

Newsletter

Season's Greetings to all our Readers

Communicating with Diverse Audiences

DIRECTOR'S INTRODUCTION

We read a lot in the press about the benefits of modern communication methods such as E-mail and mobile 'phones', yet however good modern methods of communication are, it is the quality and relevance of the messages which are exchanged which will determine whether communication is effective or not. Over the past few years at the Macaulay, we have evolved a 'Communications Strategy' which aims to match the message to the audience. This issue of our Newsletter picks up on some of our activities in this respect.

One of our main target audiences is other scientists. Increasingly we are developing project specific websites for this purpose, one example of which is mentioned in the article on the Soil Health Initiative, a project which is joint between ourselves and the University of Aberdeen. A website specific to the project rather than to either organisation helps to give the project a real identity. Another audience for our scientific outputs includes policy-makers and we were delighted to be able to present the work of this Initiative to Rhona Brankin (who was the Deputy Minister for Environment and Rural Development at this time) during her visit to the Institute in August. During this visit, we also talked about our research on native habitats of Scotland. One example of this is a study on montane heathland. Maintaining heather in the Scottish landscape is very important for tourism and we are seeking to understand how montane heath responds to changes in the climate and in management practice - understanding these responses will be important to inform future policy both for agriculture and tourism as was highlighted this year, in relation to the Foot and Mouth Disease outbreak. We are part-way through a study of the effects of the FMD outbreak on the economy as a whole and hope to report on this in the next issue.

One of the aims of our Communications Strategy is to present the outputs of our research to the local community and in part fulfilment of this aim, we have been developing a



Margaret McGinlay from Scottish Enterprise Grampian is pictured (third left) presenting the Investor in People Award to Professor Margaret Gill, Director and some of the IIP Committee. The Institute gained the Award in August 2001.

programme of workshops with local schools. This initiative has been highlighted in photos in earlier issues of the Newsletter, but we describe it in more detail in this issue.

Our 'Communication Strategy', is not just about external audiences, however, and we also view internal communications as very important. Thus we were delighted to be awarded 'Investor in People' status which demonstrates our

commitment to the importance of investing in our staff for the continued success of the Macaulay. In the last few months two of our staff who have given more than 75 years of service between them have retired, well at least in theory, since you will see that we managed to persuade Berwyn Williams to write an article on peat for this Newsletter. Berwyn worked at the Institute for 35 years and we are very appreciative of such loyalty. Alan Sibbald's contribution to the Institute spanned an even longer time-frame - over 40 years - with much of his time recently being spent working on agro-forestry. Alan is spending part of his retirement in developing an agro-forestry toolbox, to communicate the results of this research to practitioners. We are delighted to have a continuing association with someone who has shown such a commitment to the Institute.

Margaret Gill
Director

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Soil Health Initiative

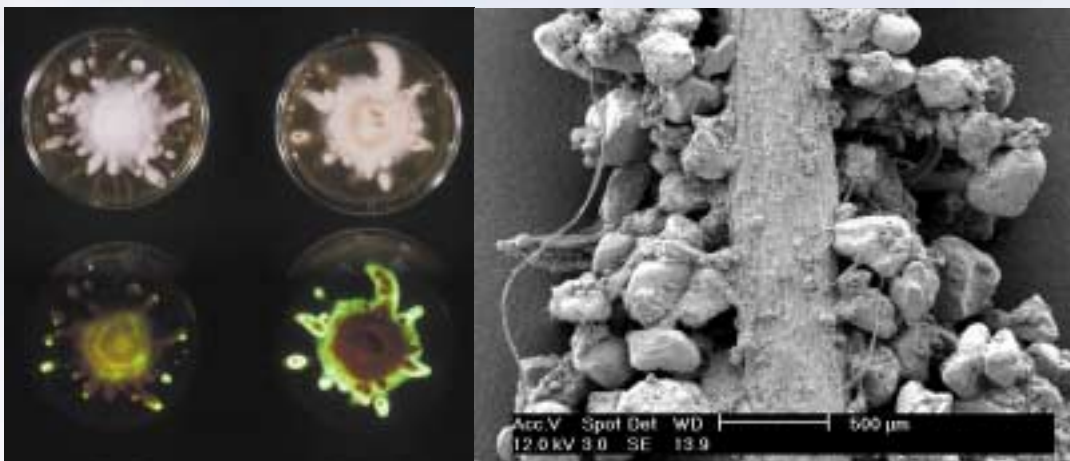
Molecular Ecology of Soil Microorganisms

