

in-land

Inside this Issue

The Active Outdoors

Scanning Electron
Microscopy

Art & Science





One Land...

Many Options



Major issues such as the security and availability of food, water and energy, and the protection and use of natural resources are central to the scientific work carried out at the Macaulay Land Use Research Institute. Issues relevant to both climate change and land use are threaded through all our science and it is clear that our work has never been more relevant or important than it is today.

The Macaulay Land Use Research Institute is a main research provider to the Scottish Government and provides research and consultancy services to a wide range of organisations and individuals concerned with the sustainable management of natural resources in Scotland and internationally. We provide the facts that support informed choices for the future of land use.

To find out more, please email us at biggerpicture@macaulay.ac.uk or visit macaulay.ac.uk



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“ It could be argued that, on a global level, peat bogs are Scotland’s most iconic soils ”

Rebekka Artz

Features: The Active Outdoors

Dogs and Outdoor Access: 7

Exploring a range of perspectives of outdoor access with dogs

Assessing Future Recreation Demand: 11

Policy aims for greater use of the outdoors

Tick-borne Diseases: 12

Research into Lyme borrelia exposure

Come Walkabout at Glensauigh: 36

Also inside:

Art & Science: 8

Exploring a creative mix of arts and science images

Scanning Electron Microscopy: 18

A new era of microscopy and imaging

Choosing our Tomorrows: 20

An interactive exhibit designed to improve public awareness and understanding of the issues surrounding future energy supplies, transport and food security



“ Whether it is sludge from a contaminated site, rock from the sea bed, an unknown deposit in a pipeline or rusting metal, Macaulay scientists now have even better resources than ever to help our clients make informed technical decisions ”

Evelyne Delbos

Editor: Clare Neely
Photographic Editor: David Riley
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Any comments, please email: in-land@macaulay.ac.uk
Printed on 80% recycled paper

Front page image depicts *Penicillium* sp. at a magnification of approximately x 75,000 taken with the Institute’s new Scanning Electron Microscope

Welcome



After an unusually cold winter we are now entering a period of warmer days and lighter evenings. Whilst many of the research scientists are now enjoying these improved conditions as they carry out the field work so essential for our scientific research, it also seems the appropriate time to focus on the 'active outdoors'; the theme of this edition of in-land.

From a short stroll around the newly redeveloped pond in the grounds of the Institute where we have improved conditions for aquatic biodiversity as well as improved access (page 6) to the new public access trail at Glensaugh Research Station (page 36) we hope you manage to enjoy all the outdoor facilities that the Scottish countryside has to offer.

As a dog owner I appreciate that there are often conflicting viewpoints between dog walkers, recreational users and land managers when taking dogs into the countryside. I hope you take the opportunity to view the film created on this subject which also highlights ideas for managing these issues (page 7). Dogs in countryside areas was also a research area chosen as one of the topics in the Enlightenment: The Art of Science photography exhibition created from the research of the *knowledgescotland* partnership and managed by the Moredun Institute (page 9). Research on ticks, and the diseases they carry is highlighted on page 12 and we would all be advised to refresh ourselves on the tips for avoiding them.

This edition of in-land also provides an opportunity for us to promote some of the other research activities that the Institute has been involved in recently. A £250,000 investment in a new Scanning Electron Microscope, the only one of its kind north of the Central Belt, will allow Macaulay Scientific Consulting Ltd (MSCL), the commercial arm of the Macaulay Land Use Research Institute to expand the wide range of services offered by capturing images, not only at very high magnification but unprecedented levels of clarity and detail.

This facility is expected to benefit local companies operating in the oil and gas exploration and production sector but was also utilised recently by the Scottish Environment Protection Agency for the analysis of volcanic ash from the Icelandic eruption. Read more on page 18.

I was also delighted to be able to attend the premiere of the Institute's Climate Change Installation at the Scottish Parliament in February. Building on from the successful 'Choosing Our Tomorrows' film resource, the Institute now has an exciting interactive exhibit which will be used not only to raise public awareness around issues such as food security, climate change and future energy supplies, but also will be used to collect information from the public on their attitudes toward climate change and behavioural change (page 20).


A large part of our work recently has been to provide input into the Scottish Government's Land Use Strategy. Originally launched at the Macaulay Land Use Research Institute in September 2008, we were heavily involved in the Rural Land Summit held in Inverness last November (page 14) and continue to work on the links between different types of land use, their competing demands and the wide range of economic, social and environmental benefits which Scotland's rural land delivers.

I hope you enjoy reading about our recent highlights. Many other examples of our work can be found on the Institute website and we are, of course, always pleased to hear from you directly.

Until we meet,

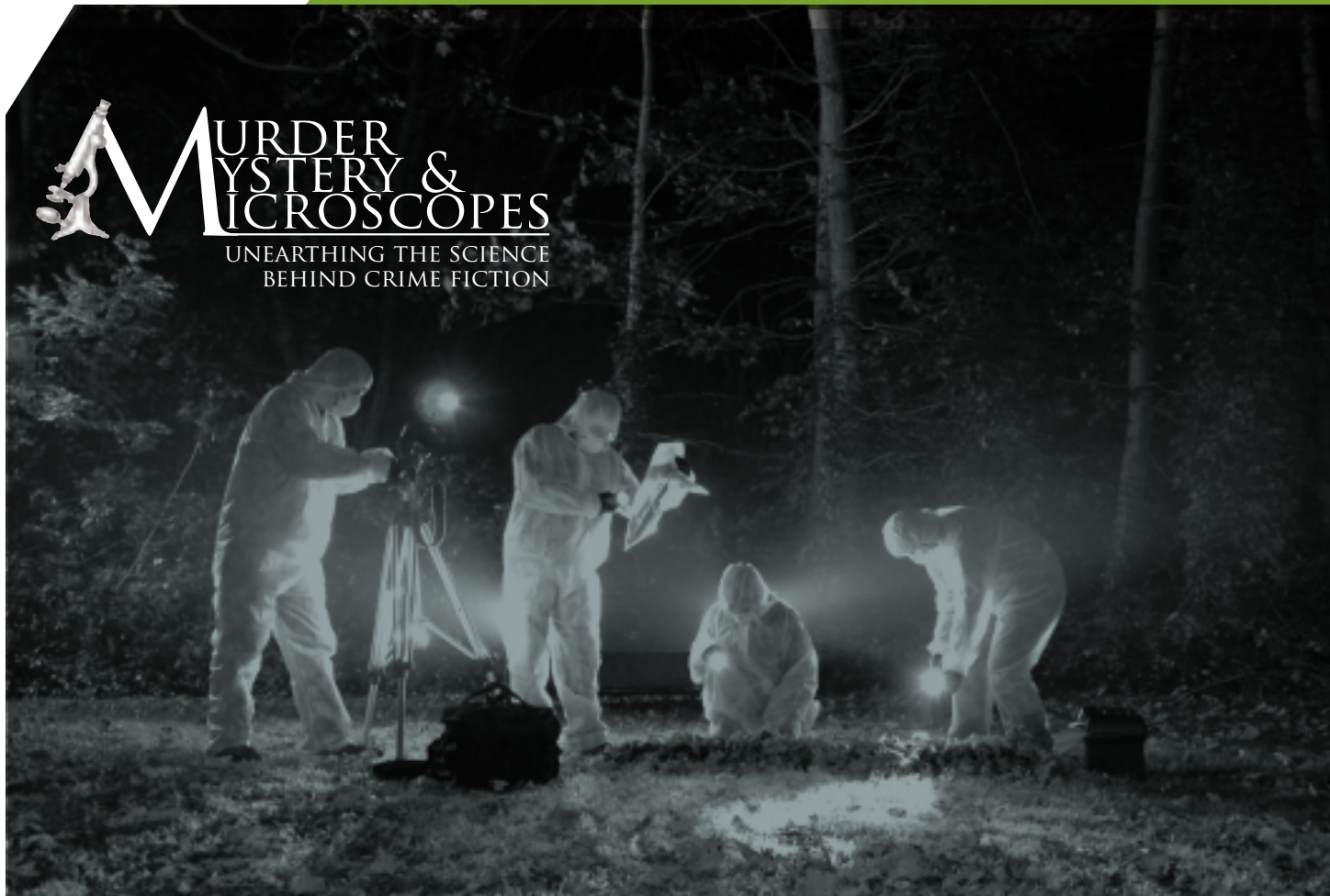
Richard
Richard Aspinall
Chief Executive





MURDER MYSTERY & MICROSCOPES

UNEARTHING THE SCIENCE
BEHIND CRIME FICTION



Murder, Mystery & Microscopes named the 'Best Live Communications Event'

The Institute scooped the 'Best Live Communications Event' for 'Murder, Mystery & Microscopes: Unearthing the Science behind the Fiction' at the British Association of Communicators in Business (CiB) Scotland Awards 2009. Judged by a panel of respected and leading industry figures, the Murder, Mystery & Microscopes team were announced as winners at the prestigious awards ceremony, which took place in Glasgow in February.

