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Scottish Consortium
for Rural Research

SCRR Newsletter
Issue 98
Spring 2022

www.scrr.ac.uk

PHOTOGRAPH: LAURIE CAMPBELL



This issue in abbreviations

OEC is the Ocean Explorer Centre at SAMS in Oban – **page 3**

SCENE is the Scottish Centre for Ecology and the Natural Environment in Glasgow – **page 4**

LCA is life cycle analysis, used to inform developments in aquaculture – **page 4**

PCN are potato cyst nematodes, one of the main causes of yield loss in this crop – **page 5**

SAR is synthetic aperture radar, a way to capture high-resolution data from satellites – **page 7**

Nature is climate, climate is nature

Prof Des Thompson, principal adviser, NatureScot, on the nature-climate crisis

ON FEBRUARY 28, 2022, and understandably with less media attention than we would have expected because of the invasion of Ukraine, a monumental report appeared.

The concluding phase of the IPCC's 6th reporting cycle confirmed that the extent and magnitude of climate change impacts on nature are greater than previously assessed. The changes we see today are appearing much faster, and are more disruptive and more widespread, than anticipated 20 years ago.

The report focuses on the tight interactions between the climate, ecosystems and human society, and the risks from climate change, ecosystem degradation and biodiversity loss. Approximately half of the species assessed globally have shifted polewards or, on land, to

higher elevations. The IPCC makes a compelling case for safeguarding biodiversity and ecosystems as fundamental for climate resilience. Put another way, unless we take urgent action to care for planetary health, the climate and our wellbeing will suffer calamitously. Nature is climate, and climate is nature!

The Glasgow Climate COP 26 in November 2021 grabbed exceptional attention, and we have to hope that COP 27 a year on in Sharm El-Sheikh, Egypt, will result in key global commitments. Meanwhile, planning is well advanced for the Biodiversity (CBD) COP 15 in Kunming, China in autumn 2022.

Key preparatory meetings in Geneva in March are working through the detail of the global post-2020 framework for biodiversity. This

Above: a species that indicates a healthy ecosystem, the golden eagle is thriving in 2022

outlines the ambition and the key work needed to halt the loss of biodiversity, increasingly referred to as 'bending the curve' – upwards.

In Scotland, the Scottish Government, working closely with NatureScot and a wide and deep range of stakeholders, will publish in May 2022 a draft 25 years strategy for biodiversity. The evidence base is key to developing a strategy that will

Continued on page 2

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 on the back page.

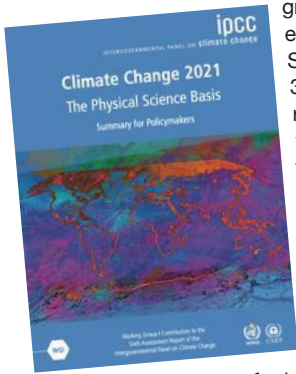
News from SCRR

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truly make a difference for nature, and for all of us. Every member organisation of the SCRR will contribute to the strategy and its outcomes.

Scotland has a phenomenally well-connected rural research and land management community, and we should never lose sight of the importance of this and the interdisciplinary approaches which we need to find global solutions. Every effort to enrich nature in a field, on a peat bog, along a river, in a wood or with a village community will make a difference in reviving nature – and slowing climate change.

Something good to end with. In early March, 2022, there was widespread media coverage of the



growing number of golden eagles in the south of Scotland. There are now 30+ birds, arguably a record number in 200 years, thanks to a fantastic collaborative project funded largely by the Heritage Lottery Fund. Several members of the SCRR actively work with this project, which is an important contribution to bending the curve for biodiversity.

Please enjoy this SCRR Newsletter for spring 2022, as we continue to celebrate the research outcomes of this fantastic, diverse and connected network across Scotland.

IPCC 6th Assessment Report:
www.ipcc.ch/report/ar6/wg1/

Updates on the UN CBD appear here:
twitter.com/UNBiodiversity

SCRR welcomes new Secretary/Treasurer



SCRR IS DELIGHTED to welcome Lyndsey Hayes as our new Secretary/Treasurer, taking up post in July 2021.

Lyndsey also works part-time in an administrative role in the Global Academy of Agriculture and Food Security at the University of Edinburgh, and can be contacted at: lyndsey.hayes@ed.ac.uk

SCRR/RSE Peter Wilson Lecture 2022

Save the date: May 10, 2022 at the Royal Society of Edinburgh

SCRR'S ANNUAL PETER WILSON LECTURE, run jointly with the Royal Society of Edinburgh, is scheduled to take place on May 10, 2022 at the RSE.