The Macaulay Institute and the University of Aberdeen have established a £0.85 m research initiative to study soil health using molecular biology techniques. The aims of the initiative are to extend current expertise in molecular ecology to further understand the role of microorganisms in underpinning soil health. The initiative increases the critical mass of scientists in Aberdeen studying the molecular ecology of soil microorganisms and will further enhance the international reputations

of the two organisations and generate additional income. The ultimate vision is the improvement of environmental quality through analysis and manipulation of the functioning of microorganisms that are responsible for sustaining healthy soils.

Biological indicators of soil quality and health, such as plants, animals and microorganisms, are useful because they integrate the complex physico-chemical interactions that occur in soil and provide a target organism against which the impact of anthropogenic activity may be judged. Soil microorganisms underpin all of the soil's ecological functions and are therefore increasingly considered to have potential as indicators of soil health in response to a wide range of pressures such as land use, climate change and pollution.

Environmental microbiology is a rapidly expanding area of research and applications to agriculture (plant growth promotion, plant protection, bio-pesticides), environmental protection (waste treatment bio-remediation of pollutants) and environmental monitoring (bioindicators and biosensors) are increasing. The principal challenge in environmental microbiology is to obtain reliable information and greater understanding of microbial function in situ. In contrast to traditional laboratory approaches to microbial ecology in controlled and homogeneous systems, natural environments are generally complex and heterogeneous such that functional activities are difficult to monitor and more difficult to predict and control. In such cases, microbial function is governed by the ecological parameters of the particular environment in which the activities are being carried out. Currently, many ecological parameters that determine microbial metabolic activities, particularly in soil, are unknown.



1 - Light produced from bioluminescent fungi is a sensitive indicator of stress on the organism and fungal bioassays have been successfully developed to assess various soil pollutants.

2 - The rhizosphere is the interface between plant roots and the soil where microbial populations are highly active. Molecular methods are being used to monitor and manipulate them to degrade pollutants in contaminated land.

For further information please contact Colin Campbell at c.campbell@macaulay.ac.uk

The initiative has four main themes each addressing new and important areas and is led by a research fellow:

- rhizosphere engineering - manipulation and monitoring of soil microorganisms around plant roots for the degradation of pollutants (Dr Ed Moore)
- functional diversity of fungi - development of molecular tools appropriate for fungi involved in C/N cycling in the acid organic soils which dominate upland Britain (Dr Ian Anderson)
- fungal biosensors - use of bioluminescent fungi as biosensors for a range of environmental diagnostics (Dr Hedda Weitz).
- pathogens in the environment - detection, survival and movement of human pathogens in soil and in organic wastes applied to land (Dr Jenny Ritchie).

The initiative has already been successful in attracting funding from the Scottish Executive, the European Commission and Health Canada to study a range of topics from the survival of E.coli O157 in Scottish agricultural soils and the potential for contamination of private water supplies to the use of various bacteria in the bioremediation of contaminated land.

Further information about the initiative can be found on its website at www.macaulay.ac.uk/soilhealth.html

A perspective on nitrogen in peat

'Berwyn Williams is known internationally for his work on nitrogen transformation processes in peat and forest soils. He recently retired from the Institute and in this article he reflects on the different stages in his career which matched the changing needs for understanding the below-ground processes in peatlands.'

I joined the Macaulay Institute for Soil Research in 1966 to investigate the physico-chemical properties of peat in relation to afforestation. During the sixties it became clear that after fertilization of drained peatland with phosphorus and potassium, the availability of nitrogen was limiting growth of some tree species. It didn't take much persuasion for me to begin studying the nitrogen transformations in peat and in forest soils as well, where the poor recycling of nitrogen was attributed to the formation of recalcitrant substances.



