THE MACAULAY INSTITUTE

research today for land use tomorrow

in-land

The Newsletter of the Macaulay Institute
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SPRING 2007

30TH T.B. MACAULAY LECTURE

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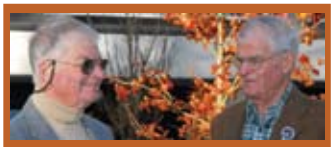

Founder's grandsons visit Institute

Treated like dirt

Grazing, bugs and birds

What impact are livestock having on our upland wildlife?

Building on a vision...

In 1930, a wealthy Canadian businessman of Scottish descent donated the money to establish a small institute for soil research, with a view to improving the agricultural conditions across his ancestral homeland.

That man was Dr TB Macaulay and the centre was duly named in his honour.

In the intervening years the Macaulay Institute has grown into a world-renowned centre of scientific excellence – probably far exceeding what its founder could ever have originally hoped for.

The Institute has established its international reputation by exploring a wide range of issues related to agriculture, the environment, land use, and the livelihoods of rural communities both in Scotland and across the world.

Recently we have been developing a new science strategy for the Institute, linking this with a comprehensive communication strategy related to the key audiences for our work. The science strategy presents our plans for using high-quality science to find innovative ways of using our land resources more sustainably for the good of both society and the environment.

A further goal of the Institute's science strategy is the development of a strong scientific understanding as an evidence-base to inform policy and management. Both the science, and our understanding of the role of science in evidence-based policy, will also be enhanced by increasing our interaction with policymakers and land managers during the course of our research.

Dr Macaulay's original concern to develop sound scientific research that underpins policy and management of land resources continues to this day – even if many of the challenges we now face did not exist when the Institute was founded 75 years ago.

Climate change, biodiversity, rural economies, as well as health and the environment, all provide an array of issues of fundamental importance not only in Scotland, but throughout the UK, Europe and internationally. These issues are central to the questions explored in our research programme and the scientific understanding that we develop.

This latest edition of in-land describes some examples of our recent work in these areas. You will see how we have helped define less-favoured agricultural areas, examined biodiversity and carbon storage in former peat extraction areas, and developed an understanding of the health of wildlife on Scottish hillsides as a consequence of changes in the EU's Common Agricultural Policy.

The last of these formed last year's Institute exhibit on 'Grazing, Bugs, and Birds', which we took to various high profile events, including the Royal Highland Show and 'Science and the Parliament'.

Many of the lessons we learn studying land use issues in Scotland, as well as the skills and expertise of the Macaulay's scientists, are also relevant to applied policy and management questions in other parts of the world and we have a growing list of international collaborators and partners.

Research carried out in remote, northern Alaska by Dr Martin Sommerkorn on the effects of climate change on Arctic ecosystems, and the work of the Ørskov Foundation in providing grants to help graduate students from developing countries are just two such examples highlighted within these pages.

We also continue to develop new applications for our knowledge, our scientific expertise and the methodologies we have developed – and sometimes these lead us into unexpected areas.

Soil forensics is being developed by Dr Lorna Dawson in the hope that previously untapped soil information will soon be assisting criminal investigators. In related work Professor David Miller is exploring the use of ground-based radar, digital map databases and our virtual landscape theatre (for visualising and reconstructing crime scenes) as part of a high-profile, international geoforensics network.

November saw the 30th annual Macaulay lecture, and appropriately, given our Canadian connections, it was presented by Professor Anthony Sinclair, from the University of British Columbia. The lecture was also attended by Dr TB Macaulay's grandsons, Tom and Doug Macaulay, who, I am pleased to say, were also able to make the trip from Canada to help us celebrate their grandfather's enduring legacy.

It gives me great delight that more than three quarters of a century after it was established, the Macaulay Institute continues to develop its research activities building on our founder's vision for improving communities and environment in rural Scotland.

I hope you enjoy this issue of in-land.

Richard

RICHARD ASPINALL
CHIEF EXECUTIVE

Chief Scientific Advisor to Scotland, Professor Anne Glover gets to grips with the game Pipit Run at 'Science and the Parliament"

African wildlife expert, Professor Tony Sinclair converses with Professor Richard Aspinall and SEERAD's Professor Maggie Gill

Tom and Doug Macaulay visit the plant growth rooms as part of their tour of the Institute

Tom Macaulay plants a commemorative maple as his wife Diana, brother Doug and Institute Chairman Michael Gibson look on

Institute heads hi-tech crime fighting network

A NETWORK of international forensic experts coordinated from the Institute has had a high-profile first year.

There was considerable television, radio and newspaper coverage of the forty-strong group's first two meetings, held in Aberdeen and Nottingham.

The innovative collaboration between leading forensic scientists and practitioners is working to find cutting-edge technologies that could help in future police investigations.

The GIMI (Geoforensics and Information Management for crime Investigation) network aims to assess how new technologies might help in the forensic investigations of crime scenes.

According to Professor David Miller, who is coordinating the group, such assistance includes locating the graves of murder victims, uncovering buried items of evidence and helping to narrow down areas of search for the police. He said: "Traditionally police searches for murder victims' graves or buried artefacts rely on recognising obvious visual signs of ground disturbance and discarded items.

"Large-scale ground search operations can be very costly in terms of manpower and time, and are often unproductive. The methods currently available may result in the loss or damage of evidence."

The network consists of forensic experts, from agencies such as the National Centre for Policing Excellence (NCPE), the Forensic Science Service, as well as the legal profession, universities, research organisations and private enterprise.

New technologies under consideration for focused, non-invasive searching included linking ground-based radar surveys to the information held within digital map databases. A demonstration of how virtual reality can aid scene of crime reconstruction was also on the agenda.

These initial meetings have also been followed up by teleconference discussions with overseas members from Australia, Canada, New Zealand and the USA. These conversations centred on the unique opportunity of sharing samples, to compare analysis techniques between international teams.

Partners will circulate samples from various projects for additional analyses to those performed in their own laboratories. The first scheme aims to find a technique that both detects the presence of a decomposing body, and determines time after death.

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The network will also coordinate and run the 2nd Soil Forensics International Conference, planned for Edinburgh at the end of October. This meeting will link with the annual meetings of other interested groups and include sessions on analytical methods in environmental forensics, forensic geology, non-invasive measurement techniques, crime scene reconstruction and geostatistical modelling.