Lorna Dawson, Head of Soil Forensic Science said,

"On behalf of everyone from the Macaulay Land Use Research Institute, we are honoured to have received such a significant award. This is a tremendous achievement and great recognition of all the hard work that went in to making this event."

The CiB Awards Scotland celebrate the most influential business communications in Scotland. They provide an opportunity for organisations to share the work they are proud of, and be commended for their achievements and contribution to business and society. ■

Join the MMM team on tour:

- **22-25 July 2010**
*Theakstons Old Peculier
Crime Writing Festival*
- **7 September 2010**
*Orkney International
Science Festival*

Or follow them on twitter:
twitter.com/MacaulayMMM

macaulay.ac.uk/MMM



Image: David Riley

The pond area is accessible to the public, with access from Macaulay Drive. A self-guided tour of the pond area is included in A Guide to the Estate and Grounds, which highlights points of interest in the grounds of the Institute.

This can be downloaded from:
www.macaulay.ac.uk/OpenDoors2009/macaulay-arboretum_guide.pdf

For a hardcopy, please contact:
enquiries@macaulay.ac.uk



Couper's Pond

To improve aquatic biodiversity as well as the aesthetics of the area, contractors have recently completed environmental improvement works to Couper's Pond, an ornamental pond created when the Craigiebuckler estate's previous owner, Mr John Cardno Couper, landscaped the grounds at the end of the 19th century.

Typical of many late Victorian layouts, the pond area was planned on an oriental theme using Chinese or Japanese shrub and tree species. The design also included a water feature, a boathouse and an arched rustic bridge leading to an island on which sat a pagoda –shaped ornament.

Although many of the original features are now only a memory, the pond continues to have an important role in both regulating the flow of the Buckler Burn during rainfall events and in providing a habitat for a wide variety of flora and fauna.

However, through time, the pond had become silted up and the surrounding area had become badly overgrown, with conifers and laurels overshadowing the water surface. A small working group from the Institute contributed to plans for improving the area, whilst retaining its charm and sense of history. Fortunately this was helped in that the area has a good collection of established tree specimens, either remaining from the original layout or from later planting

initiatives. Some interesting examples include Dawn Redwood (*Metasequoia glyptostroboides*), Camperdown Elm (*Ulmus glabra 'Camperdownii'*) and Monkey Puzzle (*Araucaria araucana*).

The improvement works have involved dredging the pond, removing or pruning overhanging bushes and shrubs and re-creating pathways. Plants, shrubs and trees that are in keeping with the original planner's ideas will be reintroduced.

Now that the water is deeper and less shaded, it is hoped that a better environment for aquatic invertebrates has been created and that aquatic birds will be attracted to the area. Some parts of the pond have been left un-dredged to suit aquatic plants that need a shallower environment. Plant species and density will be monitored and supplemented to ensure that suitable habitat for pond life is maintained.

A belt of trees and shrubs has also been retained at the southern boundary of the area to act as a habitat for woodland birds and to act as a wildlife corridor for species such as roe deer. ■

With thanks to Aberdeen Greenspace who generously provided a grant to assist with the cost of the project.





Image: Katrina Brown

Dogs & Outdoor Access

A film which aims to explore a range of perspectives of outdoor access with dogs has been produced. The intention is to stimulate debate and encourage mutual understanding between the different viewpoints of dog walkers, recreational users, land managers, access professionals and policymakers within the Cairngorms National Park.

Made as a collaborative project between the Cairngorms Local Outdoor Access Forum (CLOAF) and the Institute, 'Dogs and Outdoor Access' discusses the benefits of taking dogs into the outdoors, identifies some of the challenges involved in putting 'responsible' access into practice in different situations, and highlights various ideas for managing these issues.

The film was created following research on the implementation of the Scottish Outdoor Access legislation in the Cairngorms National Park and was produced, directed and edited by Katrina Brown, Rachel Dilley and Keith Marshall plus Nic Bullivant from CLOAF. ■

The twelve minute film can be viewed at:
macaulay.ac.uk/videos/CLOAF/

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Keith Marshall

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Image Andy Taylor

(Above) Carol Taylor viewing her painting 'Sphagnum blanket' (Below) 'Memories from the Carnwath Moss'



The Institute has been involved in two exhibitions which explore the links between art and science.

Beauty and the Bog which includes paintings and limited edition prints inspired by native

Scottish plants, was launched at the Dancing Light Gallery in West Linton during February. The exhibition aims to raise public awareness of the importance and beauty of bogs both as an important natural resource for carbon sequestration and as a fascinating ecosystem in which to observe organism interactions and functions.

The Institute supported the exhibition through a Knowledge Exchange Grant to South Lanarkshire-based artist Carol Taylor, sister of staff member Andy Taylor. Some of the paintings in the collection were inspired by Andy's work as well as research carried out by Rebekka Artz.

Rebekka said, "Awareness of peat bogs is most often governed by images of waterlogged, simple landscapes with little amenity or conservation value, whereas the reality of the system is far from these images. It could be argued that, on a global level, peat bogs are Scotland's most iconic soils."

The exhibition includes 54 pieces of art including 11 canvases painted during the period of the Knowledge Exchange Grant from the Institute. The remainder of the show includes paintings and limited edition prints inspired by Scottish native plants plus scanning electron micrographs of moss and lichens.

Enlightenment

The Art of Science by photographer David McIntyre

Enlightenment: The Art of Science features a creative mix of arts and science images by Scottish photographer David McIntyre. The exhibition showcases the work of the research institutes forming the *knowledgescotland* partnership, funded by the Scottish Government.

There are 30 images being displayed in the exhibition, each with accompanying text and it is hoped that the images will draw people to the caption to find out more about the science that inspired the image.

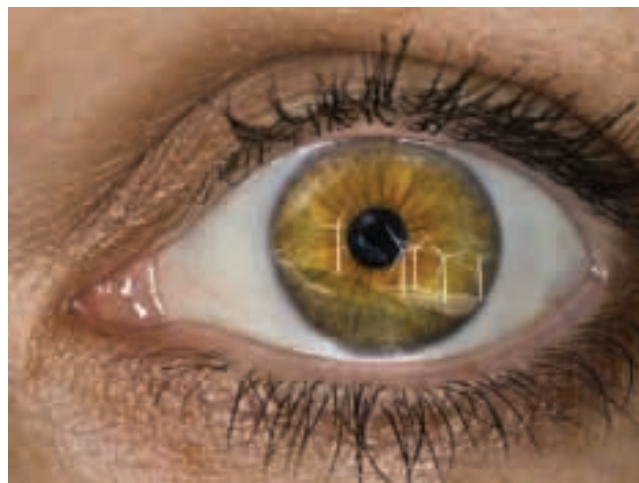
David McIntyre explained, *“I wanted to produce images that would reflect the stories behind the research. Some images are quite abstract in nature and show multilayered themes, while others involve a single bold concept. All are related to the scientific story that inspired them and I hope they may invite curiosity, provoke interest and lend themselves to imaginative interpretation.”*

The five images produced for the Institute explore the National Soils Archive, rural access, planning, catchment management and soil forensics.

The enlightenment exhibition was launched at Dovecot Studios, Edinburgh in March and, following a display at the Royal Botanic Gardens, Edinburgh, is due to go on show at various other venues throughout Scotland. ■

To view all the images and for more information visit:

moredun.org.uk/enlightenment
knowledgescotland.org



Wind Power in the Glen



Image Donald Barrie

A new 50 kilowatt wind turbine has recently been erected at Glensaugh research station to provide power to the farm.

The turbine is located on a site of rising ground exposed to the prevailing south-westerly wind, approximately 200 metres from the main farm complex. An exposed but accessible ridge lying about 2 km from the farm at an altitude of 300 metres was originally considered but at that distance only multiple turbines would justify the costs of cabling power to the farm, plus a pair of peregrine falcons were nesting nearby.

Installing a wind turbine is a big investment decision for landowners, with the difficult question of turbine size following consideration of site selection. A turbine generating 50 kilowatts sounds impressive but it must be taken into

account that it will only generate approximately 25% of its stated capacity.

Determining the size of the wind turbine was also challenging as funding criteria under the Scottish Rural Development Programme stipulate that 70% of generated power must be used by the applicant, and although planning restrictions do not apply to installations of 50 kilowatts or less, the local Planning Department decided that planning consent was required, although this was obtained without difficulty.

It is difficult to make good business decisions when so many variables have to be considered, but in a world of diminishing resources, power will always be in demand. With that in mind, a 50 kilowatt Canadian built turbine was ordered in late 2009, and following the coldest winter at Glensaugh since 1963, was commissioned on 12 March 2010.

To date, the turbine has generated about 5 megawatts of power, but only after a year of operation will the level of success of the investment be known, especially as initial assumptions about output price per kilowatt hour were understated and Renewables Obligation Certificate (ROC) payments, tradable permits between generators and distributors of power, were increased, later doubled and were finally scrapped in favour of a new feed in tariff scheme.

