

INTRODUCTION FROM PROFESSOR JEFF MAXWELL DIRECTOR OF THE INSTITUTE

This Newsletter features research on rural and urban landscapes, the work of the Plant Science Group in 'unlocking the secrets of the soil' within a collaborative and co-ordinated SOAEFD Flexible Fund programme which is now also linked to the NERC Thematic Programme on Soil Biodiversity. Also featured are three of our EC funded programmes. These have made important advances in understanding the mobility of heavy metals in soils on afforested sites, resulted in the creation of a decision support tool to assess the risk of wind, snow and fire damage to forests and the construction of computer based models to predict and scale-up the impact of acid deposition and atmospheric levels of CO₂ on biogeochemical cycling and forest management practices. There is much here for those who have both a specialised interest and general interest in land use issues that are at the forefront of current policy and research development.




(L to R) Lord Sewel, Professor Maxwell and Magnus Magnusson KBE at the official opening in September of the international conference on Landscape Character, which was jointly organised by SNH and the Institute (see overleaf).

'STREETSCAPES' PROJECT AIMS TO CREATE TOWN CENTRES YOU WANT TO LINGER IN!

A computer-based tool is being designed for organisations such as Scottish Enterprise and associated agencies to enable them to predict the economic impact on a development of different investments in factors such as landscaping, arrangements of the buildings and access. It will enable organisations concerned with planning and investment to obtain cost-effective, scientifically-validated information about streetscape planning at a crucial early stage of a project. The project has been launched by the Institute in collaboration with The Robert Gordon University and Scottish Enterprise.

Research has already shown that how much people enjoy a visit to a town centre depends a great deal on their perception of the amount of open and green space, seating, traffic, pollution, cleanliness, safety and ease of access. If people find a town centre or street a pleasant place to be, then they are more likely to linger and spend money. So, the design of so-called 'streetscapes' is vitally important to the economic success of a city.

"Unfortunately, at the moment there is no cost-effective way of incorporating the public's preferences into the design of new urban environments, which tend, therefore, to be designed solely on the basis of expert opinion. The tool which we develop in this project will fill this vital need" said Dr David Miller who is leading the project at the Institute, in partnership with Graeme Slaven, Research Development Co-ordinator at the Scottish Centre for Environmental Design Research of the Robert Gordon University

"At the Macaulay Institute, we have already developed a computer tool that enables landscape architects to assess the public's view of potential rural landscape change, and this new project is a logical extension of that work to the urban environment," said Dr Miller.

COMPUTER VISUALISATION TECHNIQUES FOR MANAGEMENT OF LANDSCAPE CHANGE

Novel approaches to the measurement and visualisation of changes in the landscape have been developed at the Institute using a combination of historical and current aerial photography and computer-aided design.

"People are no longer prepared to sit back and watch as the landscape they live in is adversely affected by the actions of man," said Dr David Miller, who is leading this research at the Institute. "If it is likely that a landscape will be altered, it is important to be able to visualise that change and model how a negative effect could be minimised to reduce a decline in the scenic quality of the landscape."

The following projects illustrate the wide range of potential applications of this work:

• Mapping Individual Scots Pine trees in the Cairngorms

Individual Scots Pine trees were identified and mapped using historic aerial photographs from 1957, 1975, 1992 and 1995 for two study sites in the Cairngorm Mountains. The results allowed the loss and regeneration of trees in each area to be assessed, together with the change in both the spatial distribution of woodland and its density.

• Landscape preference model

This model is based on an analysis of surveys of what people like or dislike about landscapes. Any proposed changes in the landscape can be simulated by the computer and the changed landscape will be assigned a 'score', which may be higher or lower than the score for the original landscape depending on how the public's preference for the altered landscape is assessed by the model. It will enable landscape architects to get an assessment of the public's view of landscape change, rather than relying solely on expert opinion, which is what tends to happen at the moment.

• Visual impact of windfarms

In a collaborative project with the Countryside Council for Wales a novel computer-based tool has been developed which places computer designed wind turbines in the landscape with an animated feature of rotating turbine blades. The customer can 'fly-through' the model and visualise the landscape with and without the turbines, with the added value of being able to assess the potential effects of movement within the landscape rather than a static image.



