

Newsletter

LOOKING TO THE FUTURE

I started my introduction to our last Newsletter with the phrase: 'We live in a changing world' Little did I know what changes were to come in the next 6 months! As an Institute, we have been relatively unscathed by the Foot and Mouth outbreak, compared with those who have suffered losses of livestock and/or income, but we are only too



well aware of the consequences for individuals, businesses and the economy as a whole. In Scotland we can, however, now begin to look ahead and we believe that our research has a role to play in the debate on the options for rural communities and the Scottish landscape, post Foot and Mouth. We have therefore launched a website (<http://www.macaulay.ac.uk/fmd/>) which provides access to some of the relevant outputs of our research in terms of future land-use options. The Institute is also making a contribution to a conference on 'Beyond Foot-and-Mouth: Ways Forward for the Scottish Economy', which is being organised by the Edinburgh Centre for Rural Research, in association with the Aberdeen Research Consortium and we recently contributed to a conference in the Netherlands on the implications of Foot and Mouth for landscape ecology.

The importance of research on the impact of agriculture on the environment is recognised in the recently published Scottish Executive 'A Forward Strategy for Scottish Agriculture'. There are certainly challenges ahead and we hope that we can continue to transfer the results we generate into practical help for rural communities. Some of our work on forecasting the future of Scottish landscapes is described in the article by Dick Birnie in this Newsletter.

NEW FUNDING

The last 6 months have also seen the Institute bid successfully for additional funds from the Scottish Executive, to add depth to our existing expertise and to develop novel ecological and environmental science and economic approaches to addressing land use issues. One of the major themes of this new work is the development of social science methods to support policy-makers in addressing the potentially conflicting priorities of different stakeholders. We will be using the Water

Framework Directive as a Case Study for the research and you can read more about the Directive and diffuse pollution in the article by Bob Ferrier in this Newsletter.

The second main theme which we will be developing with these new funds, is in the area of 'biodiversity and ecosystem functioning'. This is a very broad

topic and the specific hypothesis we will be testing is how dependent the diversity within different components of an ecosystem is on certain characteristics of dominant species. The Case Study we will be using is native Scots pine woodland and we will be studying how variation in the levels of different compounds in the needles of the trees, determine soil processes and the diversity of the above and below ground flora and fauna.

SUBSTANTIAL GROWTH

These two themes, together with 4 smaller components will require the recruitment of 11 new postdoctoral scientists, two technical staff and one PhD student. Together with five new PhD studentships funded by the Macaulay Development Trust, this indicates a period of substantial growth for the Institute. It's just as well that our new building, housing the Directorate and a new seminar room was completed in April, in time for a very successful Macaulay lecture. You will also note that since the last edition of the Newsletter we have 'rebadged' the Institute as the Macaulay Institute, which encompasses both the Macaulay Land Use Research Institute and our commercial arm, the Macaulay Research Consultancy Services. All in all a six-month period of change! I hope you enjoy reading the Newsletter and we look forward to receiving your feedback.

Margaret Gill *Director*

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Future of Scottish Landscapes

There can be no doubt that the Foot and Mouth outbreak has concentrated our minds on the role of agriculture in the UK economy. Whilst the direct benefits of agriculture, in terms of employment and contribution to GDP, have steadily declined since 1970, its indirect contributions in terms of landscape and amenity, have been highlighted by the impact of the FMD outbreak on tourism. Although rural economists have been saying it for over 20 years, our countryside has long ceased to be primarily a place of production, and is increasingly a place of consumption. This covers conservation, amenity, recreation and environmental aspects.

If 2001 marks a sea change in our thinking about the role of agriculture in the British countryside it begs questions on what our future countryside will look like and whether this is what we want? These are not new questions. Professor Coppock, author of the Agricultural Atlas of Scotland, wrote in 1977 that the rural landscapes of 1950 were readily recognisable in those of 1976, and it seemed probable that the countryside in the year A.D. 2000 would not differ in its broad outline from that of 1976. With the exception of the dramatic increase in broadleaf tree plantings, he was right, but will this continue to be the case? Will the Scottish landscape of 2001 be recognisable in that of 2025?