Moidach More, a raised bog near Grantown on Spey and field site for Nitrogen Deposition studies

Subsequently, it emerged that different peatland types contained different quantities of plant nutrients according to the topography and this was reflected by the dominant plant species in the vegetation. For example, the nitrogen content and availability in Sphagnum dominated raised bogs is lower than that in Molinia covered blanket peat. The state of decomposition of the peat also reflected the nutrient content and under conditions where microbial activity was stimulated, as by liming or drainage, there was intense competition for available nitrogen between the microbial biomass and plant roots.

The interest in microbial immobilization of nitrogen increased when with the then North of Scotland College of Agriculture, we investigated poor nitrogen availability in a large area of reseeded blanket peat in Forsinard, Sutherland. The response of the grass to Spring dressings of nitrogen was extremely poor, less than 15 per cent of that applied. The peat had a relatively low total nitrogen content and had been limed and immobilization was a potential cause. However, in addition to immobilization, any nitrate added to the peat was quickly denitrified during early spring because of the very wet conditions and lost to the atmosphere.

This work on nitrogen transformations in peat enabled us to successfully bid for funding from the EC to study the impact of atmospheric nitrogen deposition on carbon balance in peat.

With colleagues in Finland, France, Switzerland, Estonia and Poland I coordinated a three-year study that showed that Sphagnum mosses could assimilate nitrogen in atmospheric deposition provided growth was not limited by factors such as low phosphorus availability or a falling water-table. It emerged from this work that at high rates of inorganic nitrogen addition, Sphagnum released dissolved organic nitrogen (DON) into the surrounding waters.

With the development of analytical methods, it has become clear that DON is present in the headwaters of upland streams at greater concentrations than nitrate nitrogen. The controls on the release of DON from soils and vegetation are far from clear. The plant rhizosphere, microbial biomass and the soil adsorption phase are all potential sources. Perturbations to the soil, such as freeze-thaw events and drying followed by rewetting increase the concentrations of DON. With Macaulay colleagues we showed that free and bound amino acids account for significant proportions of the DON that vary between soils and that DON is released from the soil by addition of sheep urine.

As carbon and nitrogen retention in peats and soils have become more important for the environment and water quality, losses of organic carbon and nitrogen in drainage waters have gained in importance. The challenge in the future is to enable effective comparisons between soils and waters by determining the composition of DON in different circumstances and identifying the controls on its release into the soil and drainage waters.



Field visit to see the impact of ploughing on erosion in blanket bog, Mull of Kintyre

Diary Date

The first Scottish Agricultural and Biological Research Institutes (SABRI) Lecture co-organised with The Royal Society of Edinburgh, will be given by Professor Roy Anderson FRS who will talk on "Epidemics of infectious diseases in livestock: the interface between scientific research and policy formulation".

Friday April 26th, Macaulay Institute

Montane heathland

Scotland contains a wide variety of heathland types both natural and semi-natural (formed and/or maintained by human actions). Heaths are found throughout Scotland at all altitudes from maritime heath to alpine tundra. The large area and variety of Scottish heathlands makes them internationally important for conservation and they are also a vital part of our landscape and cultural heritage, who can imagine Scotland without heather?



Winter sampling at experimental site in the Cairngorms

Montane heathlands are one of few examples of natural climax vegetation types in Britain and occur above the potential tree line up to a maximum of around 1000m in the Cairngorms (lower in the west). These wind-clipped carpets of dwarf shrubs, lichens and mosses are home to important populations of birds such as ptarmigan and dotterel. Montane heaths represent the climatic and altitudinal limit of heathland development in the uplands and as a result are thought to be very sensitive to disturbance and environmental change. In recent years there has been increasing concern about the impacts of climatic change and atmospheric pollution on mountain ecosystems and how this might interact with land management activities. However, making predictions about vegetation change as a result of these impacts requires knowledge of the important ecosystem processes that regulate the interactions between species. Such information is also vital for effective conservation and management of mountain ecosystems. While heathlands in the lowlands and uplands have been reasonably well studied, we know very little about what happens above the tree line.

In a five-year study currently underway at the Macaulay, we aim to shed light on the processes controlling species dynamics on montane heathlands and community responses to environmental change. Focussing on prostrate heather heathlands, a type unique to the Scottish Highlands, the study investigates the relative effects of climatic factors, nutrient limitation (including the

effect of atmospheric nitrogen deposition) and land management (principally the impact of grazing and accidental fires) on community dynamics. The project combines a number of different approaches to gain an understanding of the interactive effects of multiple environmental factors. In particular the work focuses on how these environmental factors affect species composition, diversity, spatial structure of the community, competition between dominant species and productivity.