The farm continues to rely on the National Grid for power when the generator is not working, but long-term, the aim is to feed in more than is drawn out.

Generating power on the periphery of the Grid represents a fundamental shift in our national energy strategy. Wind turbines may not look beautiful, but they do not emit carbon dioxide and they help to displace centrally generated power. Therefore education is required to raise public awareness around the issues of future energy supplies and how our national energy supply will be made more secure by complementing central generation with embedded peripheral generation.

Visitors to Glensaugh are always welcome, and we would be happy to talk in more detail about our renewable energy projects. ■

For more information contact:

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or visit macaulay.ac.uk/glensaugh

Policy aims for greater use of the outdoors

Encouraging greater participation in outdoor recreation is a key policy objective in Scotland, both in terms of increasing numbers and frequency of use, and in encouraging a broader range of people to participate.

A recent study conducted by the Socio-Economic Research Group of the Institute in partnership with the Countryside and Community Research Institute, Cheltenham, examined the social, economic and environmental drivers of change in recreation demand. These were then applied to current trends in order to forecast how recreational use of the outdoors is likely to be affected in 5, 10 and 20 years time, who will participate, and in what activities and settings. The implications of these predicted changes for the planning, provision and management of outdoor recreation were also considered.

Key findings

- Overall, regular outdoor recreation in Scotland is increasing very slightly over time. Between 2003 and 2007 the proportion of the Scottish adult population undertaking regular (more than once a week) outdoor recreation grew from 33% to 44%
- This increase can principally be attributed to a growth in local recreation. Urban-based and short-distance outings are increasing whilst countryside trips are reducing
- Within this increase, however, participation is differentiated by age and social grouping. For example, 25 - 44 year olds are currently the most active regular participants. Lower socio-economic groups, women and ethnic minorities tend to be under represented

Katrina Brown who was involved in the research said, *“Maintaining the recent slight increase in outdoor recreation participation is likely to be difficult in the absence of intervention given the key drivers in operation. These include a population that is ageing and increasingly made up of in-migrants, fragmented leisure time, mobility constraints arising from growing economic and environmental costs of travel and access to quality green spaces.”*

“Ironically, despite health being one of the main reasons to increase participation, poor health is one of the reasons people give for not using use the outdoors more.”

Policy implications

A key implication will be the need to provide quality outdoor recreation opportunities, both in terms of the infrastructure and services, particularly in proximity to places of work and residence plus measures for encouraging and managing access for a diversity of uses and users. ■

For more information contact:

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Image Jonathon Dawson

Most Lyme disease infections are caught from ticks in woodland or forests as there tend to be more pheasants, small mammals and small birds in wooded areas than in open habitats and hence more ticks.

To minimise the chance of being bitten by a tick

- **Avoid ticky habitats**
- **Don't stray from the footpath**
- **Use insect repellent**
- **Wear pale-coloured long sleeves and trousers tucked into socks**

After your excursion, check every part of your body thoroughly for ticks. If you find one, remove it as soon as possible using a tick remover (available from some pet shops or BADA bada-uk.org/products/tickremover.php) or fine tweezers: grasp the tick as close to your skin as possible and pull firmly (no twisting necessary), then apply antiseptic to the bitten area. Do not squeeze the ticks body, burn it or use Vaseline or alcohol. Keep the tick in case it is needed for later analysis. Seek medical attention as soon as possible if a bulls-eye rash or flu-like symptoms develop.

For more details please visit the websites for the European Concerted Action on Lyme Borreliosis (EUCALB)

meduni09.edis.at/eucalb/cmsindex.php?lang=en and lymediseaseaction.org.uk/ticks.htm

Images courtesy of Gabor Pozsgai, an entomologist at the Institute who has a keen interest in photography, especially insects.

For more photos by Gabor, please visit www.photogabor.com

Ticks

Ticks are of growing concern and reported cases of Lyme borreliosis (Lyme disease) are increasing in Scotland at a phenomenal rate: from three reported cases in 1999 to 285 in 2008, according to the Health Protection Scotland website.

Lyme borreliosis is caused by the bacteria *Borrelia burgdorferi* transmitted by the sheep tick *Ixodes ricinus*. This is the tick commonly found on clothing, pets, sheep and deer. It has three active stages: larvae, nymphs and adults and it is the nymphs that cause most Lyme borreliosis cases.

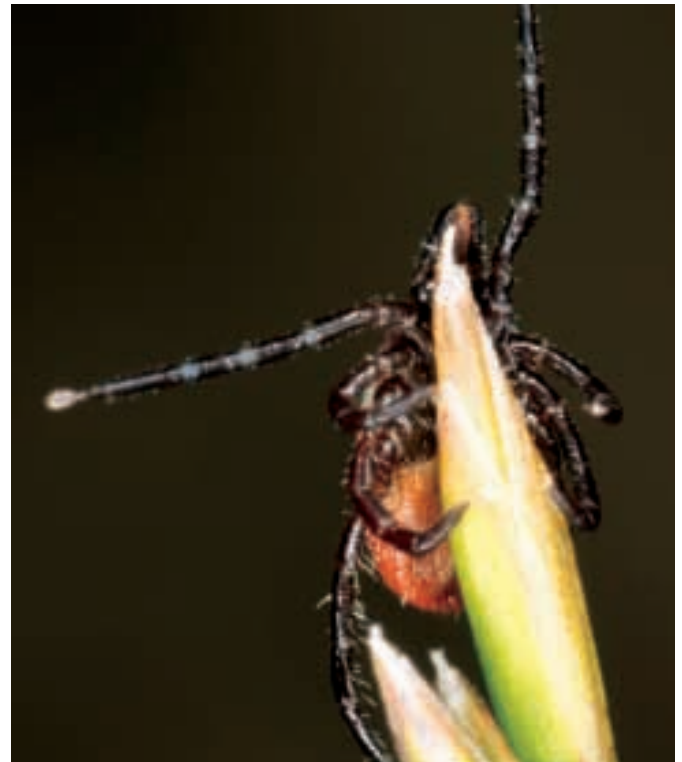
The rise in reported cases of Lyme borreliosis in Scotland is probably due to enhanced awareness as well as a real rise. Evidence shows that ticks in some areas are increasing and spreading. One reason could be changes in the numbers and distribution of their main hosts in Scotland – deer. Roe deer have been increasing and spreading throughout the UK for the last few decades but climate change could also make conditions more favourable for ticks.

To be active, ticks require certain minimum temperatures, which is why the main tick season in Scotland tends to be from April to October. As more weeks per year reach temperatures above these thresholds, ticks have more time for finding a host, which is essential for their survival. Research at the Institute has recently shown that ticks get much rarer as you walk up hills. This is because the cooler temperatures shorten the tick's host-finding season, thereby decreasing tick survival. As the climate warms, ticks may get more common at higher altitudes, increasing the risk to hill walkers.

Other changes impacting on ticks include afforestation. The Scottish Government is aiming for 25% (from the current 17%) woodland cover by 2050, partly for climate change mitigation. However, recent research shows that the biodiversity, as well as the mild micro-climate, in woodlands generally means more ticks in woods than in open habitats, unless deer are excluded. ■

For more information contact:

Lucy Gilbert l.gilbert@macaulay.ac.uk



Images Gabor Pozsgai

The Institute is undertaking research into Lyme borrelia exposure. If you have been diagnosed with an infection of Lyme borrelia in Scotland in the last five years, and you know where you picked up the offending tick, an online questionnaire is available at: macaulay.ac.uk/lyme/onlineform.php

All information given will be treated with strict confidentiality and only be used by members of the research group. No personal data will be published on the website or in any literature.

Rural Land Use Summit

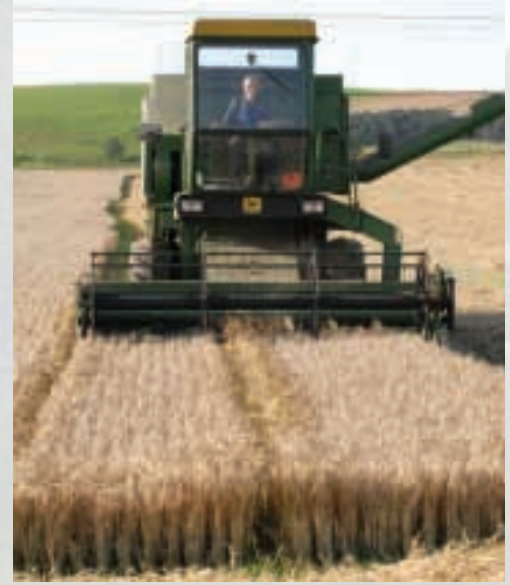


Image s:David Riley

Scientists from the Institute presented key findings to over 150 delegates and stakeholders, including Cabinet Secretary for Rural Affairs Richard Lochhead, at Scotland's first ever Land Use Summit held in Inverness last November. The Land Use Strategy is being developed to help meet challenges of food security, energy production and tackling climate change.

