



# Newsletter

## STRATEGIC RESEARCH HAS Global Relevance

We live in a changing world. The effects of climate change have been only too evident to people in the UK in recent months and discussions on the risks associated with European and Global decision making have been prominent in the press. The nature of strategies for coping with change is therefore very topical, although the potential contribution of research does not perhaps feature in the debate as much as it might. Strategic research can help us to understand underlying processes, for example, 'How and why do grazing animals eat what they eat?' The article with this intriguing title by Iain Gordon and colleagues appears on page 2 of this issue and demonstrates how techniques developed at the Macaulay, in Scotland, can be used to solve problems in countries overseas. Having come to the Macaulay after working for 10 years on agricultural and environmental problems in developing countries I see plenty of potential for applying other techniques developed in Scotland to more extreme problems overseas, thus widening the impact of our research.

Having an interest in Overseas Development does not mean, however, that Scottish problems will be neglected and I am very pleased to include reports in this issue on the establishment of three Centres of Excellence in collaboration with the University of Aberdeen and local research institutes. I firmly believe in adding value to our research through responsible partnerships with other organisations. Having recently come from running a company I am committed to working not only with public sector partners but also with increasing our links with the private sector. An example of one such opportunity forms part of our final article in this issue on page 5.

Communicating with readers like yourselves is also an important feature of my approach to research management and I would be delighted if you would send any comments on issues you would like to see addressed in this Newsletter or in other electronic or paper formats to our Public Relations Manager, Sue Bird. From 1 January Sue will be operating as Public Relations Manager not only for the Macaulay but also for the Rowett Research Institute as part of our commitment to closer partnerships. We wish Sue well in this dual role and look forward to sharing ideas with the Rowett on how to communicate research more effectively.

Finally, I would like to pay tribute to the work of my predecessor. Jeff Maxwell was the first Director of the

Macaulay Land Use Research Institute and as such had the unenviable task of integrating two different cultures, of establishing the remit for the new Institute and of convincing the sceptics that the correct decision had been made. He achieved all of that and more and has handed over to me an Institute in good heart, well positioned for serving Scottish rural communities and for increasing its impact at an international level. We wish Jeff and his wife Chris health and happiness in this next phase of their lives.

**Margaret Gill** *Director*



*During a recent trip to the Isle of Lewis, Maggie Gill is pictured visiting a crofter who combines machinery contracting, sheep and cattle farming, and Harris Tweed weaving as integrated components of his crofting business. The Institute administers the The Lewis Endowment, which is currently funding two Township development schemes that aim to integrate their agricultural, environmental and social development opportunities.*

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# How and Why do grazing animals eat what they eat?

## A 'TOOLBOX' OF METHODS



*A Kazak shepherd tends his flock on the steppe in winter.*

The foraging decisions that grazing animals make are key to predicting the effects that they will have on vegetation. They have important consequences for environmental and land use change and for the performance of wild and domestic large herbivores. Animals have evolved a number of ways of linking their foraging behaviour to the nutritional outcome. To further our understanding of the food choices they make, we have developed a range of methods for measuring foraging behaviour. These methods range from the controlled presentation of foods and video analysis of processes taking place at the level of individual bites of food, up to the way in which animals move across whole landscapes, measured using satellite tracking.

We are using these techniques in the UK predominantly in the context of conservation issues associated with the impact of grazing animals, but we are increasingly applying these techniques overseas, both in Europe and in countries such as Zimbabwe, South Africa, Pakistan and Kazakhstan, where we are contributing to the development of more sustainable systems of livestock production.

At the scale of individual bites and the selection of individual plants, we use swards grown in trays or trees grown in pots, which are presented to animals to test hypotheses concerning, for example, why animals prefer one plant species over another. This method has revealed the sensitivity of red deer to the repellent properties of a group of chemicals called monoterpenes, which are common in coniferous trees. (Newsletter No. 5, 2000; Annual Report 1999, p 18. Both available on

[www.mluri.sari.ac.uk](http://www.mluri.sari.ac.uk)). We have also shown that, when feeding on browse plants typical of African savannas, the thorns hinder the feeding behaviour of cattle more than they do goats. However, for thornless species it is the size of the individual leaves which affects the intake rate of cattle.

In the Eastern Cape of South Africa goats play an important part in livestock production systems. A joint project between the Institute and the University of Fort Hare compared the diet preferences and food intake of Boer and Nguni goats for several common plants of the False Thornveld savanna of the Eastern Cape. Individual feeding experiments revealed that the goats selected diets which maximized intake rate, rather than choosing on the basis of specific plant nutrients. The ability to measure actual bite sizes and hence intake rates from this study has provided a sound basis upon which intake rates could be estimated from field experiments using free-ranging animals. This study also revealed the use of different feeding heights by the two breeds of goats. These outcomes are contributing to the development of ways of managing the savannas to meet agricultural and environmental goals.