One of the major parts of the project is an experimental study based on an area of prostrate heather heath at 750m in the eastern Cairngorms. At this site plots are subject to varying combinations of burning, grazing and nitrogen deposition treatments. Detailed measurements are made of plant growth responses to the treatments and changes in species composition. Monitoring of environmental conditions including climate and chemistry of soil, soil-water, rainfall and cloud-water is also carried out throughout the year. Year-round sampling can be quite a challenge in a mountain environment but provides valuable insights into processes and events that would not otherwise be seen. Using these data we hope to gain a detailed understanding of the fate of pollutants such as nitrogen deposited at the site and the consequences for both montane ecosystems and water quality further downstream. Other studies conducted at a range of sites throughout the Highlands look at variations between sites with differing climate and geology, to allow scaling up of findings from detailed experiments at a single site to produce more general conclusions. Such 'scaling up' is important if we are to increase the usefulness of research findings to end-users such as land managers and conservation agencies.



Forest on the move? What will be the consequences of environmental change for montane ecosystems?

Further information please contact Andrea Britton
e-mail: a.britton@macaulay.ac.uk

What do 'end users' think of the Macaulay?

Sue Bird interviewed four people who have been involved in different Institute projects

Iain Clark

The benefits of keeping up to date with land use research



Iain Clark, who is a Regional Agri-business Manager with the Clydesdale Bank, attended a workshop to discuss the development of one of our land management tools - the Land Allocation Decision Support System (LADSS).*

The aim of the workshop was to seek the views of a wide range of practitioners working in land-based industries on the relevance of the work done so far on the project. Through a series of discussion groups, the participants were able to feed back their ideas on what would need to be added to LADSS to make it of use to themselves or their customers.

"It was very interesting to find out about a development project which could be of significance to the rural economy and hence might be important to my business and that of my customers," said Mr Clark. "I enjoyed finding out more about the Macaulay's work in general and having the opportunity to network with other professionals working in the land use sector. I also appreciate that we have been kept informed about developments with LADSS since the first workshop."

Looking to the future, Mr Clark said that he would welcome future opportunities to meet and discuss land use research with Macaulay scientists and fellow professionals. Mr Clark sees it as part of his role to be informed about developments in land use research, and he also believes that knowing what research Government is funding can sometimes give a clue to their thinking on future policies.

***LADSS is a computer based rural land use planning tool being developed within the Land Use Systems Programme at the Institute. It supports strategic, farm-scale, land use planning by suggesting possible combinations of land uses to meet multiple-objectives. It also provides a framework within which the financial, social and environmental consequences of changes in land use may be evaluated. For more information about the LADSS project, visit the web site www.macaulay.ac.uk/ladss**

Richard Cooke

Macaulay scientists are prepared to listen to practitioners



Richard Cooke is the Secretary of the Association of Deer Managers and he is also a Commissioner of the Deer Commission for Scotland. He has been involved with the Macaulay for a number of years, most notably as a member of the steering group for the development of

HillDeer. HillDeer is a computer-based software package which was launched in 1998. It is designed to help deer managers explore the relationship between deer numbers and the impact on habitats.

"What has particularly impressed me about the Macaulay scientists is their willingness to involve and listen to the practitioners" said Mr. Cooke. "For example, I was keen that the Hilldeer model should take into account the impact of rabbits, which is significant in some parts of the deer range. I am glad to say that they readily took this point on board and rabbits are indeed allowed for in the modelling process".

Mr Cooke was also very positive about a number of visits he has made to Glensauigh, the Institute's research station situated about thirty miles south of Aberdeen in the eastern end of the Grampian Mountains.

A major programme of research was undertaken during the 1970s and 1980s at Glensauigh to develop systems for farming deer. Although Mr Cooke's interests lie mainly with wild deer, he was full of praise for the work carried out by the late Bill Hamilton, who was the Manager of the deer farm at Glensauigh for many years.