THE NEXT 25 YEARS

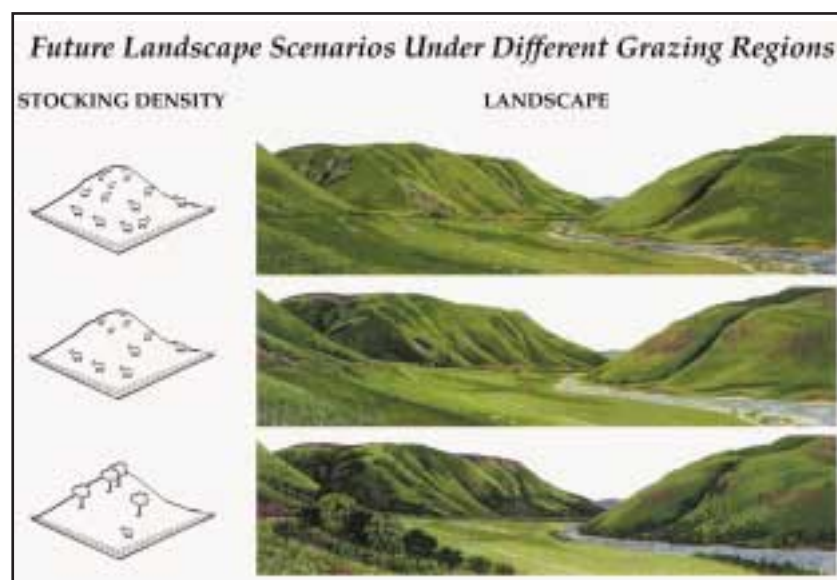
The short answer has to be a qualified "yes". This is simply because there are elements of the rural landscape of 2025 that we have already created, for example, the Millennium Forest. The longer answer is more of a challenge. In collaboration with colleagues in a number of UK research centres, a team from the Macaulay has been researching different scenarios for land use change over the next 20-25 years. These scenarios are based around differing assumptions about:

- i) agricultural markets and production technologies
- ii) UK economic policy
- iii) UK planning policy
- iv) EU policy particularly in the context of CAP reform, rural development and EU enlargement.

Irrespective of which policy scenario we choose (e.g. rapid move to world prices; gradual decoupling of support payments from production; emphasis on community-led rural development) the pressures for restructuring of Scottish agriculture seem irresistible. Considering a continued cost-price squeeze together with the top-heavy age structure of the Scottish farming community, and the existing high dependency on agricultural subsidies, also suggests that this restructuring will be rapid.

So one element of our answer is that whilst the countryside of 2025 may look similar to that of today, there will be real and significant differences in terms of how it is owned and managed. In many respects this represents less of a "sea change" more a continuation of long-term trends in increased mechanisation, decline in agricultural employment, and farm structural adjustment (e.g. farm amalgamations). However, in landscape terms we forecast that this restructuring may mean very different things in different parts of Scotland:

1. In **areas with production advantages** (e.g. eastern coastal lowlands) agricultural units will increase in size and continue to become highly mechanised and specialised, seeking to produce at world prices.
2. In **areas with environmental advantages** (e.g. within the new National Parks and other high amenity areas) agricultural units could follow several different change pathways:
 - i) destocking with compensatory environmental payments to provide biodiversity gains.
 - ii) shift to part-time/hobby farming either with or without changes in ownership.
 - iii) land purchases by conservation and/or recreational organisations (e.g. John Muir Trust, RSPB, SWT etc)



3. **Areas with neither production nor environmental advantages** (the so-called "middle countryside") are the most problematic. These areas include parts of Banff and Buchan, Caithness and Orkney. Much will depend on land values, and the demands for agricultural, forestry and/or amenity land. With wider countryside, rather than targeted environmental support schemes, these areas could provide the greatest opportunity for conversion of low-ground to "environmentally-friendly" production systems. On the other hand, lack of adequate financial support might trigger significant structural change with rapid loss of the smaller, often family-farmed, units. The social consequences of such changes could be locally significant particularly in areas with little alternative employment.