The Institute has pioneered the n-alkane technique for measuring the diet composition and intake of free-ranging herbivores. The cuticular waxes of dietary plants contain hydrocarbons (mainly n-alkanes) which are excreted in the faeces of herbivores. Since the patterns of n-alkanes differ between plant species, the n-alkane pattern found in the faeces enables diet composition to be estimated. In addition, intake can be estimated by orally-dosing with a similar n-alkane at a known rate. Other plant-wax compounds, such as fatty alcohols, can



*Goats grazing thornveld savanna.*





Moose.

similarly be used as faecal markers. The n-alkane method was used in a project funded by the EC to look at radiocaesium levels in wild moose in the Boreal forests of northern Sweden following the Chernobyl accident. It was predicted that the radionuclide intake of herbivores would depend critically on the composition of the diet in terms of plant parts and plant species. This project used intra-ruminal, controlled release devices (CRDs) which release n-alkane markers over a period of several weeks. The method was validated using captive red deer and moose, before being used with the wild moose (see Moberg et al 1999). The use of CRDs in conjunction with GPS tracking to locate faeces of particular individuals, allowed both diet composition and intake to be measured in wild herbivores. The results showed that the winter diet of moose is dominated by Scots Pine and in the summer the diet is dominated by broadleaved tree species, primarily birch.

In an EC-funded project which addresses Human Interactions in the Mountain Birch Ecosystem (HIBECO), the damage to birch trees by sheep or deer is being mimicked under controlled field conditions at contrasting sites. The tolerance of the birch to this damage, and the growth responses of the trees, can then be monitored in order to quantify the basis for the compatibility of grazing herbivores and woodland regeneration. This work is complemented by laboratory work on the use of stored nitrogen reserves in response to browsing and by comparisons of birch responses under a similar experimental browsing regime in northern Finland, where the reindeer have considerable impact on the vegetation.

At the landscape scale Global Positioning System (GPS) collars have been used to track red deer stags on a highland estate in the north-east of Scotland. Stags from four different herds were collared and their locations monitored several times each day over a 2-year period. The data are being used to describe daily and seasonal patterns of movement, which will be related to information about environmental factors such as the vegetation type, topography and weather. The effects of human disturbance on deer behaviour are also being measured by relating deer movements to patterns of

human activity in the area. This work will help to determine the relative importance of the various factors that affect the foraging behaviour of free-ranging deer. (See below for information about a conference on this topic.

(Moberg et al. 1999. *An integrated approach to radionuclide flow in semi-natural ecosystems underlying exposure pathways to man (LANDSCAPE). Final Report, European Commission Nuclear Fission Safety Programme*).

Key Macaulay contacts include Glenn Iason, Bob Mayes and Alison Hester. For further information please contact Iain Gordon, email:

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Programme Manager:

Animal Ecology in Grazed Ecosystems.



A deer stag with newly fitted radio-collar.

## Dates for your Diary 2001

- **12-13 March**

**Conference : Tracking animals with GPS:**

Satellite tracking methodologies in the study of animal grazing ecology. Information is available at:

**<http://www.mluri.sari.ac.uk/gps>** or contact Angela Sibbald **email: [angela.sibbald@mluri.sari.ac.uk](mailto:angela.sibbald@mluri.sari.ac.uk)**

- **Friday 18th May**

**25th T.B. Macaulay Lecture**

Topic: "The benefits which new technologies can provide for agriculture in the 21st century". (Title to be confirmed). To be given by Professor Chris Pollock, Director of Research, Institute of Grassland and Environmental Research, Aberystwyth.

# Three Aberdeen Centres of Excellence

The Aberdeen Research Consortium (ARC) exists to promote high quality collaborative research between its ten members (viz. Centre for Ecology and Hydrology (Banchory), Fisheries Research Services, Macaulay Land Use Research Institute, Robert Gordon University, Rowett Research Institute, Scottish Agricultural College, University of Aberdeen, Grampian University Hospitals NHS Trust, Grampian Primary Care NHS Trust, Biomathematics and Statistics Scotland). A number of new Research Units have recently been established which focus on areas of existing research strength. The Macaulay is involved in three of these units:

## Northern Studies Centre

### ENVIRONMENT AND PEOPLE AT HIGH LATITUDES

The Northern Studies Centre has been formed to develop a new and interdisciplinary research programme that will tackle problems across a range of northern environments including Scotland's islands and mountains, sub arctic areas and the high Arctic. These regions, all characterised by fragile habitats, harsh climates, long distances and sparse population, have many pressing issues in common, including sensitivity to environmental change and the need for sustainable use of natural resources.