The project is funded through the Engineering and Physical Sciences Research Council (EPSRC) Crime Initiative.

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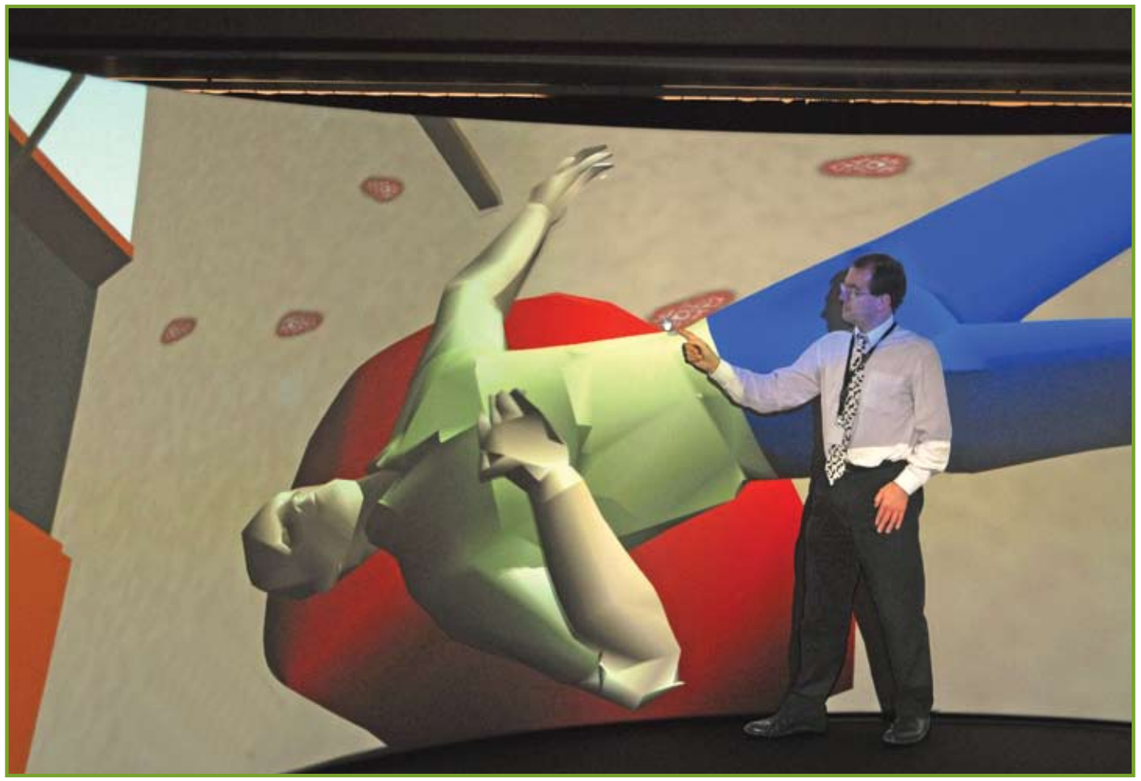

Dead clever: Professor David Miller demonstrates a crime scene reconstruction using the Virtual Landscape Theatre.

Dirty work... but someone's got to do it!

The Macaulay Institute has provided expertise in soil for over 70 years, and now a new project intends to show how more could be made of soil as criminal evidence.

Soilfit is investigating the potential of cutting-edge techniques in providing soil forensic intelligence to police enquires.

Dr Lorna Dawson (above left), who leads the soil forensic research team at the Institute said: "Despite having a long history, the application of soil evidence in criminal cases has been largely under-utilised, primarily due to difficulties in analysis.

"Soil has tremendous potential for providing forensic intelligence to police investigations, due to the complex nature of its composition."

This complex make-up of soils results from its underlying geology, as well as the host of plants and animals living within it. As such, soil from any particular site has an almost unique 'fingerprint' that could be used to identify a search area, or even match a suspect to a crime scene.

The EPSRC-funded project aims to integrate state-of-the-art soil fingerprinting methods and national soil databases with GIS – to form a 'smart map' that allows users to match soil forensic samples to their likely geographical origin. These new scientific techniques, many of them pioneered at the Institute, could now help police unlock vital information contained within soil evidence.

"The hope is that as well as providing vital clues to criminal investigators, this pinpointing of the search area will save valuable police time and effort," said Dr Dawson.

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Mind the gap

WOMEN in remote rural areas are the most likely to be poorly paid, says a recent study undertaken at the Institute.

The analysis also shows the gender wage gap to be the largest in such areas.

Dr Alana Gilbert, who has reported these findings, said: "The relatively low average wage of women in remote rural areas is mostly to do with the way in which their personal and workplace characteristics are rewarded in their local labour market."

These characteristics include factors such as labour market experience, level of education, presence of a trade union and workplace size, she added.

Previous research had shown that workers living in non-rural areas earn more than those in rural areas, and also that in Britain as a whole males earn more than females.

Dr Gilbert looked to address questions this raised about the relative position of women in remote rural areas in the earnings distribution.

She found women in remote rural areas – whose average wage per hour is £6.20 – were most likely to be at the bottom of this scale. This compared with the £7.31 earned by women in non-rural areas.

On average, men earn £8.35 in remote rural areas, and £9.34 in non-rural areas.

Whilst much work has been done over the years on the gender wage gap in Britain, very little research had been carried out on the gender wage gap in urban and rural areas prior to this study.

"While these findings have clear implications for policy, there is a need for improved data to enable sound evidence-based policy making," said Dr Gilbert.

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People prefer puffins to plants

AN INNOVATIVE collaboration is incorporating the views of local residents into the wildlife management plan for a nearby island.

On Craigleith, a small island in the Firth of Forth, the numbers of breeding puffins have dramatically halved in the last five years, mainly due to an explosion of an invasive plant species.

Expansion of tree mallow – which can grow to heights of 3 metres – is causing the birds to abandon their burrows, and may also lead to the loss of important sea-cliff vegetation.

According to social scientist Dr Anke Fischer and her ecologist colleague Dr René van der Wal (CEH), management decisions for tree mallow on the island are not straightforward, however.