"LANDSCAPE CHARACTER – PERSPECTIVES ON MANAGEMENT AND CHANGE"

This international conference, jointly organised by SNH and the Institute, was held in Aberdeen from 1-2 September of this year. It was attended by over 150 delegates from the UK, Australia, Belgium, Norway and Sweden. The Conference brought together some of the leading technologies and techniques for the geographic modelling of landscape, including landscape simulation. The conference provided an opportunity to share recent developments in science and technology with practitioners in landscape management and planning. The conference also featured the launch by SNH of the 'Landscape Character Assessment of Scotland' – an inventory of the diversity and character of Scotland's landscape. The proceedings will be published by SNH in 1999.

SOIL QUALITY FOR NATURAL HERITAGE MANAGEMENT

There is support for the establishment of a national soil monitoring scheme to assist with the measurement of environmental change. A recent project investigated the feasibility of using the existing Scottish National Soils Inventory for this purpose, rather than setting-up a new system from scratch. This Inventory contains information based on describing and sampling the soils of Scotland on a 5 km grid across the country. One of the major outcomes from the project was an insight into the applicability of soil quality indicators as proposed by the Department of the Environment, Transport and Regions to the Scottish soil resource. Two of the main indicators are pH and soil organic matter content and while both of these work well for the mineral soils used for arable and intensive grassland they are unsuitable for most of Scotland's soil resource. Over half of Scottish topsoils are highly organic with low pH values which, apart from extensive grazing, have little or no potential for food production. For these soils, natural heritage objectives will be far more important and there is a need to derive meaningful soil sustainability indicators for these sites.

EARTH, WIND AND WATER

a selection from the Institute's portfolio of EC-funded contracts.

MEMO – Metal Mobility

Effects of afforestation of agricultural land on heavy metal mobility in soil

In Europe, there are currently 8.5 million hectares of set-aside which could potentially be afforested. It is known that afforestation causes acidification of the soil, which in turn affects the bonding and mobility characteristics of heavy metals in the soil. The possible environmental impact of this potential change in land use is, therefore, an increased mobility of heavy metals through the soil and into the water course. It is thought that these changes in the mobility of heavy metals could be ameliorated by forest and land use management practices which take into account inherited site properties and previous land use. However, development of such strategies requires improved knowledge of how afforestation changes soil properties under different site conditions and how the changed properties alter the behaviour of heavy metals.

The MEMO project will study heavy metal (Cu, Pb, Zn, Cd and Hg) bonding and mobility in soils by comparing conditions in afforested farmland with land still in agricultural use. The sites being studied are located in the countries of the participating partners which are: Sweden, Finland, Denmark, The Netherlands and The United Kingdom.

The results from the project will assist in the drafting of guidelines for the establishment and management of forests on set-aside land in northern Europe, taking into account different soil conditions and under different climatic and atmospheric deposition scenarios. The MEMO website can be viewed at <http://www.sml.slu.se/memoe.html>.

Contact: Dr Derek Bain



STORMS - Silvicultural Techniques Offering Risk Minimising Strategies

Forest damage by wind, snow and fire in Europe constitutes the most serious economic problem facing the forestry industry. To address this problem, the STORMS project has developed a decision support tool which allows forest managers to assess the risk of wind, snow and fire damage at tree, stand and regional levels and also to test the contribution of alternative management strategies for reducing risks. The project involved collaboration between the Institute and other agencies in the UK, Finland, Sweden, Portugal and Ireland and was funded under the EU AAIR programme.

An innovative aspect of this project was the bringing together of a number of risk models within a single framework accessed by, and structured within, a World Wide Web (WWW) interface. This framework was developed by the Institute group and enables user access and model development and testing for different climate and forestry contexts. Users are able to assess the 'fitness for purpose' of a risk model relative to the data that are available to them. The results of this project can be viewed on the WWW at <http://www.bamboo.mluri.sari.ac.uk/air/air-home.html> and a CD-ROM is available as a teaching aid for graduate and postgraduate levels. STORMS has been adopted by DGXII of the EU as an exemplar project.

Contact: Dr David Miller



DYNAMO – Dynamic Models to Predict and Scale-up the impact of environmental change on biogeochemical cycling.

The project aims to scale-up models of nutrient and pollutant cycling, which currently operate at a site (catchment) scale, to regional and European scales and then use these models to predict future impacts on terrestrial ecosystems, over decades, of various scenarios of acid deposition, atmospheric levels of CO₂, and changes in forest management practices.