This Centre brings together researchers from the Macaulay Institute, the Centre for Ecology and Hydrology (Banchory) and Aberdeen University's Departments of Geography, Plant and Soil Science and Sociology. This exciting mix of anthropologists, geographers and ecologists, all with research expertise in northern regions, enables an integrated approach to be taken towards understanding how high latitude systems function and how they can be managed to protect the environment and sustain human communities.

The Centre is coordinated by Dr Sarah Woodin, Department of Plant and Soil Science, University of Aberdeen and the Macaulay contact is Dr Robin Pakeman.



## Population Ecology Unit

The Unit brings together four major biological research groups (Centre for Ecology and Hydrology (Banchory); Macaulay Institute; Aberdeen University; Fisheries Research Services) with complementary research interests. The Unit tackles some of the main issues facing ecologists in understanding and predicting the response of populations of a single species of microorganism, plant or animal, and communities of interacting species, to environmental change, and applying this knowledge to biodiversity issues. The Unit aims to shed light on these topics using molecular and ecological data, from microbes to large mammals, to challenge theory and refine our ability to make predictions about the impacts of disturbance on the resilience of populations.

Key contacts involved in this Unit include Professor Paul Racey from the Department of Zoology, University of Aberdeen, Dr Iain Gordon from the Macaulay, Professor Steve Albon from the Centre for Ecology and Hydrology and Drs Eric Verspoor and Peter Wright from the Fisheries Research Service.

*Photograph: L.Gill/SNH*



## Rural Development and Land Use Change Unit

*An interdisciplinary initiative between the University of Aberdeen's Arkleton Centre for Rural Development Research and the Macaulay Land Use Research Institute.*

By international standards, Aberdeen has a major concentration of rural researchers. In addition to the Macaulay, The Arkleton Centre for Rural Development Research was established within Aberdeen University (AU) in 1995, drawing together the research arm of The Arkleton Trust and many of the existing University departmental skills to create a centre of expertise in the human dimensions of rural change. The Macaulay and the Arkleton Centre share a common research interest in rural development and land use change but from complementary perspectives, with the Macaulay providing a principally environmental and socio-economic perspective.

The creation of this ARC Unit enables both organisations to jointly pursue a collaborative programme of research on the land use consequences of social and economic changes in Scotland, Europe and worldwide. Indeed, the initiative fits closely with a growing international interest in the human dimensions of land use change, how these relate to processes of development and feed through to global change.

The Unit has been set up by a team comprising Professors John Bryden

and Mark Shucksmith (AU) and Drs Dick Birnie and Deb Roberts (Macaulay). Three postdoctoral positions have been created. The first two of these are focussed on:

- case studies of land use change and decision-making
- household location decisions and rural development

These initiatives are aimed at understanding the linkages between socio-economic changes and land use decisions in a Scottish context. Currently, a wider research agenda is being developed both with respect to socio-economic issues of relevance to Scotland but also internationally. In the longer term the main objectives of this ARC Unit are:

- To establish Aberdeen as a principal European Centre of Excellence in interdisciplinary research on rural development and land use change.
- To provide a strong evidence-base for the development and evaluation of new rural development and land use policy in a Scottish and European context.

To contribute significantly to the international research efforts on the human dimensions of land use change and their role in global change.



# Chromium pollution in the urban environment

The potential for remediation of several sites in and around Glasgow which have been heavily contaminated with chromium, is being studied by a group of researchers at the Institute led by Ed Paterson, in collaboration with colleagues at Edinburgh University and the environmental consultants, Dames and Moore. The work is funded by the NERC URGENT (Urban Regeneration and the Environment) programme and forms part of a larger project led by John Farmer of Edinburgh University, which involves the Macaulay, Dames and Moore plc, Scottish Universities Research and Reactor Centre and East of Scotland Water.

Cr(VI) is a serious pollutant which is known to be both toxic and carcinogenic to humans depending on the exposure route. Very high levels of Cr(VI) are found in several sites around Glasgow, where the residues from chromite ore processing by a former chemical works, which operated between 1830 and 1968, have been used as landfill. In total, it is thought that there may be up to 2.5 million tonnes of these residues distributed around the city.

Several attempts have been made to remediate these sites by both proprietary and non-proprietary treatments largely aimed at restricting movement of Cr(VI) to surface and ground waters. However, our research underpins such attempts by providing sound scientific knowledge of the physico-chemical processes underlying the release of Cr(VI) into the wider environment. The Macaulay contribution has utilised our mineralogical and modelling skills (developed in support of our SERAD funded programme on Soil Quality and Protection) to identify the phases present in chromite ore processing residue (COPR).