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These trends may or may not be what we collectively want. For example, the focus of production on prime land may have unacceptable costs in terms of specific habitat and species losses. Our view of the future suggests a more differentiated and specialised countryside than we already have - with production being the imperative in the eastern lowlands and conservation and environment being the imperatives elsewhere. This is not a view of an integrated, multi-functional landscape, and does not sit well with the concept of sustainability. If our view is correct, we have to guard against replacing specialised agricultural landscapes with specialised conservation ones. The challenge is to find ways of supporting integrated solutions which are sensitive to local conditions but which are applicable across the whole of Scotland. This would require a further shift away from the "one size-fits-all" approach towards one that provides

LAND MANAGEMENT CONTRACTS

local solutions that satisfy a universal requirement for the delivery of multiple benefits (i.e. social, economic and environmental). One approach is to base future public funding support around the concept of a Land Management Contract for each farm or estate. Such an approach has been heralded in the Scottish Executive's new 'Forward Strategy for Agriculture' (www.scotland.gov.uk). This approach would require cost-effective management-unit based strategic planning tools, such as those being developed at Macaulay (e.g. the Land Allocation Decision Support System LADSS, see www.macauley.ac.uk/ladss).

For further information please contact Dr R V Birnie, r.birnie@macaulay.ac.uk

THE CHALLENGE OF DIFFUSE POLLUTION



Diffuse sources of pollution to our rivers and lochs are becoming increasingly significant as the traditionally dominant sources such as industrial and sewage effluent are brought under control. The new EU Water Framework Directive (WFD), with its target of good ecological quality has made diffuse pollution a priority area.

So what actually is "diffuse pollution?" Perhaps the most practical definition describes diffuse pollution as "that arising from land use activities (both urban and rural) that are dispersed across a catchment or sub-catchment, and do not arise as an effluent from an industrial, waste water treatment or agricultural activity."

Pollution of this kind includes surface water outfalls serving a town or city, field drains in the countryside, and surface runoff from industrial yards and roads, farmland and forests. It includes the atmospheric deposition of pollutants and groundwater contamination.

Recently SEPA¹, SNIFFER² and the Environment Agency commissioned a review³ of diffuse pollution under the auspices of the Chartered Institution of Water and Environmental Management and the International Water Association. They appointed a management team for the project, co-ordinated by Dr Bob Ferrier, who is head of the Institute's Integrated Catchment Management programme. What followed was the most comprehensive compilation to date of environmental and academic



information regarding the impacts of diffuse pollution in the UK. It involved representatives of the water industry, regulatory authorities, academia, conservation and fisheries interests, and other non-governmental organisations.

The range of pollutants involved is substantial (Table 1, page 6) with regard to both their sources and impacts, and the report suggests that diffuse pollution is a growing problem because of agricultural intensity, and the expansion of industrial and urban development and peri-urban activities. Diffuse pollution has major consequences for the UK Water Industry, because of the cost of removing pollutants from drinking water supplies, and the increased cost of effluent and bio-solids treatment as a consequence of increased background levels of pollutants

Diffuse pollution research is a key element of the Institute's Catchment Management Programme. Understanding the origins and transport of pollutants, coupled with the development of catchment based predictive models, allows for the assessment of impacts on the aquatic environment and its ecology and for the evaluation of potential management options. The research is focused towards providing essential scientific underpinning of the objectives of the EU's WFD. These include: catchment based management, focusing on

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Macauley Photo Album



International Grassland Congress, Brazil, February

Carol Marriott accompanied fellow international scientists to the Embrapa Cerrados Research Station, near Brasilia, to discuss shade adaptation of native *Stylosanthes guianensis* germplasm. Farm workers can be seen managing cattle on the 9000ha on horseback.



Krakow, March

Jeff Bacon (left) and colleagues meet together at Jagellonian University in Krakow for the Mid-project workshop of the EU Inco Copernicus project "heavy metal transfer to food chain".

The delegates are seen, left, visiting their study site near Krakow.



Kazakhstan, April

A Kazakh shepherd (left) tending his flock was photographed by Iain Wright during his trip.

Each household has one or two cows which graze together in pastures outside the village.



Cows leave a village in Kazakhstan after morning milking (left).



Korea, March

Simon Langan (second from right) organised and chaired this international workshop in Seoul, South Korea in March. The British Council sponsored the conference, which aimed to introduce some of the methods and studies in the UK and Europe, to assess the impact of acid deposition on environmental and ecosystems.



Zimbabwe, April

Glenn Iason visited PhD student Netty Purchase in Zimbabwe in April. Netty, who is investigating behaviour interactions between lions and hyenas, is pictured here using satellite-tracking equipment to find her subjects.



January - June 2001



Edinburgh Science Festival, April

Visitors to the Macaulay display in the exhibition hall at the Royal Botanic Gardens in Edinburgh enjoyed the many different attractions on offer. Visitors, young and not so young were fascinated by the satellite technology, the computer visualisation techniques and the competitions!