The name of this year's speaker and the subject of the lecture have yet to be announced.

Now in its 18th year, the lecture was created in memory of the distinguished agriculturalist, former general secretary of RSE and former Professor of Agriculture and Rural Economy at the University of Edinburgh, Prof. Peter Wilson CBE.

Last year's event took the form of an online seminar chaired by Dr Rebekah Widdowfield, former chief executive of the Royal Society of Edinburgh, on the subject of 'Science for Rural Recovery and Resilience'.

SCRR mini-conference for Early Career Researchers

Our popular ECRs mini-conference, which unfortunately had to be postponed last year due to the pandemic, is planned to be held in Perth during 2022 – watch out on our website for further details.

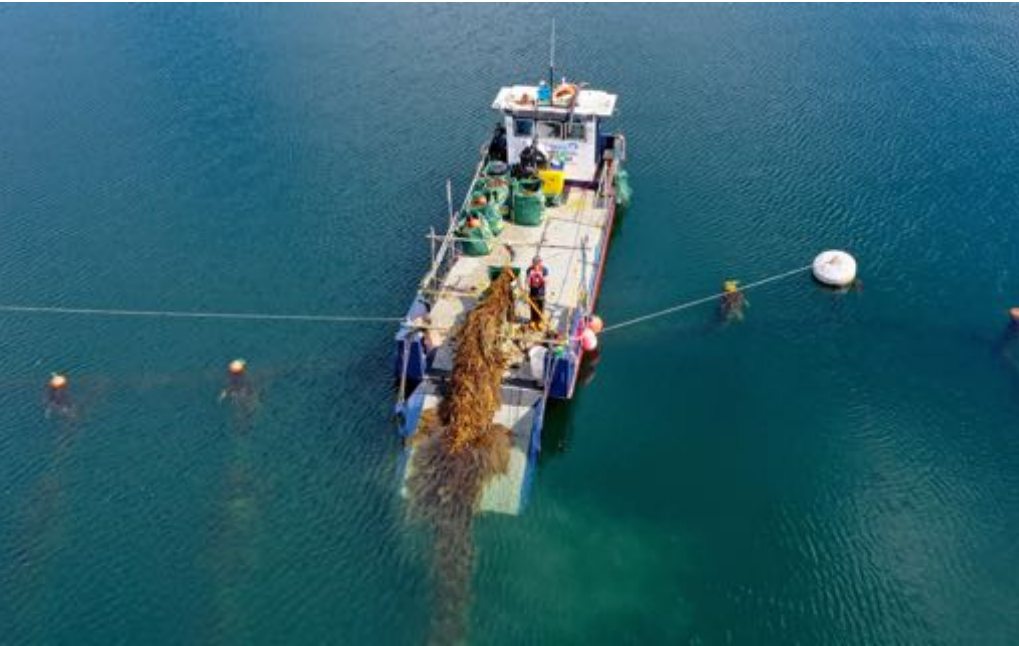
Events at SCRR: scrr.ac.uk/events/



Wind turbines in the snow – an image from the online seminar that replaced SCRR's Peter Wilson lecture in 2021

Members' reports

Scottish Association for Marine Science



Seaweed project funding will benefit the 'blue economy' in the UK

A global growth area, the farming of seaweed to feed both people and animals has been given a further boost by the establishment of its own research and training facility in Oban by the Scottish Association for Marine Science

THE FLEDGLING UK seaweed farming industry has taken a major step forward after the Scottish Association for Marine Science (SAMS) gained funding to develop training and business development for the sector.

The Seaweed Academy, which will be based at SAMS, near Oban, will be the UK's first dedicated seaweed industry facility, offering advice to start-ups, training workers and sharing the latest research to help businesses develop.

The aim of the academy is to catalyse growth of an industry that has a crucial role to play in the UK's net zero, regional growth and levelling up aspirations. It will provide an innovative service to the sector, from seeded line through to research and practical skills at SAMS' existing seaweed farm sites.

The £407,000 grant from the UK Government's Community Renewal Fund is one of 56 projects across Scotland to share an £18m investment to help people into work and deliver net zero.

Globally, the seaweed farming industry has been growing exponentially and is estimated to be worth around \$15billion per annum.