Tree mallow's pink flowers make it attractive to both insects and people, and despite its rapid expansion, it is still fairly unique to the region, they say.

Dr Fischer said: "Should anything be done about this development? This is an urgent question that requires not only ecological expertise, but also value judgments.

"Changes are more likely to be successfully implemented if local communities are consulted about their views and values prior to plans being made."

A survey led by Dr Fischer of 244 locals living in nearby North Berwick and surrounding villages, has found that the majority favour cutting the plants as the best of the options presented to them.

"Our survey shows that many people are very aware of potential impacts of management interventions on the island. Most of our respondents emphasise that Craigleith's ecosystem should not be put at risk," she said.

This information is now being used in the development of an SNH-funded management plan.

The joint initiative between CEH and the Institute is funded by the Scottish Executive, and also featured in a Channel Four series on wildlife conservation, produced by the makers of *Wife Swap* and shown in November 2006.

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Photograph Anke Fischer

Invasive tree mallow is forcing puffins from their island homes

PATH leads to Edinburgh

A RECENT international conference has helped pave the way towards greater participation in scientific policy-making.

The Participatory Approaches in Science and Technology (PATH) project, funded by the European Commission's Science and Society programme, held its final event in Edinburgh last summer.

The Institute-led project and conference focused on how the public, stakeholders, scientists and policymakers can interact to develop better policies related to science and technology.

Project leader Dr Wendy Kenyon said the conference played an important role in bringing together influential stakeholders engaged in public participation to exchange knowledge and discuss future directions for public involvement in policy making.

One hundred and twenty delegates from all over the world, all expert and experienced in public participation, considered theoretical and practical aspects of public participation. They focused on case study areas such as genetically modified organisms, nanotechnology and water.

Dr Kenyon said: "The conference was not merely a talking shop though. Delegates particularly enjoyed the structured workshops in the programme, where a series of action plans were developed which suggest specific and targeted actions to promote better participation in future."

High profile speakers included John Dryzek, Professor in the Social and Political Theory Programme at the Australian National University, and Carolyn Lukensmeyer, founder and president of AmericaSpeaks, an organisation which engages citizens in the public decisions that impact their lives in the U.S.

In a series of workshops, conference participants were put to work to consider three questions:

- How well the public are currently integrated into the policy development process
- How well different sections of society are represented in participatory processes, and
- How participatory methods can be used for both small and large scale problems.

Delegates developed action plans for each of these three areas, in an effort to improve public participation in future policy development throughout Europe and further afield.

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All's Well

A SCOTTISH EXECUTIVE technical manual to assist those responsible for monitoring and providing private water supplies has been produced in collaboration with the Institute.

Along with colleagues in the Robert Gordon University and the Centre for Environment and Health, the Institute has helped to develop key aspects of the manual, in particular, the risk assessment procedures.

Dr Allan Lilly, who led the Institute's involvement in the project said: "These procedures offer a simple and systematic method for assessing the key control points in the supply and distribution network, and will allow professionals and individuals to protect and enhance the quality of the water."

Around 150,000 people in Scotland obtain their water from sources other than the national mains network. The majority of these are in rural areas. As well as a large number of households on private supplies, there are also large hotels, campsites and food premises – many of which cater for tourists.

Among those responsible for the quality monitoring of these water supplies are local authorities, and this manual will assist them in carrying out their responsibilities for ensuring that the water is fit for purpose.

The water can be derived from wells, springs, boreholes, rivers and reservoirs and, according to Dr Lilly, is often of variable quality.

"This is the culmination of work over many years and will bring cleaner and safer drinking water to the rural population, as well as protecting the many visitors that come to Scotland each year," he added.

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The manual can be found at
www.privatewatersupplies.gov.uk

Grazing & bugs & birds

HUNDREDS of visitors, including European Agriculture Commissioner, Mariann Fischer Boel, and Scottish Minister for Environment and Rural Affairs, Ross Finnie MSP, visited the Institute's stand at Edinburgh's Royal Highland Show last June.

Whilst there they heard how European agricultural reform could have a major impact on Scottish upland wildlife through its impact on sheep and cattle numbers.

As part of this year's 'Grazing, Bugs and Birds' theme, the exhibit demonstrated that a total removal of grazing livestock will not be beneficial for a healthy balance of wildlife on Scottish hillsides.

Macaulay Institute ecologist, Professor Robin Pakeman said: "Grazing animals, such as sheep and cattle, have had a major influence on shaping our landscape for hundreds of years. EU Common Agricultural Policy (CAP) reforms affecting the way we farm mean that the once common sight of lots of sheep on our hillsides may very soon be a thing of the past. Fewer sheep should help to restore wildlife but a complete loss of sheep and especially cattle may be detrimental to upland biodiversity."

The huge rise in sheep numbers in previous decades lead to over-grazing, but now some sites face the reverse situation, he added.

In many areas sheep numbers have recently started declining, due in part to changes in EU support subsidies. Indications are that a lack of financial incentive may lead to a complete loss of mixed livestock (sheep and cattle) farming in many upland areas.

Recent research carried out by the Institute and its collaborators has shown that a reduction in grazing regimes to one third of commercial densities is the most beneficial to wildlife – such as the meadow pipit, a widespread upland songbird – because of the mixture of short and tall vegetation patches this grazing management creates. These vegetation patches provide feeding and nesting sites for the birds.

Under these conditions, there are not just more pipits nesting, but they lay eggs that are a third bigger than when there are typical levels of grazing, or no grazing. Bigger eggs generally mean healthier chicks.

Reduced grazing levels also allows a mixture of plant and invertebrate species to flourish – with twice as many invertebrates found compared to areas with typical sheep numbers.

"We need to understand exactly how grazing contributes to the balance of different species if policy makers are to produce farming legislation for the good of both society and wildlife," said Professor Pakeman

Visitors to the show at Ingliston were encouraged try their hand at a number of interactive exhibits and activities including 'Pipit Run', the 'Grazing Puzzle' and 'radio tracking' of beetles.

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Michael Gibson and Bill Ritchie share a joke with Ross Finnie...

...whilst Commissioner Fischer Boel takes time out to play Pipit Run

The Grazing and Upland Birds (GRUB) project has been running since 2002 and is the largest experiment of its type ever attempted.