May, Macaulay Lecture
Professor Chris Pollock, Director of Research at the Institute of Grassland and Environmental Research, Aberystwyth, gave the 25th TB Macaulay Lecture "21st century agriculture: if new technology is the answer, are we asking the right question?".



To mark the occasion of her retirement as Chairman of the Institute's Board of Governors, and in recognition of her loyal service to the Institute, Professor Janet Sprent is awarded an honorary fellowship. Professor Sprent, who retired in July, having been Chairman for six years is pictured here with Douglas Boyd, Vice-Chairman.

Fort Hare, May
Peter Dennis (right) presents a reference collection of grasshoppers and bush crickets to Leigh-Anne Kretzmann, Assistant Conservator, Sam Knott Nature Reserve of the Great Fish River Reserve Complex, providing easy identification of new material collected. Several insects are common to this part of the Eastern Cape and provide information on other inhabitants such as the black rhino and elephant.

The day concluded with a lively Discussion Forum which debated "Will the use of GMO technologies be positive or negative for our environment?". Panel members (from left to right) Professor Chris Pollock (IGER); Professor John Milne (Deputy Director Macaulay Institute); Dr Colin Campbell (Macaulay Institute) and Professor Margaret Gill, (Director, Macaulay Institute).

Chile, May

Student Pía Bustos tracks huemul in Chile on the Patagonian Andes in the Tamango National Park with satellite equipment. Pia is an MSc student, supervised by Iain Gordon, who visited the project funded by Darwin and Wellcome in January.



...Diffuse Pollution continued

ecological quality, and the identification of cost effective management strategies.

To meet this challenge our research brings together a unique combination of biogeochemical scientists (with specialists in hydrology, water quality and soil science), geographers, socio-economists and IT specialists. An important component is the development of decision support methodologies aimed at meeting the needs of land and water managers and those formulating and implementing policy.

For example, the Institute currently co-ordinates a pan-European assessment of the impacts of atmospheric deposition (<http://www.macaulay.ac.uk/recover/recover2010.htm>), and has recently been involved in the development of a classification scheme for assessing the impact of nutrient enrichment on Scotland's lochs, and the impact of nutrient flows into coastal and estuarine waters and the North Sea from Scotland's rivers. This and other catchment based research within the Institute aims to provide the necessary support framework for delivering sustainable management of waters, not only in Scotland and Europe, but also further afield overseas.

¹ Scottish Environmental Protection Agency

² Scotland and Northern Ireland Forum for Environmental Research

³ *Diffuse Pollution Impacts: The environmental and economic impacts of diffuse pollution*, published by Terence Dalton Publishers ISBN 1 870752 46 5

For further information please contact Dr Bob Ferrier, r.ferrier@macaulay.co.uk



New Chair of Economics

The Institute and the University of Aberdeen have appointed Professor Clive Spash to a joint Chair of Environmental and Rural Economics. Professor Spash is presently the Director of Cambridge Research for the Environment at the University of Cambridge and he will be joining the Institute and the University full-time from September. At the Institute Professor Spash will be leading the Socio-Economic Research Programme (SERP) and will be overseeing a period of expansion in this area, with four new posts recently advertised. At the University he will be based in the Department of Agriculture and Forestry. Professor Spash is President of the European Society for Ecological Economics.

TABLE 1:

Pollutant	Sources and transport	Impacts
Oil & Hydrocarbons	Spills from storage and handling, road and contamination, industrial runoff, disposal of waste oils.	Toxicity, sediment contamination of ground and drinking waters. Poor aesthetic quality
Pesticides	Agriculture, municipal amenity and domestic applications	Toxicity, contamination of drinking water supplies
Sediment	Agricultural erosion, urban runoff, construction industry, forestry	Destruction of fish spawning habitats, sedimentation of ponds and reservoirs
Organic wastes	Farm wastes, silage, sewage sludge, industrial wastes applied to land	Increased biochemical oxygen demand, nutrient enrichment
Faecal pathogens	Misconnections to sewers, dog faeces, farm wastes	Health risks, failures of bathing water standards
Nitrogen	Fertilisers, manures, atmospheric deposition	Eutrophication of coastal waters, contamination of drinking water, acidification in upland areas
Phosphorus	Soil erosion, fertilisers, detergents and organic matter in urban runoff	Eutrophication of freshwaters, algal blooms, habitat degradation
Trace Metals	Urban runoff, industrial and sewage sludges spread on land, mining	Toxicity
Iron	Groundwater rise following cessation of mining	Toxicity, and aesthetic nuisance
Acidifying pollutants	Traffic and industrial emissions, fires	Acidification of sensitive waters, potential eutrophication of soils and waters
Industrial Chemicals	Domestic and industrial runoff	Toxicity, endocrine disruption, contamination of potable supplies