Top: an aerial view of harvest time at the seaweed farm. Above: inspecting a crop of kelp

However, the vast majority of this activity is in Asia and there is huge growth potential in Europe, with a growing demand for seaweed from gourmet restaurants to livestock feeds.

Already used extensively in food ingredients, agriculture, cosmetics and pharmaceuticals, seaweed farming has a low carbon footprint, using no fresh water and with minimal land-based infrastructure.

SAMS Director Prof Nick Owens said: 'Using our own seaweed farms and the most up to date research, we have been laying foundations for a

thriving UK seaweed farming industry. We are excited to now move into the next phase of training, education and business development, which will see our ambitions realised.

'SAMS works internationally on seaweed research and we are well placed to deliver the most up-to-date advice for start-ups and existing farmers who wish to develop their business.

'We are grateful to the UK Government for its investment in this climate-friendly industry that will not only support the regional economy of the Highlands and Islands, but will show others an example of the best of the blue economy.'

The Seaweed Academy will be operated by SAMS, in partnership with SAMS Enterprise and Argyll College, a fellow academic partner within the University of the Highlands and Islands, and will deliver immediate economic benefit to Argyll and Bute. It also aims to stimulate the growth of UK seaweed aquaculture, exploring high-value markets, and using the latest research to increase the competitiveness of UK products globally.

SAMS will also promote seaweed production as a means of bioremediation, including the resulting carbon sequestration, therefore mitigating the impacts of climate change.

SAMS Professor Michele Stanley, who specialises in seaweed research, said: 'Seaweed is already widely used in food, cosmetic, pharmaceutical and agriculture industries and has potential as a biofuel.

'But the benefits of seaweed farming go beyond natural products; it increases and restores biodiversity by providing habitats for marine creatures and can help to mitigate climate change through carbon capture and methane emission reduction.

'There is also a growing commercial demand for higher value seaweed-derived products, such as hydrocolloids and for food ingredients and medical treatment and high-bacto agar used as a laboratory medium for COVID-19 testing.'

To help fully embed the new industry at a community level, SAMS' Ocean Explorer Centre (OEC) will develop STEM educational outreach materials to raise awareness of seaweed farming, climate change and the importance of net zero, from primary storytelling to workshops for Higher/A-level curricula, ensuring a holistic approach from primary to PhD level and beyond.

At-risk freshwater fish is reintroduced in Scotland

A project led by University of Glasgow shows that the rare freshwater powan can successfully adapt to new locations

AN AT-RISK SPECIES of fish has established itself in lochs across Scotland with the help of conservation managers and by rapidly adapting to its new environment, resulting in changes to their DNA, their ecology, and body shape, according to a new study.

In an urgent bid to conserve the freshwater powan, scientists introduced eggs and fish to new loch sites across Scotland over the past 30 years, with the aim of establishing new and robust populations.

The research shows that the translocated fish have indeed established in their new loch homes. The new populations have lower genetic diversity than the source populations, but not worryingly low.

By using state-of-the-art genome analysis techniques, the study showed that the translocated populations are tapping into specific regions of the genome in adaptive evolutionary changes to the new populations.

The powan (*Coregonus lavaretus*, sometimes known as *Coregonus clupeoides*) is one of Scotland's rarest fishes and found natively in only lochs Eck and Lomond. Powan is a species of high natural heritage value for Scotland, but is in worrying decline due to habitat destruction caused by climate change, increasing water temperatures and the non-native ruffe

fish in Loch Lomond, which voraciously feeds on powan eggs.

With the long-term health of the population depending on its genetic diversity and the evolutionary effect of translocation, the scientists wanted to find out how the populations changed, to look more closely at the genetic health of the species and determine if translocation was a successful strategy.

The study brought together a team of fish biologists, ecologists and evolutionary geneticists at the Scottish Centre for Ecology and the Natural Environment (SCENE) and the Institute of Biodiversity, Animal Health and Comparative Medicine at the University of Glasgow; and the Limnological Institute at University of Konstanz in Germany and the UK Centre for Ecology and Hydrology.

Lead author Dr Marco Crotti, who recently completed his PhD on these fish, noted: 'We can see evidence of the translocation as changes in the powan genome and their ecology, but they are genetically healthy and are establishing.'

The study is published in the journal *Evolutionary Applications*.