The links between different types of land use and their competing demands were discussed at the summit, highlighting the wide range of economic, social and environmental benefits which Scotland's rural land delivers.

In partnership with several other research organisations, the Macaulay Land Use Research Institute led two of the three research projects (see text box opposite), which comprised the Rural Land Use Study, originally launched

at the Institute in September 2008. These projects focused on the drivers and decision-making for land use and change in Scotland, and the potential contributions of rural land to the Scottish Government's overarching purpose of delivering sustainable economic growth.

David Miller, who led the project on drivers of land use change, said, "Our research revealed the increasing role that local communities have in decisions relating to land use. This is through their direct management of land, and the increased consideration given to local communities by both public and private land managers.

"Inequality of the availability of information is a potential concern, and constraint on the uptake of new opportunities, and pressures on land use."

Bill Slee, leader of the project on sustainable economic growth, said "Rural land has a pivotal role in generating well-being for people in Scotland and more widely. This is because land has many values: as a provider of food, fibre and energy and its vital role in important supporting, regulating and cultural ecosystem services.

Because so many of the values of rural land are not captured effectively by markets, getting the right balance in land use is a challenging task. By better understanding the causes of land use conflict and by learning from good examples of complementarities in practice, the Rural Land Use Study provides the evidence-based foundations on which a stronger Scottish land use strategy can be built."

For more information contact:

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Bill Slee b.slee@macaulay.ac.uk

"Our land and environment sustains businesses and jobs, supports families and communities, puts food on our plates.

"Yet, until now, we did not have evidence in the one place on the various, often conflicting, pressures on this resource to help us determine how this most valuable asset can be managed to ensure that we not only gain from it but preserve it for future generations."

—Richard Lochhead

The full titles of the two research projects led by the Macaulay Land Use Research Institute were:

Project 1. Changing land use in rural Scotland - drivers and decision- making (led by David Miller)

Project 2. Realising the potential contributions of Scotland's rural land to delivering sustainable economic growth. (led by Bill Slee)

Key findings from the comprehensive programme of research into rural land use in Scotland include:

- Scotland's rural land delivers a huge range of benefits including income and employment, strong and resilient communities, food, fuel and energy, and carbon sequestration
- the specific pressures likely to face Scotland in the short and longer-term, including the key importance of climate change
- the parts of Scotland in which those pressures are most likely to occur, with intermediate quality land under most pressure from competing demands
- examples of how land managers are successfully dealing with these competing demands
- the increasing involvement of communities in rural land use decisions
- information, training and skills development is crucial to ensuring that rural Scotland is equipped to meet fresh challenges



Have your say on the Scottish Government's Land Use Strategy

How can Scotland produce enough food, develop its renewable energy capacity and protect its iconic landscapes and habitats?

The development of Scotland's first Land Use Strategy offers a landmark opportunity for you to have your say on the way Scotland's land is used for generations to come.

The strategy must set out the Government's objectives in relation to sustainable land use, as well as proposals, policies and their associated timescales for meeting those. The objectives, proposals and policies must contribute to obligations under the Climate Change (Scotland) Act 2009 on emissions reduction targets, to climate change adaptation objectives and to sustainable development. ■

For further information visit:

scotland.gov.uk/Topics/Environment/Countryside/Landusestrategy

Findings from the Study will help inform a wide range of policies, in particular the Land Use Strategy, scheduled to be placed before the Scottish Parliament in March 2011.



World Water Day

To help celebrate World Water Day on Monday 22nd March, Susan Cooksley and Simon Langan from the Institute's Catchment Management Group participated in an interactive online event focused on Hydrology, Environment, Life and Policy (HELP) river basins in Scotland.

Organised by the UNESCO Centre for Water Law, Policy and Science at the University of Dundee, the innovative event offered a collective gathering of knowledge, expertise and opinion from amongst the worldwide network of HELP stakeholders with Susan and Simon focusing on the River Dee.

International World Water Day is held annually as a means of focusing attention on the importance of freshwater and encouraging the sustainable management of freshwater resources. ■

Videos and presentations from the online seminar are available to view by visiting:

www.be2camp.com/page/world-water-day-workshop.

Presentations also include those made by the Dundee UNESCO Centre, the Tweed Forum, SEPA and RSPB.



Adapting farming to climate change

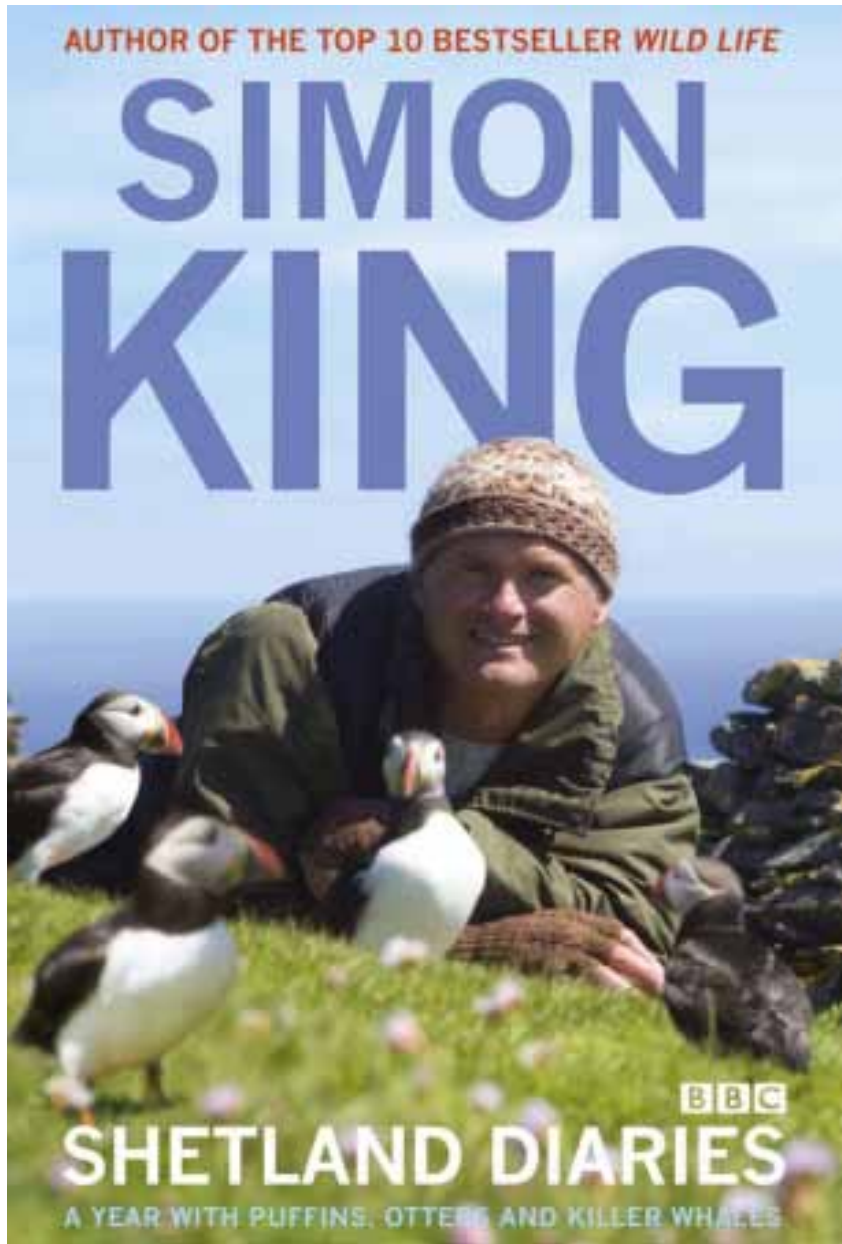
Climate changes and stricter environmental regulations pose new opportunities and challenges to farmers. Extended periods of rainfall increase erosion and input of nutrients and pathogens to water, and periods of drought hinder the ability of water to dilute diffuse inputs. In order to maintain an efficient agricultural production under the changed conditions, farmers must adapt their production.

This is the basis for project Aquarius, which is partly funded by the EU-North Sea Region Programme Interreg IVB.