Rapid Assessment of Grazing and Trampling Impacts on Upland Habitats

Scotland is a country of wild and beautiful open spaces with dramatic scenery enhanced by the contrast between settled agricultural lowlands and rugged mountains and glens. Not surprisingly, the environment has been modified by human activity over millennia, including the near complete removal of native woodland and scrub. However, the semi-natural vegetation communities of moorland, grassland and blanket bog account for over 60% of the land area. Although the primary use of much of this land is for grazing by domestic stock and wild herbivores, notably red deer, there is an increasing awareness of the natural heritage value of such habitats. Along with this, there is a desire to manage them on a sustainable basis to benefit the wide range of land uses that they support.

Deer Management Groups, which exist to foster collaboration between neighbouring estates to manage discrete deer populations, are leading the way with encouragement from the Deer Commission for Scotland and Scottish Natural Heritage. There has been considerable debate regarding the increase in the red deer population in Scotland and their effects on native woodland and semi-natural habitats. Management plans are being formulated to address the issue of sustainable management and an essential stage in this process is the assessment of current impacts. However, as Deer Management Groups range in size from around 200 to greater than 1000 sq km, complete survey coverage is considered impractical due to the high inputs of time

and cost required.

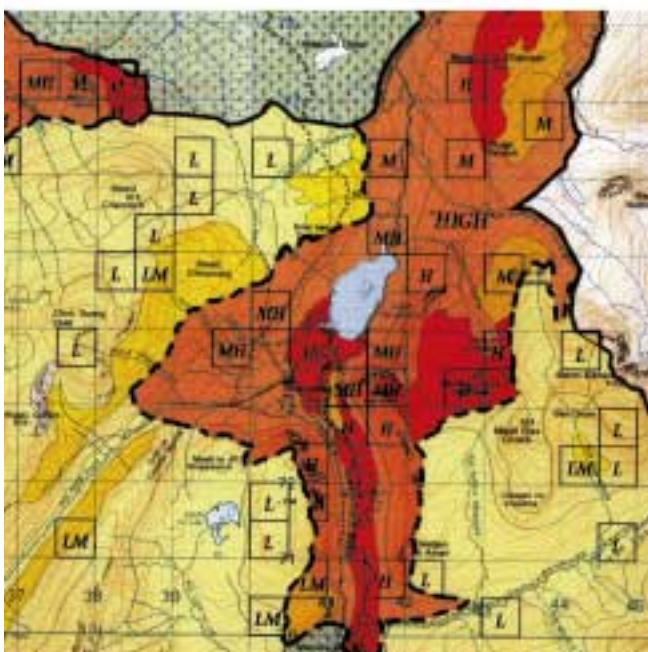
In a three-year collaborative project with the Deer Commission for Scotland and Scottish Natural Heritage, a methodology has been developed and tested that enables resource assessments to be carried out rapidly over extensive areas with a high level of accuracy. This modelling approach is based on sampling and prediction of impacts using the Land Cover of Scotland dataset as a vegetation map base, overlain with boundaries determined by type and densities of herbivores present. A GIS-based computer model is used to select sample areas. Following assessment of grazing and trampling impacts in the field, the sample area data are used as input to the model and a final coloured map of overall impacts is produced.

Testing of the methodology, based on comparison with complete survey datasets gathered during the project, has indicated that accuracy to within one class different overall (based on the five-class system of Light, Light-Moderate, Moderate, Moderate-Heavy and Heavy impacts) can be maintained with sampling intensities ranging from under 10% to 25%. In terms of cost-benefit analysis such sampling intensities may be regarded as optimal, in that they define a point from where there is a decreasing return in further accuracy against increasing inputs of cost. The optimum sampling intensity for any given area is influenced by a number of factors, notably the complexity, range and variation in vegetation patterns occurring, and the numbers and types of herbivores present and their ranging behaviour.