For further details, please contact ali.howard@glasgow.ac.uk or elizabeth.mcmeekin@glasgow.ac.uk, 0141 330 6557 or 0141 330 4831

Below: as a native species, powan are found only in Loch Lomond and Loch Eck



PHOTOGRAPH: BIOPIX VIA NATURALIST.ORG



PHOTOGRAPH: THE SCOTTISH SALMON COMPANY

Optimising fish farming's contribution to climate and environmental policy

A report from the University of Edinburgh and Open University Scotland highlights that aquaculture will be an important contributor to sustainable food production

AQUACULTURE IS a rapidly growing contributor to Scotland's food-related economy, particularly the circular bio-economy that will be more environmentally, economically and societally sustainable.

A policy report, funded by the Open University Scotland, demonstrates the role of innovative technologies in contributing to this improved sustainability of aquaculture in Scotland, meeting key government policies on Net Zero carbon emissions, the circular economy, zero waste, marine biodiversity, and improving the nutritional quality of the nation's diet. Where relevant the report draws attention to the interactions between meeting climate change targets and contributing to biodiversity targets.

Globally, wild-capture fisheries have little capacity to expand without risking a collapse in fish stocks and seriously damaging marine biodiversity. The capacity of seafood to meet the world's increasing demand for protein will therefore need to come from farmed sources. This highlights the importance of being able sustainably

Climate change, nematodes and effects on potato crops

Research at Biomathematics and Statistics Scotland addresses concerns that yields could be hit by increased infestations

POTATO CYST NEMATODES (PCN) are the most damaging nematodes to affect potato crops, capable of causing over 70% yield loss.

Further, there are concerns that climate change will lead to elevated soil temperatures in coming years, which could increase growth rates of PCN, resulting in more rapid increases in infestation levels and even greater yield loss. Scientists at Biomathematics and Statistics Scotland (BioSS) have worked with the James Hutton Institute, Science & Advice for Scottish Agriculture (SASA) and the University of Strathclyde to develop a mathematical model to predict how increased temperatures under climate change might influence PCN populations in the future.

Two species of PCN are present in Scotland; *Globodera rostochiensis* (the golden cyst nematode) and *Globodera pallida* (the white cyst nematode). Recent estimates based on statutory testing carried out by SASA suggest that whilst the area of land infested with *G. rostochiensis* is relatively stable, the land area infested with *G. pallida* is currently doubling approximately every 7 years, resulting in an estimated loss of £25m in 2019, which could rise to £125m per year by 2040 without action.

It is believed that this increase in *G. pallida* but not *G. rostochiensis* is due at least in part to the fact that approximately 50% of potatoes planted in Scotland are resistant to *G. rostochiensis*, while less than 3% are resistant to *G. pallida*. This increase in *G. pallida* infestation is particularly concerning because regulations in place to control the damage caused by PCN prohibit the growing of seed potatoes on land which has been found to contain PCN. If the current rate of increase were to continue then it may not be possible to grow potatoes on PCN-free land in Scotland in as little as 30 years' time.

Scientists at BioSS found that while warmer temperatures were predicted to accelerate increases in PCN infestation levels, growing potato varieties with even moderate levels of resistance to *G. pallida* would remain an effective control strategy. Therefore, it is suggested that encouraging increased uptake of resistant varieties by growers, principally through identifying and developing end markets for these varieties, is important to help protect the Scottish seed potato industry.

Below: potato crop affected by white cyst nematode, *G. pallida*



to increase the production of protein foods based on aquaculture, and the role of innovative technologies in meeting that need.

The report focuses particularly on innovation in fish feed development, fish farming systems, fish processing, and waste and by-product management. It also considers needs for future developments in life cycle analysis (LCA) and animal health and welfare.

Given the complexity of the underlying systems, and the limited development and lack of standardisation in greenhouse gas accounting methods, a quantitative comparative analysis of the innovations considered is not yet possible. However, it is possible to judge the relative potential contributions of different innovations to overall climate change and biodiversity targets, as an indication of productive areas for innovation support and for further development.

Read the full report here: www.innogen.ac.uk/media/304

Above: a typical salmon farm

Sequencing all Scotland's species

Despite the challenges of 2020 and 2021, the Royal Botanic Garden Edinburgh has made significant progress in a collaborative programme to transform biological research

THE DARWIN TREE OF LIFE is an ambitious project to sequence the genomes of all 70,000 species of eukaryotic organism in Britain and Ireland. It aims to use advances in DNA sequencing technology and informatics to create a new platform for biodiversity research – from taxonomy, ecology and evolutionary biology to conservation, food security and drug discovery.