Fifteen partners from six nations around the North Sea are conducting seven national pilot projects. The common aim is to find and implement sustainable, integrated land-water management through engaging with land managers. ■



For further information visit:
macaulay.ac.uk/aquarius



Shetland Diaries

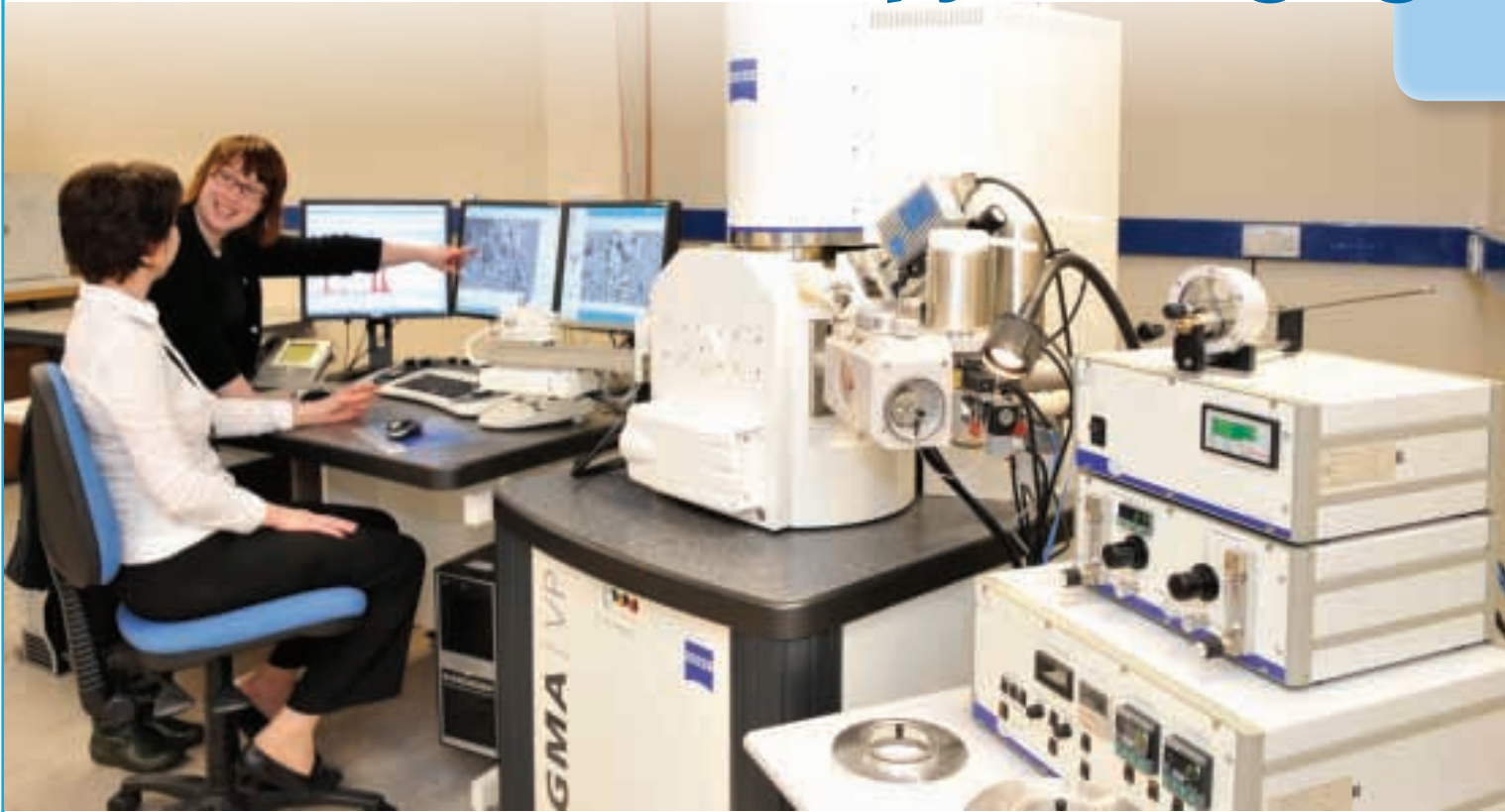
Simon King is known to millions for his many programmes on the natural world - including *Big Cat Diary*, *Spring Watch*, *Autumn Watch*, and *David Attenborough's Blue Planet*, as well as numerous appearances on BBC's *The One Show*.

As part of celebrations for the International Year of Biodiversity, the Institute was proud to sponsor the acclaimed author and film-maker as he discussed his new book, *Shetland Diaries*, based on the recent TV series at the University of Aberdeen's Writers Festival in May.

With his wife, Marguerite, and three-year-old daughter, Savannah, Simon experienced Shetland through the changing seasons and discovered the wildlife and the warmth of community in these islands battered by the North Sea. Their journey is filled with adventure, beauty, humour and occasional hardship as Simon discovers the true voice of Shetland. ■



A new era of **microscopy & imaging**



With over 70 years of accumulated knowledge dedicated to the study of soils, land use and the environment and a team of experienced analytical scientists and modern instrumentation, Macaulay Scientific Consulting Ltd (MSCL), the commercial arm of the Macaulay Land Use Research Institute, offers exceptional multi-disciplinary analysis capabilities and the flexibility to tackle a wide range of environmental samples.

As well as supporting the scientific research at the Institute, MSCL offers analytical services to external clients who are set to benefit from a £250,000 investment in new facilities and technology with the recent installation of a new state-of-the-art Scanning Electron Microscope, the only one of its kind north of the Central Belt.

Electron microscopy is an established tool at the Institute, however the new system will open up the wide range of services offered by the capture of images, not only at very high magnification but at unprecedented levels of clarity and detail, and analysis of samples too small for any other analytical technique.

Scanning Electron Microscopy (SEM) is an extremely versatile tool which allows the study of material composition from virtually all areas of science and technology. The benefits of SEM over conventional microscopy include very high resolution and greater depth of field at magnifications from x 20 to x 1,000,000.

By using electrons instead of light to form an image, unlike many microscopes, the SEM can analyse rough samples. A strength of the new SEM is that there is no need for the sample to have been dried beforehand; it can analyse fresh samples including solids, semi solids and even liquids.

“A number of geoscience specialists within oil and gas companies already have access to SEM facilities. However, the state-of-the-art instrumentation now available at the Macaulay will open up a range of new possibilities. In addition to its high resolution imaging capability, the SEM is fitted with an Energy Dispersive Spectrometer making X-Ray microanalysis and X-Ray mapping all possible. It is also equipped with a cryogenic stage allowing for the preservation of fluid phases in the samples, and analysis in situ if necessary,” explains Evelyne Delbos, Head of Electron Microscopy.

“Whether it is sludge from a contaminated site, rock from the sea bed, an unknown deposit in a pipeline or rusting metal, Macaulay scientists now have even better resources than ever to help our clients make informed technical decisions” ■

Take a closer look...

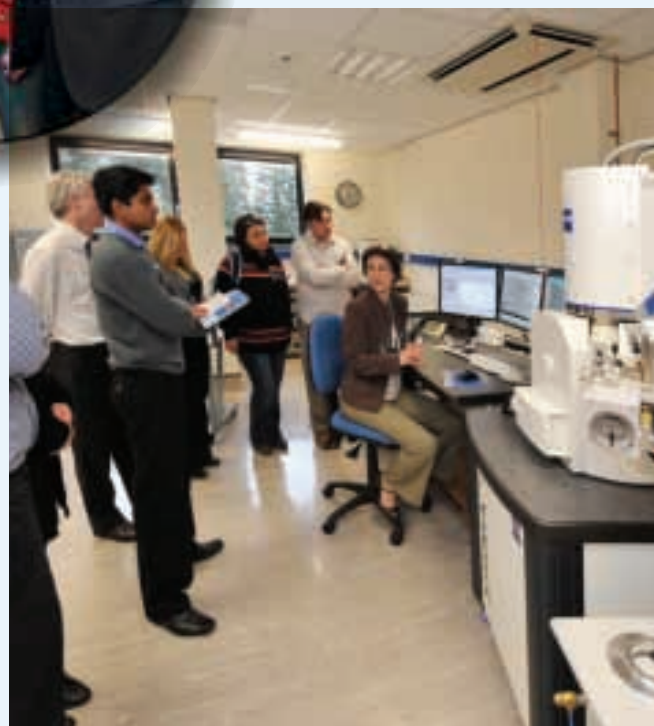
To celebrate the opening of our new Electron Microscopy facility, local companies operating in the oil and gas exploration and production sector were invited to the Institute in March for a tour of the facilities and a demonstration of the technology.

The facility was officially opened by Robert Collier, Chief Executive of the Aberdeen and Grampian Chamber of Commerce.

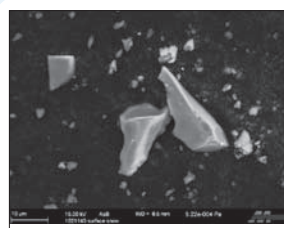
In addition to the official opening, the Institute hosted a technology awareness day which provided an opportunity for visitors to explore the industrial and research applications of the Electron Microscopy facility and its complementary analytical techniques. It also included technical and practical demonstrations which illustrated the versatility and power of the technology across a range of geoscience and industrial applications. ■

For more information contact:

Evelyne Delbos e.delbos@macaulay.ac.uk



Images David Riley



Following the eruption of the Eyjafjallajökull Icelandic volcano, a sample collected in Lerwick by the Scottish Environment Protection Agency was sent to the Institute for testing of its chemical make-up. SEPA were

particularly looking for elements which may be harmful to the environment.

Analysis conducted by the Institute showed broadly uniform sized (approx. 20 micronmetre) particles of angular shape some exhibiting striations and others with surface fractures typical of quartz and glass.