Comparison of grazing management regimes is being carried out in the Trossachs, at Glen Finglas, 23 miles northwest of Stirling, with the kind permission of The Woodland Trust.

Twenty four fenced plots have been established and each plot is about the size of five football pitches (3.3 hectares). Each plot has been stocked in one of four ways – each with different numbers of sheep and cattle:

- Nine sheep per plot – this is standard commercial stocking density
- Three sheep per plot
- A mixture of sheep and cattle (but equivalent to three sheep all year round)
- No sheep or cattle

The plots were fenced off in 2002, and measurements of vegetation, invertbrates and birds were taken. Sheep were then introduced in January 2003.

Each plot is divided up into grids, and records of the plants, invertebrates and birds are regularly taken at the same points. This way, we can accurately measure the biodiversity response over time due to changes in grazing management.

The work is funded by the Scottish Executive Environment and Rural Affairs Department. Other partners in this project are:

Scottish Agricultural College,

Centre for Ecology and Hydrology,

RSPB (Royal Society for the Protection of Birds),

BioSS (Bio-mathematics and Statistics Scotland),

University of Aberdeen,

University of Exeter in Cornwall.

Founder's grandsons visit Institute

The annual Macaulay Lecture – the thirtieth – was given extra significance this year because in attendance were the grandsons of the founder of the Institute.

Canadians, Thomas and Doug Macaulay were visiting Scotland at the invitation of the Institute to attend the lecture given by African wildlife expert Professor Tony Sinclair.

The trip also marked the pair's first visit to the Institute founded by their grandfather, T.B. Macaulay, in 1930.

They also visited the Isle of Lewis, and the towns of Fraserburgh and Peterhead during their stay, in an attempt to learn more about their Scottish ancestry and the various enterprises for which their grandfather became known during the four visits he made to Scotland over the course of his life.

"Doug and I are delighted to be attending the Macaulay lecture this year, which marks thirty years of talks from a host of distinguished speakers on a wide range of topics, from the ecology of the Serengeti to the concept of a renewable energy future," explained Thomas Macaulay.

"Our grandfather's legacy is apparent in various parts of Scotland, not least at the Macaulay Institute here in Aberdeen, and I am convinced that he would be very proud of the Institute and the continuously ground-breaking work of its staff if he was with us today."

Professor Richard Aspinall, Chief Executive of the Institute said, "It is a great honour to have the grandsons of the Institute's founder in attendance for the 30th annual Macaulay Lecture.

"Dr Macaulay's continued loyalty to his ancestral homeland is evident in the return trips he made and the numerous donations to the country of his forebears, including that which led to the creation of the Macaulay Institute."

Among Macaulay's generous donations was a substantial endowment to the public library on the Isle of Lewis, the home of his ancestors, where he also funded the construction of a new wing in the local hospital.

In 1930, in accordance with his long-held hobby and interest in farming and soil fertility, he donated the capital to buy fifty acres of estate at Craigiebuckler in Aberdeen, and soon established the Macaulay Institute for Soil Research as it was then known.

30TH
T.B. MACAULAY
LECTURE

The 30th Macaulay lecture was held at the AECC in November and was attended by over 200 invited guests, Institute staff and members of the public.

This year's eminent speaker was Professor Tony Sinclair, who was until recently the Director of the Centre for Biodiversity Research at the University of British Columbia, Canada.

Professor Sinclair has spent 40 years researching the ecosystem dynamics of the Serengeti National Park and he spoke about the lessons that can be learnt from human-wildlife conflicts in the region, a unique area famous for the spectacular mass-migration each year of over a million wildebeest.

In reference to his wealth of experience, Professor Sinclair said: "I observed in the Serengeti system long-term trends in both the climate and human populations. The profound changes in the system have provided a unique opportunity to understand how natural ecosystems work, what role biodiversity plays in the system and which human influences are threatening this biodiversity. This unique record of events provides a valuable lesson for the conservation of world ecosystems."

To see the lecture, visit macaulay.ac.uk/macaulaylecture

TB Macaulay (1860 – 1942)

Dr Thomas Bassett Macaulay, one of Canada's Scottish sons, is remembered for many things – not least of which is the foundation of the Macaulay Institute in 1930.

Aside from his induction into the Insurance Hall of Fame (in recognition of his landmark presidency of the Sun Life Assurance Company of Canada) or the fact that almost all Holstein cattle carry bloodlines from his original herd, TB Macaulay was also a great humanitarian donating considerable sums of money to many worthy causes both in Canada and his ancestral Scotland.

Under Macaulay's leadership and direction, the Sun Life Assurance Company of Canada (for which he worked for 47 years) was the first company in the world to remove policy restrictions on travel, occupation, residence and suicide.

By the mid 1920s, the company expanded its global reach to over 55 countries worldwide.

Through his continued drive and leadership, Sun Life Assurance soon became the largest assurance company in Canada and one of the world's leading life assurance institutions.

As a result of his passion for farming, Macaulay set up a farming and research station in Hudson Heights in Montreal in 1924, where he bred prize Holstein bulls with high quality cows and managed to develop Holsteins into a successful dairy breed.

Now, almost all of the world's Holstein herds are estimated to contain a bloodline from his original herd.

Images courtesy of Sun Life/ Hudson Historical Society

Thomas and Doug Macaulay

Born in 1929 and 1931 respectively, brothers Thomas and Douglas Macaulay grew up in Hudson, 35 miles west of Montreal in Canada.

There they literally lived in the shadow of their grandfather, T.B. Macaulay, whose house and farm, where he kept a herd of 70 prize Holstein cattle, were situated at the top of the hill overlooking theirs.

The grandsons attended McGill University and both graduated as Bachelors of Engineering, Doug in Electrical and Thomas in Mechanical (although Doug started his first year at Macdonald Agricultural College).

Neither pursued a career related to agriculture. Doug began his career working for the electronics division of Canadian General Electric in Toronto, later returning to Montreal and eventually joining the RCA Victor Company where he worked for the next 20 years before becoming a consultant engineer.

Thomas worked for a variety of different companies in the nuclear, industrial chemicals, industrial design and consulting and municipal engineering fields, before retiring in 2000 two weeks before his 71st birthday.

Accompanying the brothers on the trip was Thomas' wife Diana.