The programme is a collaboration of ten partners including the Royal Botanic Garden Edinburgh (RBGE) and University of Edinburgh.

RBGE is a Genome Acquisition Lab, amassing expert-identified samples of bryophytes and lichens, alongside Scottish native vascular plants. The Garden's scientists are also refining the genetic techniques used, including developing protocols for extracting high-quality DNA from plants.

The Darwin Tree of Life is part of an even larger initiative, the Earth Biogenome Project. As its name suggests, this global collaboration seeks to sequence and characterize the genomes of all eukaryotic species on Earth – including many thousands not yet known to science – in a decade, underpinning future research and conservation of the natural world.

Initiated in 2019, with its first stage funded by the Wellcome Trust, Darwin Tree of Life provides important proof-of-concept for the Earth Biogenome

Pincushion plant, *Diapensia lapponica*, found growing on a peak in Glenfinnan



Project. Focusing on the British Isles, with probably the best known and most intensively studied biota in the world, means methodology and workflows can be tested and refined on a remarkably broad sample of biodiversity (60% of all eukaryote orders, 40% of families, 25% of genera) before scaling up to planetary level. The first, two-year phase aims to sequence and make publicly accessible 2,000 genomes, covering around a third of families present in Britain and Ireland, and to demonstrate their utility in pure and applied research.

Despite the limits imposed by COVID lockdowns, by the end of 2021 more than 200 genomes had been sequenced and assembled. RBGE's own team spent 63 days in the field in 2021, collecting over 2,000 samples of 230 priority species of vascular plants, bryophytes and lichens.

This brings their total since the start of the project to 398 species representing over 150 families.

In August, on the 250th anniversary of the first recorded ascent of Ben

Nevis, an RBGE team repeated the ascent, not to document the plants of the mountain for the first time, as their predecessor James Robertson did in 1771, but to sample the species of this unique site for genome sequencing.

An exciting find on that expedition was the ecologically-important snowbed species *Polytrichastrum sexangulare* (northern haircap moss), a climate-change-threatened species restricted to the summits of our highest mountains where snow patches persist nearly year-round. Elsewhere, on Skye the team found samples of *Eriocaulon aquaticum* (common pipewort); on Rannoch Moor, *Scheuchzeria palustris* – the Rannoch rush; and on a peak in Glenfinnan, *Diapensia lapponica* (pincushion plant). All were the only UK members of their respective families and therefore crucial to the project.

Looking forward, many exciting organisms remain to be sampled and sequenced. 2022 should see the publication of genomes from species as diverse as the ancient yew trees (*Taxus baccata*) in RBGE's heritage hedge, a three-way symbiotic lichen (*Stereocaulon*) harvested on the Ben Nevis expedition, one of the UK's few remaining pure wild apples (*Malus sylvestris*), and a Scottish endemic moss, *Bryoerythrophyllum caledonicum*, recognised as recently as the 1980s.

To suggest a species of your own for priority sequencing, go to www.darwintreeoflife.org/suggest-a-species/

For further details please contact Alex Davey adavey@rbge.org.uk

'Sequence locally, think globally: The Darwin Tree of Life Project' doi.org/10.1073/pnas.2115642118

Assessments of large-scale plant biosecurity risks to Scotland now available

ASSESSMENTS COMMISSIONED by Scotland's Plant Health Centre and led by Forest Research exploring large-scale biosecurity risks in Scotland are now available.

The assessments aim to improve understanding of current biosecurity awareness and practices relating to woodland creation and expansion, and habitat restoration in Scotland, against a backdrop of ambitious targets for

tree planting and ecological restoration. They cover three areas of concern:

- (1) non-specialist and online horticulture sales;
- (2) landscaping and infrastructure;
- (3) planting for environmental benefits.

Find out more on the Scotland's Plant Health Centre website, www.planthealthcentre.scot

Using satellite imagery to assess the impact of Storm Arwen

Following the gales that hit Scotland in November 2021, Forest Research used 'earth observation' specialisms to get a rapid view of the scale of the damage

STORM ARWEN brought severe winds across the UK overnight on November 26 to 27, 2021. This was one of the most powerful winter storms of the last decade and caused widespread disruption and damage, bringing down large numbers of trees in the north, east and south of Scotland and in northern England.