The key observations that have been made so far revolve

around the mineralogical and physical properties of the COPR and the way in which they control both the leaching of Cr(VI) from the residues and the response to known remediation treatments. This knowledge is now being incorporated within a model to be used by a range of end-users. The model construction has been carried out using the ORCHESTRA modelling tool, developed at the Institute (see 1998 Annual report, page 40, available on our web site).

Alongside this work is a PhD project undertaken jointly with Edinburgh University, which is looking at the impact of chromium and arsenic on soil microorganisms, using bioassays that have been developed both here and jointly with Aberdeen University.

Initial results from this project in the form of two oral contributions, five posters and one computer demonstration were very well received at an international conference held recently in Glasgow. Over 80 scientists from industry and academia discussed many different aspects of chromium pollution and visited some of the contaminated sites themselves.

The NERC funded chromium project will run until February 2001. However we hope to obtain future funding that will help us to take forward the concept of 'informed remediation', developed within this project.

Colin Campbell, Steve Hillier, David Lumsdon, Hans Meeussen and Martin Roe are the Macaulay staff involved in this project. Clemencia Licon-Manzur is working for her PhD jointly with Edinburgh University.

Contact Ed Paterson for further information.



*Photograph of football stadium where COPR has been used in order to form terracing for spectators.*



*Photograph of the area surrounding White's Chemical Works, the original source of the chromite ore processing residue now distributed across a number of sites in and around Glasgow.*

*Sampling COPR from one of the sites investigated during the project. Safety precautions were taken because Cr(VI) is a known carcinogen via respiratory processes.*



# Macaulay Photo Album

A SELECTION OF OUR EVENTS AND VISITS  
DURING THE SECOND HALF OF 2000

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## China (July)

While on a visit to the Huazhong Agricultural University, Dick Birnie (below, centre), Mr Li (below, right) of the Institute of Soil Science in Nanjing, China and the head of the local community in Shitiamba, visited erosion control experiments to explore the potential for controlling erosion on steep slopes, using perennial fodder crops, mulches and hedges. These techniques are low-cost alternatives to the building of terraces and are particularly important in the context of the resettlement programme associated with the Three Gorges Dam.



## Macaulay Lecture and Exhibition (May)

John Home-Robertson, MP, MSP, opened our 24th Macaulay Lecture and Exhibition. (above). The lecture was given by Professor Jeff Maxwell, who retired from his post as Institute Director in October. Professor Maxwell is pictured here (right) with Professor Janet Sprent, Chairman of the Board of Governors. The lecture is available at [www.mluri.sari.ac.uk/maclec.htm](http://www.mluri.sari.ac.uk/maclec.htm).



## Visit to Sourhope Research Station (August)

MSPs, local representatives of SNH, SLF, NFUS, Yetholm Community Councillors, Scottish Borders Councillors and local neighbours are pictured examining the NERC Soil Biodiversity field site during a visit to our research station in the borders. Iain Wright (above, left) is pictured describing some of his work with beef cattle.



## Aberdeen TechFest 2000, (September)

Two visitors to TechFest 2000 (above, right) are intrigued by the 3D Landscape Visualisation display, part of our Dr Miller's Countryside Change Toolkit exhibition at the Aberdeen Exhibition and Conference Centre. Our stand was enjoyed by both young and old alike (above, left).



## Aberdeen TechFest 2000 Schools Programme (September)

We took a workshop based on Dr Miller's Countryside Change Toolkit to schools in Aberdeenshire. David Miller (far left) explains the Toolkit to the pupils at Ellon Academy, while Willie Towers (left) helps Mearns Academy pupils understand the problems facing land managers.

## Darwin project in Mongolia (September)

Iain Gordon (right) and Javier Perez-Barberia (left) tour the Khan Kenti National Park accompanied by their Mongolian guide (centre), before Iain hosted a workshop for the Darwin funded project "Large mammal conservation and sustainable resource exploitation in Mongolia".



## Professor Jeff Maxwell's Retiral (October)

Jeff Maxwell is pictured here (right of picture) on the occasion of his retiral from his post as the Institute's Director on 6 October. John Milne, Deputy Director (left) and staff join in the celebrations to mark the occasion.

For further information contact Dr Sue Bird, Public Relations Manager, The Macaulay Land Use Research Institute, Craigiebuckler, Aberdeen AB15 8QH. Tel. 01224 498235, Fax. 01224 311556, email: [s.bird@mluri.sari.ac.uk](mailto:s.bird@mluri.sari.ac.uk), <http://www.mluri.sari.ac.uk>.