Soils add some SPICe to Parliament Briefings

A RESEARCH briefing for MSPs on 'Soil Protection in Scotland' has been produced with considerable input from Institute soil scientists.

Dr Colin Campbell, head of the Soils Group at the Institute said the Macaulay's first interaction with SPICe was very positive.

"As our work is increasingly being judged on its relevance as well as quality, we see the Scottish Parliament as a key audience for us," he added.

Scottish Parliament Information Centre (SPICe) research briefings are for use in support of parliamentary business in the Committees and in the Chamber. This particular briefing is concerned with the threats to soils, as well as the role of soils in climate change and maintaining bio-diversity.

The briefing also reported on the progress of the emerging Scottish soils action plan, which is due next summer.

Alasdair Reid, Senior Research Specialist at SPICe said: "The Macaulay's assistance to SPICe staff in the drafting of the briefing note on Soils and the provision of material for inclusion was greatly appreciated and we are keen to develop further this relationship on other topics."

The Institute has subsequently also provided some information to SPICe for the 'Sludge from Wastewater Works' briefing note.

Both briefings can be found at www.scottish.parliament.uk/business/research/

For more information on how we support policy, contact policy@macaulay.ac.uk

www.macaulay.ac.uk/policyrelevence

Less Favoured Areas defined

RESEARCH for SEERAD has shown that the Institute's system for classifying the agricultural potential of land might offer a robust method for designating parts of Scotland as eligible for support as Less Favoured Areas (LFAs).

Land allocated to certain classes of the Macaulay Land Capability for Agriculture (LCA) system were found to closely match with those areas already designated as LFA.

The Institute has now produced a summary of that research as a contribution to the debate on the future options for support to the LFAs. Payments under the scheme amount to £63 m.

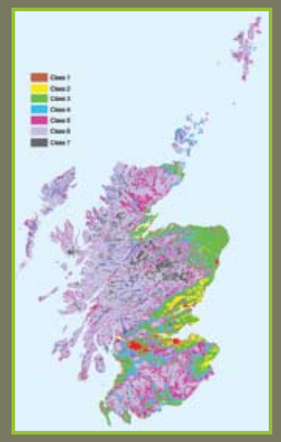
The report came about because an early draft of the revised EU Rural Development Regulation suggested that future LFA support should be targeted to provide support for sustainable use of agricultural land through payments to farmers in areas with 'natural handicaps, notably low soil productivity or poor climate conditions.'

Co-author of the report, Dr Dick Birnie, said: "Given that the Macaulay Land Capability for Agriculture system includes soil and climate, it was an obvious candidate to explore to see if it could be used for designation of LFAs."

SEERAD commissioned the Institute early in 2005 to research whether the existing LCA classification system could be used as a systematic basis for defining such areas of 'natural handicap' in Scotland.

This research was completed before the final Rural Development Regulation was agreed. Although no agreement was reached on the re-designation of LFAs, the new Council regulation includes provision for a revision to LFA designation and support, which will now come into force in 2010.

The report was discussed recently at a workshop attended by



representatives of a range of stakeholder organisations, including the National Farmers Union of Scotland, The Scottish Crofters Foundation, The Scottish Rural Property and Business Association, Scottish Natural Heritage, The National Sheep Association and SEERAD.

Andy Robertson, Chief Executive of the National Farmers Union of Scotland said: "This report is a very useful contribution to the debate on the future support for LFAs in Scotland and shows a possible way forward when the criteria for designation of LFAs needs to be re-visited in 2010."

The LCA classification was developed by the Institute over 25 years ago to describe the agricultural potential of land based on its limitations. It is based primarily on climate, a number of soil properties, (for example depth and stoniness), wetness, erosion risk and slope. Vegetation cover is also taken into account in some categories.

"Despite being first published in 1982, the system has proved robust enough to stand the test of time and demonstrates the long term benefit of applied research," commented Dr Birnie.

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Mapping out the future of wetlands

INSTITUTE expertise has recently helped one local authority to protect its important wildlife habitats.

Scottish Borders Council commissioned Macaulay Research Consultancy Services (MRCS) to develop cutting-edge software which would help find the best management solution for their local wetlands.

The new software, a Decision Support Tool, can also identify areas that could become wetlands in the future, increasing bio-diversity but also helping with flood and pollution control.

Using Geographical Information Systems (GIS), a type of 'smart-map', the models can act as a planning tool, identifying existing, historical and potential wetland areas.

GIS expert, Dr Jonathan Ball said: "The software also allows local authorities to explore 'what-if' scenarios by making changes to the models or incorporating other information. We are pleased to have developed an accessible planning tool that can be applied by local authorities across Scotland in managing not only wetlands, but also other important habitats."

Scottish Borders Council plans to use the software to help guide its Sustainable Flood Management programme.

As a future development, it also aims to produce web-based wetland maps for farmers, landowners and land managers. The user-friendly maps will help land managers decide on Land Management Contracts and identify opportunities for wetlands development to meet the requirements of the EU Water Framework Directive.

Recent changes in EU and national legislation have placed increasing demands on local authorities to undertake this kind of work.

*At the time of going to press, the software had been nominated for the Development Planning award at the Scottish Awards for Quality in Planning.

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Where r u?

ECOLOGISTS have been receiving mobile phone messages from a reindeer – as a means of tracking the animal's whereabouts.

This novel use of text messaging has allowed researchers to quickly and easily monitor the location and movements of a herd in the wild.

In a recent trial, a collar worn by the lead animal pinpointed the exact position of the herd, using information from satellites – and that information was then sent to researchers via the mobile phone network.

Whilst researchers at the Institute have been studying the movements of wild deer for some years, this is the first time they have utilised text messages as a means of keeping tabs on a herd's movements.

Project leader, Dr Angela Sibbald said: "We have carried out a number of studies of deer movements in the Cairngorms over the last few years, using these collars, but previously they either had to be brought back to the lab to download the data, or else we had to go out into the field to download the data from the collar via a radio link.

"This year we tested a collar which is able to transmit data via the mobile phone network. This collar was fitted to one of the animals belonging to the Reindeer Centre in the Cairngorms, and sent us a text message on a daily basis – if it could get a signal."

The collared female – a nine year old called Arnish – is part of a group of about 20 animals which are released to free-range in the Cairngorms over summer. Arnish was rearing a calf at the time, as were a number of the other females in the group.