Energy Dispersive Spectrometer (EDS) analysis showed most particles to be of a similar composition consisting of silicon, oxygen, aluminium, sodium, calcium, magnesium, potassium, iron and chlorine.

Choosing our Tomorrows



Images David Riley

Two years ago, the Institute developed a film resource centered around the challenge of climate change but specifically addressing the idea that we have choices in the ways that we individually and collectively respond to this challenge.

The key message was that these choices will result in very different outcomes. To illustrate this, 'video diaries' were created based on the experiences of three members of a farming family living in Scotland in 2050. The diaries were collectively entitled "Choosing our Tomorrows" and formed the key element of a science engagement programme aimed at improving public awareness and understanding of the issues surrounding climate change, future energy supplies and food security.

This film resource has been used extensively and has been adopted as part of the resources for the Transition Towns initiative. However, as it was felt that the resource needed to be seen by a much wider range of people and also be used in a more interactive way, the Institute has created an exciting new interactive exhibit to allow members of the public to view the diaries, interact with the information they provide and consider their own behaviours in relation to climate change.

The exhibit was unveiled at the Scottish Parliament in Edinburgh in February and includes an indecisive polar bear and choices around travel, transport, water and energy use which are designed to highlight and educate all ages of the Scottish public about their lifestyles and behaviour which may impact on future climate change.

We will also be gathering data from this interactive exhibit. This data will be used for two Scottish Government Rural and Environment Research and Analysis Directorate (RERAD) funded projects looking at household behaviours and climate change. One project aims to develop an understanding of the psychological antecedents (e.g. attitudes, emotions, norms, habits, values) to household environmental behaviours that impact on climate change: the other will examine the links between individual and community response to mitigation and adaptation measures and policies. The survey results will also provide a benchmark for future research.

Dr Richard Birnie, Head of Communication Services at the Institute said,

"The exhibit invites the public to sit down and take a look at what Scotland could be like in 2050 depending on the choices we make today. It features touch screen technology for users to take part in an attitude survey, fun and informative video diaries, and interactive games.

"The interactive survey is designed to improve public awareness and understanding of the issues surrounding future energy supplies, transport and food security and supports the Scottish Climate Change Bill which aims to reduce greenhouse gas emissions by 80% by 2050."

Following its debut at the Scottish Parliament, the exhibit went to the John Hope Gateway of the Royal Botanic Garden, Edinburgh and will tour Scotland. ■

macaulay.ac.uk/climatechange/installation/

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Clare Neely c.neely@macaulay.ac.uk



callistoproductions.com



scotland.gov.uk

ABSORB

The fourth edition of ABSORB is out now. ABSORB is a collection of briefings summarising socio-economic research conducted by staff at the Macaulay Land Use Research Institute and the Scottish Agricultural College (SAC). It begins with a Foreword from Alan Renwick, Manager of the Land Economy and Environment Research Group (LEERG) in SAC, highlights some of our research on Sustainable Economic Growth and features research conducted by PhD students from both organisations. ■

For more information visit:

macaulay.ac.uk/absorb

Institute raises money for cancer charity

Staff presented a cheque for nearly £1,200 to Friends of ANCHOR, a cancer care charity in Aberdeen. The money was raised during a Quiz Night held at the Institute and was presented to Friends of ANCHOR fundraising manager, Fiona Pearson, during a visit to the Institute.



Image David Riley

Friends of ANCHOR was formed in 1997 to support the Aberdeen & North Centre for Haematology, Oncology & Radiotherapy (ANCHOR) unit at Aberdeen Royal Infirmary. The ANCHOR unit cares for patients with all forms of cancer, blood diseases and blood disorders. The charity funds the purchase of equipment for the ANCHOR unit and provides additional care, comfort and support for its patients. It also funds crucial ground-breaking cancer research at the University of Aberdeen.

Fiona Pearson said, "On behalf of the charity, we would like to thank everyone who organised this fundraising event and everyone who came along and joined in the fun. Without supporters who raise funds we would be unable to offer the level of support we do at the ANCHOR unit. Your donation will make a big difference to the hundreds of patients who attend the ANCHOR unit every year and who will benefit from your generosity and support." ■

Beaver Impacts

Macaulay scientists are working with Scottish Natural Heritage (SNH) to monitor the impacts of beavers on riparian woodland in mid-Argyll.

Beavers became extinct in Scotland around the 16th century, primarily as a result of over-hunting, and by the start of the 20th century, only about 1,200 individuals remained across Eurasia. Since then, the species has made a strong recovery as a result of protection and active reintroductions in at least 24 countries across Europe.

In May 2009, the Scottish Wildlife Trust and the Royal Zoological Society of Scotland released three families of European beavers from Norway onto lochs in Knapdale Forest. This initiated a pioneering five-year trial to assess the feasibility of more widespread, permanent releases of beavers across Scotland. If successful, the trials are likely to guide future efforts in England and Wales.

Beavers are famous as ecosystem engineers: they modify their environment by felling trees and building dams. Trees are felled for their bark and small branches, which provide food during winter. The tree species favoured by beavers respond to felling much as they would to traditional coppicing by humans. They typically produce abundant new growth, which becomes a valuable source of food for beavers and other herbivores.

At Knapdale, the Macaulay team have established a large number of plots which will be revisited twice a year throughout the trial. These will enable the species and size of trees that beavers prefer to fell, how those trees respond to the impacts of beavers, and how beavers, deer and other herbivores respond to the changed waterside vegetation to be identified. From this information a detailed picture can be built up of how the physical structure and species makeup of woodland around the lochs is altered by the activities of beavers.

The Institute's work is just one part of a broad-ranging monitoring effort coordinated by SNH. Throughout the trial, other organisations will be keeping an eye on the beavers themselves, as well as otters, fish, water plants, river habitat and hydrology, public health, archaeological sites, socio-economics and water chemistry. ■



Image: Ben Moore

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JANEEMO DVD Launch



An educational DVD outlining the JANEEMO project will receive its first public screening at an official launch in June.

Jointly funded by the Institute, the DVD forms part of an education pack for Scottish schools and includes two short films directed by BAFTA nominated filmmaker Julian Krubasik, and Sabine Hellmann, both currently studying Film/TV Documentary/ Cinematography at the Edinburgh College of Art.

The first 'info-film' introduces the JANEEMO initiative. Oil-rich seeds from three tree species, Jatropha, Neem and Moringa, collectively known as JANEEMO, can be processed to produce biofuels for lamps, stoves and generators. The residue from this process can be used to produce biogas for cooking and as an agricultural fertiliser. In addition, extracts from the Neem and Moringa trees have important nutritional as well as medicinal uses.

The second film 'Joseph' tells the story of Joseph Tenson, a young Malawian schoolboy. Like many teenagers, he goes to school and enjoys spending time with his friends - but he dreams of moving away to seek his fortune. The village is starting to feel the effects of a changing climate but his family need to collect firewood for fuel. The JANEEMO initiative is planting trees for renewable bioenergy, food and medicine. Could this change Joseph's choices for the future?

Grant Davidson, JANEEMO Project Leader said, "In Malawi, communities are heavily dependent on shrinking forests for firewood but sourcing firewood is becoming increasingly difficult, reducing time available for education and enterprise development. JANEEMO tackles food security and renewable energy whilst building community enterprises.

We hope that the films will be a useful tool for teachers and school children in Scotland to engage with these issues, which affect the vast majority of rural Malawians."

As well as the DVD, the education pack contains a range of classroom activities developed by Scottish schools and a series of comics developed in association with Malawian schoolchildren. All materials were created in collaboration with Learning and Teaching Scotland to ensure that they cover curriculum themes such as citizenship and sustainable development. The pack will be accessible to all Scottish schools through Learning and Teaching Scotland's GLOW website, the world's first national intranet for education.

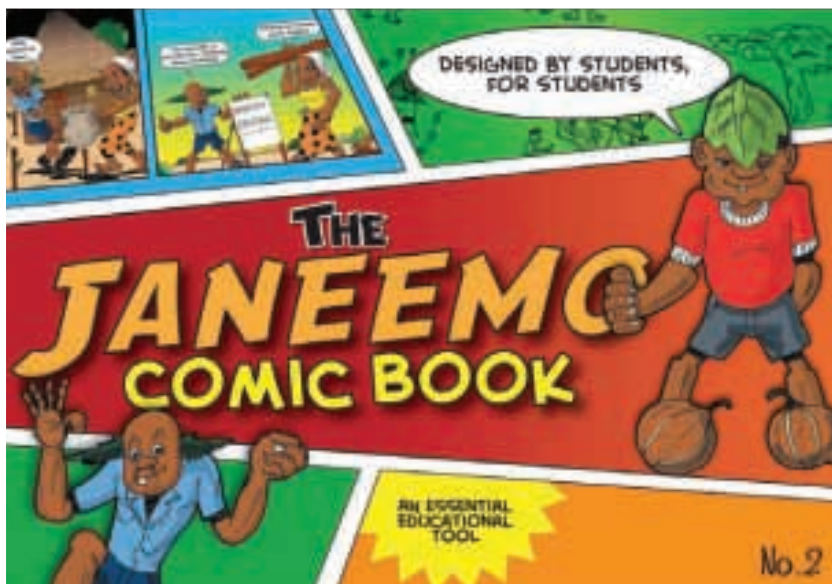
Filmmaker Julian Krubasik said, "Many aspects in a child's life, no matter where they live are similar, but



there are often big differences in the way children live and the energy they use. We want to make children in Scotland aware that children in Malawi can't just switch a switch to turn on a light or their television." ■

For more information contact:

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or visit www.janeemo.org



Images Arjen van Der Merwe

The JANEEMO project is funded by the Scottish Government's International Development Fund.