A rapid assessment of the impact of the storm was needed to inform recovery planning and harvesting. Forest Research joined forces with Confor, the Forestry Commission and Scottish Forestry to assess the volume of timber blown down and gather information on the species, size, location, as well as the condition of the fallen trees.

Earth Observation specialists at Forest Research used SAR (synthetic aperture radar) data gained from satellites to identify potential areas of windblown trees across England and Scotland.

Using a novel machine learning algorithm, this new approach provided a more immediate view of the overall damage than possible using conventional aerial photography and saved the need for extensive and some potentially risky site visits. A web-portal was made available for land managers



PHOTOGRAPH: JENNIFER PETRIE VIA GEOGRAPH

to provide validation using their own local observations, including those using drones.

As well as helping to improve assessments of the impact of the storm, the insights provided will also enhance rapid assessment of the

Trees blown down by Storm Arwen at John Muir Country Park in East Lothian

impact of future storm events on trees and woodlands. Forest Research also provides comprehensive guidance for forest managers wishing to manage their forests in ways which reduce future risk of wind damage, including a decision support system ForestGALES.

New framework to guide the management of trees, woods and forests for resilience

FOREST RESEARCH has published a Resilience Implementation Framework to provide a structured way to think about resilience and identify management actions.

The Resilience Implementation Framework provides a way to achieve a common understanding and identify potential actions for a specific set of circumstances.

It is designed to be applicable in different situations by providing a step-by-step way to think about resilience and plan at different levels, whether strategic, tactical or operational.

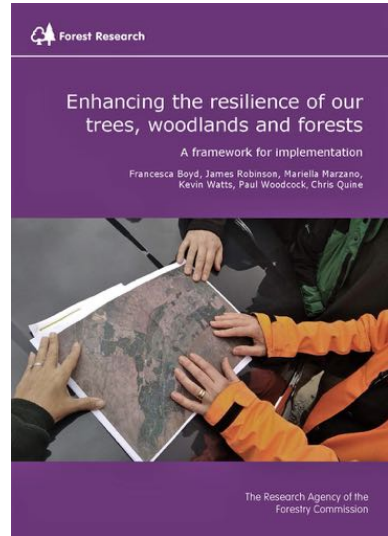
Working through the Framework with others can help bring fresh ideas

and reach common understandings and so advice is provided for those seeking to facilitate discussions about resilience and how to implement it.

The Framework, which was developed with support from Defra's Future Proofing Plant Health programme, is specifically targeted for application in relation to trees, woodlands and forests but can also be used in wider landscape settings and within organisations.

The Framework is available online at www.forestresearch.gov.uk/tools-and-resources/fthr/resilience-implementation-framework/

Right: the framework is now available online both as a web resource and as a digital publication



SCRR member organisations

The University of Edinburgh	www.ed.ac.uk
Moray House School of Education	www.ed.ac.uk/schools-departments/education
Royal (Dick) School of Veterinary Studies	www.ed.ac.uk/schools-departments/vet
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Biomathematics and Statistics Scotland	www.bioss.ac.uk
British Geological Survey, Edinburgh	www.bgs.ac.uk
Centre for Ecology & Hydrology, Edinburgh	www.ceh.ac.uk
Edinburgh Napier University, School of Applied Sciences	www.napier.ac.uk/fhlss/SLSSS
Field Studies Council, Millport	enquiries.sco@field-studies-council.org
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
Roslin Institute, University of Edinburgh	www.roslin.ed.ac.uk
Royal Botanic Garden Edinburgh	www.rbge.org.uk
Royal Society for the Protection of Birds - Scotland	www.rspb.org.uk/scotland
Royal Zoological Society of Scotland	www.rzss.org.uk
Science & Advice for Scottish Agriculture	www.sasa.gov.uk
Scotland's Rural College (formerly Scottish Agricultural College)	www.sruc.ac.uk
Scottish Association for Marine Science, Oban	www.sams.ac.uk
Scottish Natural Heritage	www.snh.gov.uk
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Centre for Remote and Rural Studies, Inverness College	www.crrs.uhi.ac.uk
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Institute of Aquaculture	www.aquaculture.stir.ac.uk
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FUTURE ISSUES

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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Printed in Scotland on recycled paper (100% post-consumer waste) by The Jane Street Printing Company, Leith, Edinburgh.

Designed in East Lothian by mobo media