Each text message contains the latitude and longtitude of the last 5 fixes taken by the collar.

"We scheduled the collar to take a fix every 4 hours; hence the collar attempted to send a fix every 20 hours. If the collar went out of signal range for any length of time, it stored all the fixes and sent up to 10 extra text messages when it got a signal again. If data was unable to be sent, the data was stored on-board and was viewed when the collar was retrieved," said Dr Sibbald.

"After receiving the text we quickly created a map displaying the latest movement, and sent it via email to the Reindeer Centre. Staff from the Centre are regularly in the hills looking for their reindeer and this has proved a useful tool for them."

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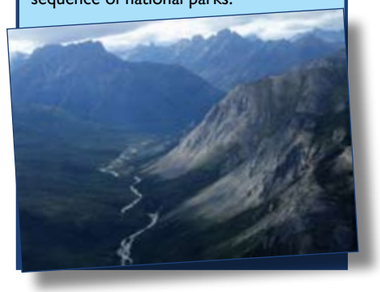
Photograph Angela Sibbald

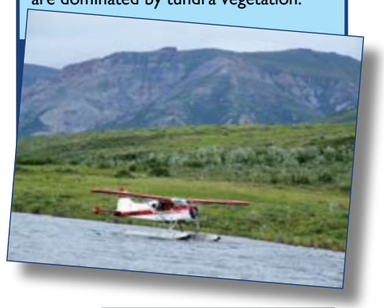
SNOW PATROL

THE INSTITUTE'S Dr Martin Sommerkorn spent two weeks last summer in remote Northern Alaska as part of an scientific expedition mapping the effects of climate change on Arctic ecosystems. Dr Sommerkorn, who specialises in plant-soil interactions, was part of an eight-strong team of international experts recording vegetation and soil characteristics that will assist future assessments of the effects of climate change. Here he recounts the details of his trip.

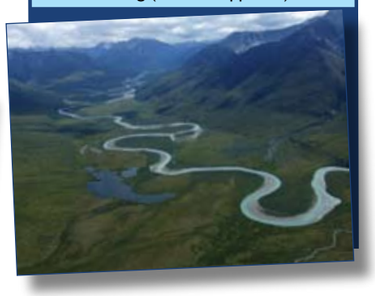
1 We set out from Fairbanks, and our journey took us north, into the mountains of the Brooks Range, the northern most stretch of the Rocky Mountains. The range is pristine Arctic wilderness, interrupted only by very few indigenous villages and crossed by the Trans-Alaska Pipeline. Most of the range is protected by an uninterrupted sequence of national parks.



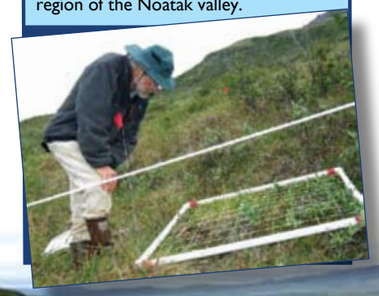
2 Our destination was the headwaters of the Noatak river in the Gates of the Arctic National Park and Preserve. The river is 435 miles long and flows westward from within the central western Brooks Range to Alaska's northwest coast. The river crosses more than a third of Arctic Alaska, draining a watershed equivalent to about half the size of Scotland. The lower reaches of the Noatak track the Arctic tree line but the upper reaches are dominated by tundra vegetation.



3 Recent evidence shows that Arctic snow cover is retreating, due to shorter winters and warmer summers. This is leading to a corrsponding expansion of shrubs into tundra and a northward shift of the Arctic tree line. Suggestions are that these major shifts are further hastening climate change, but baseline data is lacking (see box opposite).



4 Our work, funded by the US National Park Service, was to characterise potential areas of shrub expansion – mainly alder, birch and willows – for future reference. We recorded and sampled the above ground vegetation, the density and age of shrubs, as well as soil carbon and nitrogen stocks along transects of several hundred metres in the upper region of the Noatak valley.



5 Soils here are directly underlain by permafrost and contain a great deal of undecomposed plant material. It is this that gives them their high carbon content – and what makes them a potential climate change time-bomb.

6 Through the use of photography, GPS and permanent metal markers, we will be able to pin-point the same transects in the future. We can then study changes over time, both at ground level and by using them as a reference points to compare aerial photographs of the wider landscape.

7 Our camps were made on the gravel bars of the Noatak river to minimise our impact on the environment. Conservation of the wilderness is the primary objective of the Gates of the Arctic National Park, and our transport by floatplane and small water craft was the only way for a party of eight people to get permission to carry out the science.

8 The 'leave no trace' requirement meant we only spent two nights at each campsite. After spending a day sampling an area, we would travel down river for a day to a new site. This way we covered 90 river miles in the two weeks, embracing the western ecoregion of the catchment, and making sure that we could establish our transects across a variety of geological substrates, vegetation types and topographies.

9 Although north of the treeline, some several decades-old groves of poplars were present in sheltered places in the valley and we were intrigued to find very shallow organic horizons in the soils under these, pointing to a possible link between soil carbon stocks and the presence of tall woody vegetation.

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All images : Martin Sommerkorn

WHAT LIES BENEATH...

MELTING ice-caps and rising sea levels are perhaps the most graphic realisation of people's global warming fears. Few probably are aware, however, that an even greater threat lurks under the retreating snow cover...

The Arctic has warmed by about 2°C during each of the last three decades, and as well as a dramatic reduction in sea-ice, warmer temperatures have also reduced the length and severeness of the Arctic winter.

This has allowed soils to warm, causing an increased activity of soil bacteria. These bacteria feed on carbon-containing soil organic matter and release the greenhouse gas carbon dioxide into the atmosphere as a waste by-product. Carbon dioxide contributes to global warming, leading in turn to warmer soils and more bacterial action.

The region affected is vast and this is particularly worrying – the amount of carbon in Arctic permafrost soils is roughly equivalent to the amount of carbon already in our atmosphere – or to put it an other way, Arctic soils contain almost a third of the world's soil carbon.

Predictions are that an increase in carbon dioxide production could cause the Arctic to become part of a huge positive feedback loop, leading to so-called 'runaway climate change'.