These models will assist policy makers with the development of emission policies for major air pollutant gases and strategies for land use management. The project has already emphasised the inadequacy of current EU policy on emission reduction and highlighted the potential long-term problems of eutrophication and acidification as a result of land use and climate change.

The countries collaborating on the project include the UK, the Netherlands, Finland, Denmark and Norway. More details are available from <http://www.mluri.sari.ac.uk/dynamo.htm>.

Contact: Dr Bob Ferrier



FOCUS: PLANT SCIENCE GROUP

UNLOCKING THE SECRETS IN THE SOIL: THE MICRONET PROJECT

We know a great deal about how pastures and woods are affected by acid rain, soil erosion and other factors, but very little is currently known about the underground interactions between plants and the soil microorganisms. It is important to increase our understanding of these interactions because in organic and other low-input sustainable farming systems plant growth is often governed by the supply of nutrients from the soil, which in turn is dependent on the activity of the soil microorganisms.



Excavating soil for greenhouse experiment, Sourhope Research Station.

The MICRONET project aims to quantify the spatial and temporal diversity of soil microbial communities beneath characteristic grassland types (unimproved, semi-improved and improved) at ten sites throughout the UK (see map). It is a ten-year research programme, which involves collaboration with the Scottish Crop Research Institute (SCRI), the Scottish Agricultural College (SAC), the Institute of Grassland and Environmental Research (IGER) and the Universities of Aberdeen, Lancaster and Manchester. The project is coordinated by Dr Pete Millard, Head of the Plant Science Group at the Institute and it is sponsored by SOAEFD.

“We are dealing with a complex system which has millions of bacteria in only a small sample of soil and it is only recently that we have started to develop the tools to enable us to unlock the secrets in the soil. This unique programme is of international significance because we are developing and applying a wide range of molecular and physiological techniques to assess microbial diversity on the same soil samples,” said Dr Millard. “In addition to providing a unique insight into the impact of vegetation on soil microbial communities, this ten year programme will allow us to assess the utility of these different approaches and their sensitivity in detecting changes in the microbial community. There is no other similar programme anywhere in the world.”

Recent results from the Institute's contribution to MICRONET include:

- Demonstration of an inverse correlation between microbial biomass and fungal communities and a direct correlation between bacterial communities and the degree of pasture improvement. These community differences may be attributed to variation in the quality and quantity of carbon availability in the soil under different pastures.
- Overall, the diversity of the microbial community decreases with increasing management intensity.
- Demonstration that differences in microbial communities between pasture types and sites are robust over time, but vary quantitatively in response to plant productivity and environmental variables.

“If we know more about what happens in the soil we will be in a far better position to make decisions on management options for the sustainable growth of grasses, plants and trees. We know quite a lot at the moment about how to manage vegetation above ground but we have very little idea of the consequences of that management below ground,” said Dr Millard.

Right The distribution of field sites (red) used in the MICRONET project and the location of the collaborating organisations (black)



SOURHOPE FOR SOIL BIODIVERSITY PROGRAMME

The Institute's Sourhope Research Station in the Cheviot Hills has been selected as the field site for the NERC Thematic Programme on Soil Biodiversity. This programme aims to achieve an understanding of the biological diversity of the soil biota and the functional roles played by soil organisms in key ecological processes. Sourhope is also one of the most thoroughly studied sites in the MICRONET programme and as data on microbial diversity become available from MICRONET they will be made available to the Soil Biodiversity programme.

MEASURING NITROGEN CYCLING FOR TREE GROWTH

Trees are able to grow when the external availability of nitrogen is low because they can store and then remobilise the nitrogen when they require. Developing sustainable management strategies for trees requires N storage and remobilisation to be quantified in relation to fertiliser inputs. A new method to measure this has been developed by monitoring xylem sap amino acid translocation patterns. This amino acid 'signature' can now be used to assess the duration of nitrogen remobilisation by trees in the spring.

WHOLE TREE HARVESTING

We have shown that whole-tree harvesting of Sitka Spruce on less fertile sites in Kielder Forest in Northumberland can result in substantial reductions in growth rates for at least ten years following replanting with a second rotation. This has implications for sustainable forestry management practice.