Effect of weather on the interactions between red deer & sheep in Scotland



Meteorological station and thermal models of sheep (right) and red deer (back) deployed in the study area.

Species that share resources are likely to interact, especially when resources become limited. Climate change can affect these interactions as changes in climatic conditions are responsible for the quality and quantity of vegetation that many species use as food and shelter.

Landscapes, especially in the hills of Scotland, have been modelled over millennia by the effect of red deer and over the last two hundred years by sheep too. These two species have to ingest a vast quantity of the low quality food that dominates the Scottish hills and, as a consequence of their grazing and browsing activities, glens and moorlands present a mosaic structure. The patchy structure of the vegetation is key for the maintenance of biodiversity in these habitats, creating new niches that can be occupied by different species, as well as making insects and small mammals more available to other species in the food chain.

To study how weather affects the interactions between red deer and sheep, an experiment has been set up in which both species graze a large moorland plot. The animals have been fitted with GPS collars that allow researchers to record the exact position of the animals every hour across the year. Changes in the structure of the vegetation and quality and composition of the diet of the animals are also monitored to assess the levels of

competition between the species and the effect on the different vegetation communities.

A key component of the research is to investigate the effect of weather conditions. For example, red deer and sheep might compete very strongly for habitat and food resources when the weather conditions are good; however, when the weather deteriorates, exposure to the combined effects of rain, sleet or snow, strong winds, low temperatures and limited sunshine that characterise Scottish winters might force one species to move to a sheltered area reducing the competition between both species. To assess this, researchers have deployed a network of meteorological stations across the experimental plot that allows climatic conditions to be recorded.

The most challenging part of the study is to estimate the toll that adverse weather conditions have on each species. To do so, researchers are using thermal mechanical models to estimate the energy expenditure of red deer and sheep. The models measure the amount of electrical energy required to maintain the core temperature of both species (about 39.6°C) when they are exposed to the same conditions that our real animals are facing in the experimental plot. ■

For more information contact:

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Workshop to explore impacts on biodiversity in the uplands



Richard Lochhead, Cabinet Secretary for Rural Affairs and the Environment, outlined the Scottish Government's priorities for the future management of biodiversity in the uplands at a meeting in Perth in November.

Organised by the Institute, the event focused on understanding the impacts of environmental and management change on biodiversity in upland ecosystems and, in particular, the effects on practical land management.

As the changing climate is impacting on vegetation, soil and water in natural and semi-natural habitats in the uplands, the consequences for biodiversity are jumping to the top of the research agenda. With 2010 designated as International Year of Biodiversity, risks from the loss of biodiversity are increasing in profile and the event attracted a wide range of delegates from environmental institutions across the UK.

Rachel Helliwell, who organised the workshop, said, *"This event not only provided an opportunity for us to share our research with a wide range of stakeholders but for land managers actually working in upland areas to share with us their experiences of changes in biodiversity on the ground."*

The workshop also provided an opportunity for discussion on the current major environmental issues in upland areas, the pressures these areas will face in the future and the future management of climate change impacts on biodiversity from a multiple land-use perspective. ■

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Celebrating World Soils Day

Institute announces completion of national soil sampling project

To celebrate World Soil Day on 5th December, the Institute announced the successful completion of a national soil sampling project.

The National Soils Inventory Scotland (NSIS) project involved re-sampling soils from sites all over Scotland which were first sampled between 1978 and 1987 to provide a valuable snapshot of the condition of Scotland's soils, the uses to which these soils are put and to measure any changes in soil health in the last 25 years.

Soil health can be determined by studying how much carbon dioxide is released from soil but stocks of organic carbon and nutrients within soil are at risk from threats such as climate change. Global warming is causing soils to release locked carbon, contributing to increasing levels of carbon dioxide in the atmosphere. The results of the NSIS survey will help scientists address whether Scottish soils are losing carbon, if agricultural land is being lost to urban sprawl and if increases in flooding may be due in any way to the way our soils are managed.

Willie Towers explains, *"Although the surveying part of the work is now complete, a large number of analyses still need to be carried out on the more than 2,000 samples collected."*

"The results from the re-sampling will be used to help formulate new policies or guidance on land use, advise farmers if their soils remain healthy and show whether our soils are showing any indication of increased pollutant levels." ■



Image David Riley

For more information contact:
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The National Soils Inventory is a regular grid of sample locations that were sampled during 1978–87 and 2007-09 to:

- Measure any changes in the last 25 years
- Test new indicators of soil health
- Test UK and EU monitoring methods
- Report on the status and stock of organic carbon and nutrients in the soil and their risk from threats such as climate change

Capturing the Changes in Rural Scotland

*Dancing Lady- Winner
Aged 19 years and over*



Image Diana Feliciano

After the success of our 2009 School Photographic Competition 'Moments in Time', the photographic competition this year was opened to all ages and asked 'How is Rural Scotland Changing?'

Participants were challenged to capture a scene which illustrates the changes taking place in rural Scotland and was designed to raise the public's awareness of changes in relation to water, landscape, climate change, rural society, soil and wildlife.

Judged by Richard Aspinall, Lesley Ferguson, Head of Collections at the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS), Euan McIlwraith, presenter of rural affairs and countryside issues on both BBC radio and television including Landward and Out Of Doors and Andrew O'Brien, Picture Editor at The Scotsman, the competition attracted a high standard of entries. ■

Congratulations to:

Aged 18 and under

Winner - Craig Masson - Barbed Wire

Runner up - Erin Hopps - Angel of the North East

Highly Commended - Emma McIntyre - Log Pile

Aged 19 and over

Winner - Diana Feliciano - Dancing Lady

Runner Up - Peter Lewis - Reed Bunting

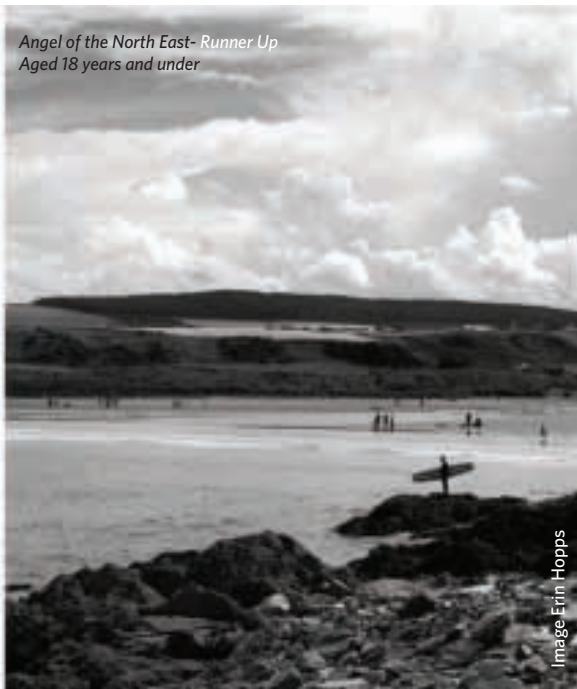
Highly Commended - Ron Roger - Dunes on the coastline from Fraserburgh to Cairnbulg

For more information contact:
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*Dunes on the Coastline from Fraserburgh to Cairnbulg-
Highly Commended Aged 19 years and over*



Image Ron Roger



Angel of the North East- Runner Up
Aged 18 years and under

Image Erin Hopps



Waiting for the Wind

Image Sue Wymes



Uig Sands

Image Heather Maslen



Reed Bunting- Runner Up
Aged 19 years and over

Image Peter Lewis



Barbed Wire - Winner
Aged 18 years and under

Image Craig Masson



Old Gate to River Dee

Image Ron Roger



Image Emma McIntyre
Log Pile - Highly Commended
Aged 18 years and under



Picnic Stop

Image Jonathan Dawson

Macaulayite on Mars?



Jeff Wilson investigating the exposure of deeply weathered granite at Bennachie in 1981...

Jeff Wilson and Steve Hillier were kept busy in December by media requests for more information on Macaulayite following a broadcast on BBC Reporting Scotland ([news.bbc.co.uk/1/hi/scotland/north_east/8400025.stm](https://www.bbc.com/news/scotland/north-east/8400025))

Macaulayite is a rare mineral, only known to be found at one location - a quarry at the foot of Bennachie in Aberdeenshire. It shares features with both clay minerals and iron oxides which are the most common and important two groups of minerals found in virtually all soils worldwide.