A further complication lies in what happens to plants under these conditions – many shrubs appear to have already expanded their range into previously open tundra areas.

Whereas the snow-covered tundra helps to reflect some of the sun's energy back into space, the darker colour of tall woody vegetation – such as shrubs and trees – absorbs this energy to a much greater extent, thereby further warming the earth's surface.

Aside from the effect on global temperatures, the implications of such fundamental changes for the landscape, ecosystem processes, wildlife and indigenous people depending on subsistence economies is unknown, but an emerging research area.

Closer to home

Similar climate feedback loops could also be important in Scotland, where Dr Sommerkorn also carries out SEERAD-funded research investigating the effects of native tree regeneration on soil carbon in heather moorland.

"There are fears that an increase in the numbers of birch and pine on moorland soils can lead to substantial amounts of the organic carbon from these soils becoming available for microbes to feed on", said Dr Sommerkorn, "but we don't know enough about the details of plant-microbe-soil interactions to be able to answer this yet. We are still trying to understand the principles of how vegetation impacts on soil carbon stores, in Scotland and elsewhere in the world."

Peatland research provides RECIPE for success

Traditional peat cutting in New Pitsligo

Spontaneous re-vegetation of commercially-cut peat

Peatland ecologists discuss restoration issues

Photographs Stephen Chapman

FORMER peatland extraction areas can recover both their biodiversity and carbon storage ability within as little as five years, according to researchers.

This is the main finding from a three-year European-wide collaboration that aimed to provide regeneration options for both conservationists and commercial peat extractors.

Project coordinator Dr Stephen Chapman said: "Peatland ecosystems possess a unique biodiversity, which may be threatened by commercial exploitation. At the same time, in many areas of central and northern Europe, peat utilisation has been, and continues to be, a source of a valuable raw commodity and of income for rural communities.

"Where they exist, there is a need to reconcile these two important attributes of peatlands."

RECIPE (Reconciling Commercial Exploitation of Peat with Biodiversity in Peatland Ecosystems) was funded by the European Union and the collaboration of ten partners was led by the Institute.

Within the range of wetland ecosystems found in Europe, peatlands have been designated as 'priority habitats for action' by the EU. Mainly because of the extent to which they have been utilised in the past as a fuel or in horticulture, undisturbed peatland ecosystems are rare.

The project looked at the microbial diversity, carbon cycle and organic chemistry of regenerating peatlands at five contrasting sites within Finland, France, Scotland and Switzerland, as well as examining their social and economic value within Europe.

Researchers found that, although in most cases vegetation recovered relatively quickly once peat extraction had stopped, the ability of peatland to retain carbon takes somewhere between five and 10 years to return.

This ability to retain carbon – which has important consequences for climate change – is in turn partly determined by microbial activity and partly by new vegetation, particularly sedge species.

Microbial processes and biodiversity indicators showed significant responses to vegetation development and have the potential to track the progress of peatland recovery following commercial exploitation, according to Dr Chapman.

The socio-economic evaluation of peatlands in each of the participant countries revealed that peat extraction as a commercial entity is only significant in Finland and Germany. Utilisation in Scotland and France, though locally important, is relatively minor, and totally absent in Switzerland. Member states were increasingly found to be putting a high value on peatlands as natural ecosystems.

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Local MP launches Ørskov Foundation

MALCOLM BRUCE recently launched the Ørskov Foundation, a charitable body set up by the Institute to help graduate students from developing countries undertake scientific projects.

The Liberal Democrat MP – who is Chairman of the House of Commons International Development Select Committee – has agreed to become patron of the charity which also aims to promote sustainable development for the poorest rural communities in the world.

Announcing the names of the first recipients of grants available through the foundation, the Member of Parliament for Gordon said he was "honoured" to be asked to officially launch the foundation.

The grants amounted to more than £11,000 and went to four students, Nelson Abila and Damian Ndubuisi Njoku both from Nigeria, Yameogo Nongasida from Burkina Faso and Tania Sanchez Santana from Cuba.

Sixty-five students from 23 different countries applied for the grant, of which 19 were short-listed. Each student was required to justify that their project would have a positive impact on poverty alleviation or environmental sustainability in a developing country.

Malcolm Bruce: flew to Aberdeen immediately after his party conference to launch the foundation

The foundation launch party was attended by over 60 guests, including Mr Bruce and fellow MPs Anne Begg and Robert Smith, as well as Professor Le Viet Ly who had travelled from Vietnam just to speak at the event.

Commenting on the launch of the Ørskov Foundation, Grant Davidson, Chair of the Trustees, said: "I am pleased to be launching the Ørskov Foundation at the Macaulay Institute, which was set up to recognise resident scientist Professor Bob Ørskov's pioneering contributions to agricultural science and rural development in developing countries.

"I am confident that the chosen applicants have clearly demonstrated the benefits their research can bring to developing countries, and hope that the Foundation will continue to help promote the advancement of education for students and rural development through community projects in developing countries, and in so doing, help reduce poverty levels and increase awareness of environmental issues."

Promoting sustainable development for the poorest rural communities in the world

The sharing of knowledge, experience and information are key factors in enabling people and communities to move towards self-sufficiency on their own terms.

We help them achieve this through a unique integration of agricultural education and community projects.

In 2006 we supported students from Africa and Latin America. We plan to provide financial support to more students in 2007, and are also starting a long-term coordinated programme of support to rural communities in developing countries.

Each of the community projects funded will be set up through the use of a revolving fund. Each project, its goals and management, is set up in partnership with the active participation of the communities involved.

The work of the Ørskov Foundation would not be possible without widespread support. Your donations, large or small, help some of the world's poorest people.

"The Ørskov Foundation initiatives are innovative and effective. I believe that the unique combination of community projects with education will have a positive and lasting impact on all those who benefit from their work."

Rt Hon Malcolm Bruce MP, (Chairman, House of Commons International Development Select Committee)

If you would like to make a donation visit www.orskovfoundation.org or contact Grant Davidson (contact@orskovfoundation.org) 01224 498259.

ØRSKOV FOUNDATION
Poverty Alleviation Through Agricultural Education

Registered Charity No SC036117

Treated like dirt

Over the coming months, the Institute will be highlighting how soils play a crucial role in almost every aspect of our lives. A series of public events will champion the importance of this under-rated resource for our food, fuel, wildlife, water – even our climate – but will also warn us of the potentially irreversible damage if we continue to take soil for granted.