SUSTAINABLE MANAGEMENT OF ORCHARDS

With Agriculture and Agri-Food Canada we have refined the timing of nitrogen application to irrigated and fertilised apple orchards, as a consequence of showing that nitrogen applied early in the season during spur leaf growth was not utilised by trees for growth.

Collaboration with the University of Bologna has enabled us to study the use of foliar sprays of urea as a means of fertilising nectarine trees post-harvest to augment their internal cycling of nitrogen.

ASSURANCE OF QUALITY IN ANALYTICAL SERVICES GROUP



Professor Maxwell presents the NAMAS Accreditation certificate to Dr Smith and his analytical Services team.

The Institute's Analytical Group have recently been awarded NAMAS (National Accreditation for Measurement and Sampling) accreditation by the United Kingdom Accreditation Service. This is the first time that a SABRI (Scottish Agricultural and Biological Research Institute) has achieved NAMAS accreditation for its analytical laboratories.

"We are very happy to have achieved what we regard as the 'gold standard' in accreditation," said Dr Alistair Smith, Head of the Analytical Group. "My staff have worked extremely hard to ensure the stringent requirements for NAMAS accreditation were met and we believe that this accreditation clearly demonstrates to all our customers a real commitment to quality and standards. The operation of a formal, accredited quality assurance scheme is essential in today's marketplace," said Dr Smith.

The analytical laboratories are used extensively to support the Institute's research programme, but the amount of commercial analytical work that is undertaken through Macaulay Research & Consultancy Services is also increasing. The extensive laboratories are extremely well equipped to undertake a wide range of analyses for many sectors of industry including oil and gas, water, whisky distilling, farming, horticulture, paper making, and waste disposal.

"No one else in Scotland has such a complete range of facilities under one roof," said Dr Smith. "This means we can offer commercial customers a 'one-stop-shop' for all their analytical requirements and the skills of our staff are such that we are also experts at data interpretation and problem solving."

'IN THE CHAIR'

with Dr Iain J Gordon

Job Title:

Manager of Research Programme on herbivore foraging for natural heritage management

Research interests:

Development of integrated livestock and wildlife management systems for anywhere in the world. I believe that wildlife will only survive if it can be shown to have benefits for the rural community and that wildlife must live side by side with the primary source of income in many communities i.e. raising livestock.

Other interests:

Sport – especially rugby (retired professional player).
Bee keeping.
Keeping tropical freshwater fish.

How did your interest in research develop?

From my childhood in the West Indies, where I kept a wide range of creepy-crawlies as pets (snakes, ants, iguanas). My long-suffering mother and sibs were subjected to experiences such as buckets full of snakes left in bedrooms, and on one occasion I left an injured lizard that I had rescued (and practised my bandaging skills on) crawling around the kitchen. I did my first research project at the age of 11 examining the different colouration of giraffes in Samburu National Park, in Kenya.

Greatest achievement (so far!)

Being selected for Zimbabwe National 7^s Rugby Squad for the World Cup, while on sabbatical in Zimbabwe in 1996.

What is your ambition?

To continue to develop my research on integrated livestock & wildlife management in developing countries and to foster collaborative links and research teams to do this work.

Greatest fear?

Going bald.

What is the most dangerous incident you have experienced during your travels?

Being blond is considered lucky in many African countries, and I think I have been lucky in my travels. The most dangerous incidents I have been involved in are related to my experiences while rescuing people from road accidents because of the high incidence of AIDS in truck drivers.

Your top tip for travelling abroad?

Always carry a pair of stout gloves with you.

Favourite country?

Mozambique: Because of the war, the inland areas are still littered with landmines and burnt-out tanks and planes and as a whole the country has a very low population density. The coast, however, is still totally unspoilt and you can sail out to pristine reefs and see the most amazing wildlife.

Any countries you still want to visit?

The Galapagos Islands, Peru, Chile, Bolivia, Brazil.



In Zambia with one of his MSc students, Iain is interviewing a village Chief about his attitude towards Kafue Lechwe (a type of antelope).



THE MACAULAY LAND USE RESEARCH INSTITUTE

A premier centre in Europe for research on land use and environmental science

We undertake research that provides scope for:

- Rural economic development and a viable rural community structure
- The protection and enhancement of our natural heritage

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