Although rare on Earth, planetary scientists at NASA are interested in Macaulayite as a mineral that might occur on Mars. The mineral is formed in the presence of water so if it does occur on the surface of Mars it could provide proof the planet can sustain life.

Jeff Wilson, who led the team that discovered Macaulayite in the 1970s, told BBC Scotland: *"It is exciting because this particular mineral contains water. It's a very fine grain mineral and water is bound to the inner surfaces. There's been a lot of speculation*

about the occurrence of water on Mars. We don't know but it could be associated with this mineral." ■

For more information contact:

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Jeff Wilson j.wilson@macaulay.ac.uk



...Colin Campbell and Steve Hillier visit the same site around 25 years later

Image David Riley

Student Seminar Day

Congratulations to Heather Smith who was judged to have given the best presentation at the Student Seminar Day held at the Institute in March.

Christian Birkel was awarded second place with Loïc Nazaries, who was 'Highly Commended' last year, placed third.

Heather and Christian will both be going forward to represent the Institute at the Science for Life Student Festival in May, organised by the Rowett Institute for Nutrition, University of Aberdeen.

Head judge Professor Janet Sprent commented that the standard of presentations, and therefore the task of the judges in picking a winner, grows each year. She passed her congratulations to all the students for their work and to Baerbel McRitchie and Stewart Rhind for organising the event. ■

Copies of the presentations are available online at macaulay.ac.uk/studentships/presentations2010.php



Image David Riley

Edinburgh International Science Festival

As part of the Edinburgh Science Festival and to celebrate the International Year of Biodiversity, Rob Brooker, Alison Hester and Simon Langan held a series of family talks at the John Hope Gateway of the Royal Botanic Garden, Edinburgh explaining what makes mountains and how plants and animals live in them, what grows on Scotland's mountains and how it might change if the climate changes and the role mountains play in the earth's water systems. ■



2010 International Year of Biodiversity



Image Lauren Farr-Miller

Climate Change? Let's talk about 'resource use'



In-depth interviews with members of the public in study sites across five EU countries, including Scotland, suggest that climate change is not a topic of major relevance to people. They are much more concerned about wasteful use of resources.

Research carried out by the Institute found that while many respondents were not overly concerned about climate change as such, they often expressed

great worry over the generally unsustainable way of living in their countries, including their own lifestyles.

Many perceived a need not only for technological change but for societal change, as resource use, and resource waste, at the current rate was not considered viable in the long run.

A wasteful use of resources was often seen as part of a deeply engrained contemporary lifestyle that had developed in recent decades. Changing this way of life was seen as essential in order to move to more sustainable resource management.

"Many of our interview partners called for strong and immediate government action," said Anke Fischer who led the study. "It was recognised that while there might be wide consensus that change was needed, behavioural change driven solely by individuals was likely to be ineffective."

"In addition, the research found that members of the public define climate change very differently from how it is generally portrayed in the media. This means that campaigns that build on presumed knowledge, for example by using concepts such as 'carbon footprint', are likely to fail, as people might not be able to relate to these concepts as intended."

The findings suggest that there is a broad willingness to accept that lifestyles have to change to avoid catastrophes and international conflicts over resources on the long run. However, this perceived need for change is not necessarily specifically connected to climate change.

Campaigns that aim to change resource use might fare better and reach a wider audience if they refer to the 'wise use of resources' rather than 'climate change' or 'carbon emissions'. ■

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*This work is part of the EU FP7 Project Gilded:
www.gildedeu.org/*



2010 Seminar Programme

The Institute once again hosted a very successful spring seminar series with staff and visitors enjoying seven talks on a range of subjects.

The seminar series began with a visit from Peter Gregory, Chief Executive and Institute Director of SCRI who outlined SCRI's work on environmental change and the opportunities and challenges for crop production and food security.

Tara Garnett, co-ordinator of the Food Climate Research Network, based at the University of Surrey, discussed the relationship between livestock and sustainability, and provided an overview of the technological options for tackling food related greenhouse gas emissions during her seminar. Her research includes a four-year study of the impact of food on climate change which found that measured by production, the UK food sector produces greenhouse gases equivalent to 33 million tonnes of carbon. The report also revealed which parts of the food chain were the most polluting. Although packaging has had a lot of media and political attention, it only ranked fifth in importance behind agriculture, especially the methane produced by livestock burping, manufacturing, transport, and cooking and refrigeration at home.

Graham Harvey, writer for GrassRoots Food, argued for a return to mixed farming -where both crops and grazing livestock are produced on the same land - in his seminar, 'The absolute importance of grassland and grazing for sustainable agriculture'. Any such system would require more labour than today's highly mechanised cereal systems, contributing not just to ensuring future supplies of

the reduction of greenhouse gas emissions and the programme of mitigation and adaptation set out in the Scottish Climate Change Delivery Plan.

Tom Nisbet, the Programme Manager for the Centre for Forestry and Climate Change in Surrey, explained how growing trees have the potential to make a significant contribution to meeting the UK's challenging emissions reduction targets. Growing trees absorb CO₂ from the atmosphere and this is leading to increased government support for woodland expansion. However, land use change presents a number of risks to soil and water that could threaten sustainable forest management. He focussed on the potential impacts on water quality and quantity, and considered the opportunities for new woodlands to aid water and flood management.

The two other seminars focused on Scottish Planning Policy for carbon neutrality and ecosystem management in the 21st century. ■

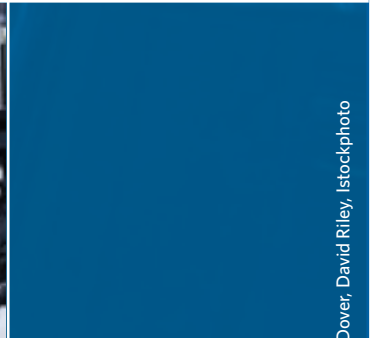
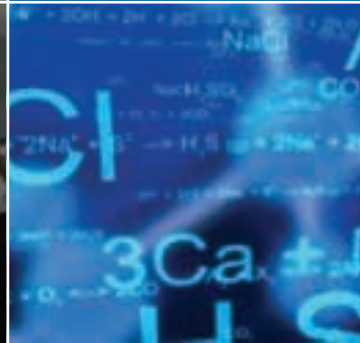
For more information contact:

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The next seminar series begins in autumn 2010.
macaulay.ac.uk/news/seminar.php

Macaulay Films

During April, filming took place at the Institute of a short documentary promoting the work of Macaulay Analytical. The film will be premiered at the Royal Highland Show, Ingliston in June.



Introducing the new Chair of the Board of Governors



The newly appointed Chairman of the new Institute to be formed by the Macaulay Land Use Research Institute and Invergowrie-based Scottish Crop Research Institute (SCRI) has spoken of his enthusiasm and optimism about the tasks that lie ahead.

Ray Perman's appointment was announced simultaneously by the two Institutes and the Scottish Government in March.

On his appointment, Ray Perman said: *"These two Institutes already have international reputations for the quality of the work they do. By coming together they are recognising that the problems the world faces, such as climate change and the sustainable use of scarce resources, demand cross-disciplinary solutions. The new organisation will have a tremendous amount to contribute to Scotland and the world and I feel privileged to be asked to play a small part in its formation."*

In October 2009, SCRI and the Macaulay Land Use Research Institute announced that they had agreed in principle to unite to form a new Institute to carry out research into food, land use and climate change.

"There is a huge amount of practical work to be done before the new Institute formally comes into being, but just as important will be helping to define the culture and goals. We won't reach our full potential unless we all agree how we are going to work together, what our ambitions are and how we are going to achieve them," said Ray.

"Just putting two organisations together is not enough. We don't just want to be bigger; we want to be better than we can be alone, to become world leaders in our chosen fields. We have to be brave enough to set ourselves stretching targets and work hard enough to achieve them."

Over the past six months, teams from the Macaulay Land Use Research Institute and SCRI have been meeting each other to document current practices and, where these differ, to discuss what options exist for harmonisation. The new Institute formally comes into being on 1 April 2011. ■

Ray Perman

Ray has a strong interest in conservation. He is a former Chair of the Scottish Advisory Council of WWF and a member of the board of trustees of WWF UK.

He is a trustee of the Botanic Foundation, which supports the scientific work of the Royal Botanic Garden, Edinburgh and also chairs the Access to Finance Expert Group, which advises the Secretary of State for Business, Innovation and Skills on policy relating to small business finance.

He was a member of the board of Scottish Enterprise from 2004-2009 and, from 2001-2009, chair of Social Investment Scotland, which makes loans to the social economy.

Ray's early career was spent in journalism working with newspapers including The Times, Financial Times, The Scotsman, and the Sunday Standard in Glasgow.



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