Here head of the Institute's soils research, Dr Colin Campbell, outlines why it is now time to take soil seriously...

"Soil is climbing high on the policy agenda. The Scottish Executive has just announced Scotland is to formulate a Soil Strategy, as well as establish a national Soil Monitoring Network.

Our heightened interest is due to the recognition that soil is fundamentally important for the general health and well being of our people and ecosystems.

The EU has also just announced the long awaited Soil Directive which sets out a common framework that puts soil on the same footing as air and water, and will provide an integrated approach to its protection and sustainable use.

In fact, soil has probably not been higher on the agenda since the 1950s, when we sought to maximise the production of food from our soil resource.

Soil still has a direct bearing on wealth creation, as (quite literally) the basis of our agricultural and forestry industries, but as a nation we also increasingly trade on our clean environment to emphasise the quality of food.

Indirectly our soil also contributes to Scotland's biggest industry – tourism – as it forms the basis of our unique habitats and landscape. Soil also protects our water supply and food chain from contamination by chemicals and diseases and is therefore central to sustaining our clean environment.

The role of soil as a major source and sink of the greenhouse gases that affect our climate means our soil is an not only an essential part of our sustainability, but that managing it appropriately is also part of our global responsibility.

"Soil is a non-renewable resource – once it's gone, it's effectively gone for ever"

Not all soils are the same, and they vary locally, regionally and nationally. Scotland's soils differ markedly from those found in other parts of the UK. Some are unique in the UK, and some are even rare on a European and worldwide scale.

Threats

However, there are new and emerging threats to our soil. In our recent joint report to the Scottish Executive – the largest scientific review of Scotland's soils ever undertaken – we warn that despite their generally good condition, they are coming under increasing threat from a range of human activities.

Within the report, we identify the four individual but strongly linked threats to Scottish soils.

The first of these, **climate change**, may have multiple effects. Warmer temperatures may increase loss of organic matter and coupled with more intense rainfall may also lead to more erosion particularly of our upland peats. Climate changes may also alter what we can grow in our soils, thereby having a major impact on our food supply. If higher temperatures and wetter soils release more greenhouse gases such as carbon dioxide and methane, this will only further contribute to increasing global temperatures.

The second major threat is to soil **organic matter** which itself may be linked to climate change . Soil organic matter is a key property of soil, and underpins all soil functions. There is evidence from England and Wales that we are losing soil organic matter and such losses will have multiple effects on soils ecosystem services.

'Sealing' soil under built structures removes all of soil's functions. Rainfall bypasses the soil filter, moves to rivers and drains more quickly and potentially increases the threat to water quality and flood risk. Currently an area the size of Dunfermline (roughly 1200 hectares) is lost every year, most of which is likely to be prime quality agricultural land.

Finally, **soil contamination** such as nitrogen pollution from the atmosphere can damage upland soils, and heavy metal contamination from organic wastes such as sewage sludge can impact on the fertility and biodiversity of agricultural soils.

The National Soil Archive houses over 40,000 samples from across Scotland

Soil is a non-renewable resource – once it's gone, it's effectively gone for ever. Even when damaged, it is often difficult to remediate. Unless we address these issues soon, the quality of some of our soils may become irreversibly compromised.

Expertise

Despite the potential seriousness of these threats, I am confident that the Institute possesses the diverse range of skills and resources to help society meet these new and pressing challenges.

For instance, we maintain the Scottish soils database which provides a comprehensive picture of our soil resources, and incorporates 'Scotland's National Soil Archive'. We are now updating the National Soils Inventory to provide evidence of change in the last 20 – 30 years.

Because of its importance in climate change, we are investigating carbon in soils tracing its flow from plants to soil, as well as developing and applying models to predict its behaviour and potential release from soils.

Minerals are also an important component of soils and provide nutrients such as potassium for plant growth as well as helping soils to buffer pollutants. We have developed novel spray-drying techniques for better quantification of minerals using X-ray diffraction. The Institute even has a mineral named after it, 'Macaulayite', and we are working with planetary scientists at NASA to determine its similarity to the red soils of Mars!

The diversity of life in soils is vast and un-explored – it is a true scientific frontier. We are at the forefront of its exploration, and are continuing to develop new techniques to characterise the soil microbial community and their functioning in soils. We are also creating a soil DNA database and archive for future scientists who will use the techniques of tomorrow in the same way we use our soil archive to provide evidence of change today.

"The diversity of life in soils is vast and un-explored – it is a true scientific frontier"

Many of our methods are applied outside the normal soils arena. For example we are now using our database expertise and analytical capabilities to help police forces to make more of soil evidence in their investigations.

The relevance of soils to many of the important issues facing society is becoming increasingly clear, and as many non-soil scientists have commented to me at international workshops recently – it is an exciting time to be in soils."

To find out more about our work on soils, visit www.macaulay.ac.uk or email in-land@macaulay.ac.uk

The report 'Scotland's Soil Resource – Current State and Threats' was authored by the Institute and the University of Stirling.

More on that report can be found at www.scotland.gov.uk

www.macaulay.ac.uk

Let us give you some good advice...

With demand for our dwindling natural resources now at unprecedented levels, and the threat of catastrophic climate change hanging over us, there has never been a greater need to find innovative ways of using our land resources more sustainably – for the good of both society and the environment.

As the largest research organisation of our type in Europe we are ideally placed to tackle these important challenges – through increasing knowledge and by providing high quality, impartial advice to those making key policy decisions on land management issues.

For over 75 years we've been world leaders in both social and scientific research into the consequences of land use for our environment and our society.

Evidence provided by our research into issues as diverse as soil and water quality, Less Favoured Area support and renewable energy has already informed the development of related Scottish, UK and EU environmental and rural policy.

With over 300 staff and an annual income in excess of £12m per year we are major players in Scotland's knowledge economy.

Our principal clients include the Scottish Executive and a wide range of UK and international governmental and private organisations.

As well as shaping the future of land management, the one thing all of our clients have in common is that they realise tomorrow's land use solutions rely on today's sound scientific evidence.

Which is why we can safely say – there is no substitute for good advice.

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