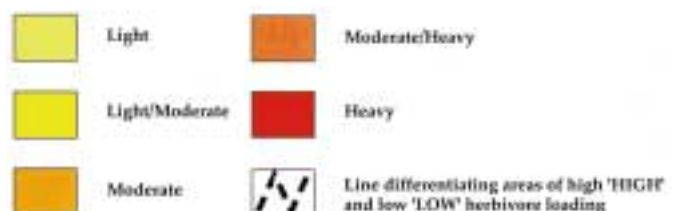
We have been able to demonstrate that rapid cost-effective and accurate methods, based on sampling and prediction, can be developed for resource assessment over extensive areas. This research will aid decision-making, particularly at the level of Deer Management Groups, and greatly facilitate appropriate management and sustainable use of the semi-natural vegetation resource.

For further information please contact Andrew Nolan, a.nolan@macaulay.ac.uk

Map Showing Assessment of Grazing and Trampling Impacts on 1/4 sq km Sample Areas



Grazing and trampling impact levels due to wild and domestic herbivores



Modelling the Impact of Market Reforms on Central Asian Rangelands

This is a chaotic period for central Asian ecosystems and economies. Nomadic pastoralists in the Soviet Union had previously been collectivised into large state farms engaged in industrialised forms of livestock production. As a result of market reforms, pastoral families now decide how many animals to keep, what to feed them and where to move them.

The ultimate outcome of this restructuring is unclear. However, in the current period of uncertainty and experimentation, a variety of new, spontaneously developed herding strategies are emerging. Some pastoral regions, which were over-utilized under the Soviet system of collective agriculture, may now have a chance to regenerate as stock numbers and grazing pressure decline. On the other hand, localized grazing pressure is increasing as private small-holders no longer have the economic capacity to take animals to distant pastures which were used in the Soviet period. The result appears to be a drop in mobility and lowered grazing pressure on far flung seasonal pastures, but a concentration of many small herds and increased grazing pressure around cities, villages, agricultural zones, water points and in those regions able to support year round grazing.

DARCA - 'Desertification and Regeneration: Modelling the Impact of Market Reforms on Central Asian Rangelands' - is a collaborative research project funded by the European Commission. Working at two sites in Kazakhstan and two in Turkmenistan, the project is documenting recent shifts in the intensity and location of grazing-induced rangeland desertification. The goals of this project are to predict the environmental impact of new, post-Soviet forms of rangeland use, to examine the effects of alternative government policies, and to identify improved husbandry options for newly-privatised livestock owners.

The project, which began in 2000 and will continue for three and a half years, is coordinated by the Macaulay Institute, with partner institutes in Kazakhstan, Turkmenistan, Belgium, Denmark and France.

This project has four objectives:

- To estimate the severity of rangeland degradation during the late Soviet period and assess post-reform shifts in its intensity and/or geographical location. A combination of remote-sensed and ground-based vegetation assessments will be used at different spatial scales in the study sites.
- To undertake inter-disciplinary field studies that provide an integrated picture of why pastoralists change their livestock husbandry and land use systems in ways that either promote or retard desertification. We will collect information on land tenure for selected communities, and on flock economic performance, output characteristics and feed availability for sentinel flocks representing different flock size classes. This material will be used to build a simple model of flock mobility and growth in response to resource availability, flock performance and prices.



Flock owners and local scientists in Turkmenistan.

- To disseminate study results that identify economically profitable and environmentally sustainable policy options and management systems for producers. This will involve discussions with shepherds, senior civil servants, national scientists, and the publication of policy-oriented reports, scientific papers, and popular articles, and use of video films.
- To introduce Central Asian scientists to new research for monitoring rangeland condition. These techniques will strengthen the contribution that scientists make to the formulation of national agricultural and environmental policy. Capacity building will involve scientific interchange and training as well as financial support to Central Asian research institutions.

Field work began in 2000 and preliminary results are expected late in 2001. Available in 2002 will be a book on the impact of market reforms on Central Asian pastoralists and an introduction to the issues examined in the current field study. *From State Farms to Private Flocks: Prospects for Pastoralism in Kazakhstan and Turkmenistan*, edited by Carol Kerven, will be published by Curzon Press, London.

For further information please contact Roy Behnke, email: r.behnke@macaulay.ac.uk

New web and email address

Please note the new address for the Institute's web site:

www.macaulay.ac.uk

and email addresses now follow the following format:

s.bird@macaulay.ac.uk

All old addresses will continue to work for at least the next twelve months.