable development agenda be improved if it was considered through a cultural lens, using different media, works, discussion and debate?

More than 2,500 people participated over three days, enjoying music, performance, visual art and conversation, exploring less trodden paths in southwest Scotland, both real and metaphorical. Several works came about as the result of collaborative partnerships between climate scientists and creative practitioners: Cinema Sark provides one example.

The Event Organisers Sector Supplement to the G3 indicators, developed by the Global Reporting Initiative, was used as a foundation from which to begin to develop a practical method for assessing the social, economic and environmental impacts of cultural events.

Cinema Sark, a study of place, ecosystems and the meaning of 'the border', presented at the English-Scottish frontier on a giant projection canvas beneath the nine-lane M74/M6 River Sark Bridge. One of the UK's shortest but geopolitically most important rivers, the Sark has marked the westernmost border since 1552. Thousands whisk over it daily but few notice it. No signs announce its presence or identity. From Allfornought Hill to the Solway Firth, Cinema Sark uses video, found sound, archive materials and interview audio to explore connections between the Sark's ecosystems and the people who live and work in them. Inspired by ecosystem services modelling, Cinema Sark flows from six months of collaboration between Pete Smith, prof of soils and global change, and John Wallace, video artist.

Environmental Art Festival: www.environmentalartfestivalscotland.com



PHOTOGRAPHS: JOHN WALLACE

'Storytelling, community, archaeology, place, environment'

Valentina Bold of the Solway Centre, University of Glasgow, describes an imaginative venture to communicate heritage

AT THE SOLWAY CENTRE for Environment and Culture, storytelling is being promoted as a means of communicating heritage, to bring together people and places. The aim is to go beyond aesthetic appreciation – though rewarding – to experience a 'storied' landscape, rich with human experience.

On Skye we learnt from internationally known seannachie Seoras Macpherson, Gaelic expert Anne Walker and historian Jonathon MacDonald. At Whithorn, we benefitted from the knowledge of postmistress Margerie Clark, Janet Butterworth and Donna Brewster. Their



stories, told respectfully and often with humour, offered a rich understanding of important places, with internationally significant depths of meaning.

StorySCAPE now hopes to secure further funding to explore four ambitious themes in linked locations: 'homecoming' in Skye; 'immigration' in Glasgow, 'pilgrimage' in Whithorn and 'tourism' in Shetland. The ambition is to build better communication between residents and tourists, fostering thoughtful approaches to community and landscape.



PHOTOGRAPHS: VALENTINA BOLD

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Members' meetings

MONDAY MARCH 24, 2014
 Moredun, Pentlands Science Park,
 Bush Loan, Midlothian EH26 0PZ
 Executive Committee meeting and
 Directors' research lunch
 11:00 Executive meeting
 12:30 Directors' research lunch
 Host: Prof Julie Fitzpatrick

Events

www.scrr.ac.uk/events.php

No events are scheduled at time of going to press. Please check the website.

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www.scrr.ac.uk/about.php

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The deadline for copy in the next issue is January 13, 2014.

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For all queries about the distribution of this newsletter, please contact the Secretary/Treasurer by email as above.

FUTURE ISSUES

Contributions to the SCRR newsletter (formerly the ECRR newsletter, and before that The Bush Telegraph) are welcomed. All contributions, comments and suggestions should be emailed to the Secretary/Treasurer as above.

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