Finally, the Institute's work to develop a rapid habitat assessment method to assist Deer Management Groups to produce their management plans was highlighted by Mr Cooke. Once again, he was pleased to note how the scientists involved in the project took note of the feedback from land managers and developed a methodology which was both practical and relatively affordable.

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Ruth Wolstenholme

Breadth of expertise and awareness of relevant research praised

Ruth Wolstenholme, is the Development Manager for SNIFFER, the Scotland and Northern Ireland Forum for Environmental Research

(www.sniffer.org.uk). Ruth has had contact with the Institute over a 10 year period as SNIFFER is a research commissioning organisation and has contracted work to Macaulay on many occasions.

There are a number of projects currently underway at the Macaulay in which SNIFFER and SNIFFER members in particular have considerable interest. One example is the SNIFFER Air Pollution Information System in which Simon Langan has been involved and another is a project funded by the Scottish Executive called 'Sustainable management of waters in Scotland: achieving good status' which is run by Bob Ferrier and is of direct relevance to the Water Framework Directive.

SNIFFER's approach to research management is through research themes in which SNIFFER seeks to involve a wide range of participants including policy makers and researchers so as to strengthen the quality and likely uptake of the research and to promote partnerships. In this context, Ruth said that she believed that the secondment of staff from the institute to relevant organisations could be a useful exercise.

Ruth highlighted various theme-related fora where SNIFFER and Macaulay scientists have worked together with a particular example being a diffuse pollution workshop. Ruth has also been involved on a steering group at the Macaulay looking at the development of a decision support tool for the application of organic waste to land.

"SNIFFER is keen to make bridges and inroads in what is often a very compartmentalized research arena, but our experience with the Institute has usually indicated a similar desire, and a good knowledge of research drivers - whether from UK or European policy or large-scale research or framework programmes," said Ruth. "We are aware of the breadth of expertise held by the Institute which we see as a particular strength. There is also a good awareness of relevant research underway within the UK, and importantly, within Europe. The focus on processes at a catchment level relates well to the approaches and needs of the SNIFFER member organisations."



Richard Bewley

Macaulay scientists focus on real world problems

Richard Bewley is the Principal Environmental Consultant with URS Corporation Ltd (formerly Dames & Moore URS), a company which specialises in the remediation of contaminated land.

Dr Bewley was the principal representative of the end user community on a project funded by the NERC URGENT (Urban Regeneration and the Environment) programme. The project investigated potential remediation treatments for a range of sites in and around Glasgow, which are heavily contaminated with chromium. The other partners in the project were the Macaulay, Edinburgh University, Scottish Universities Research and Reactor Centre and East of Scotland Water (see issue no. 6 (Winter 2000), of the Macaulay Newsletter).

Dr Bewley described the extent of the problem at these sites in Glasgow, where there are potentially millions of tonnes of soil contaminated with hexavalent chromium (Cr(VI), resulting from the use of chromite ore processing residues ('COPR') as landfill. "The research carried out in this project has been of great value in understanding the limitations of some existing remediation techniques," said Dr Bewley. "The researchers at the Macaulay have really got inside the "black box" of the chemistry of these waste materials. In some cases, their understanding of the chemical interactions has shown that certain treatments may in fact increase the release of Cr(VI). This may not necessarily be a bad thing, it all depends on how the release is controlled," said Dr Bewley.

The key output from the project has been a model to predict the suitability of various remediation treatments, and Dr Bewley was full of praise for the role of the Macaulay team, and in particular for its leader, Ed Paterson. "I was impressed with Ed's understanding of real world problems and he really helped to keep the work focussed on specific problems. I would say that it is partly down to Ed's leadership in this area that the project managed to achieve so much and deliver the end product in the time available."

Dr Bewley says that his work for URS has benefited from the project because he has gained valuable, in-depth knowledge about chemical processes, relating to COPR, which he is able to pass on to his clients by giving better, more specific advice. "On a personal level, it was good to have the opportunity to work with research scientists again. I found our meetings very stimulating, and a change from the commercial environment where there is often insufficient time available to undertake appropriate research into specific problems" said Dr Bewley.

Looking towards the future Dr Bewley hopes that the papers which will be published from the project will raise the profile of the contamination at these sites. He says that Glasgow has a big problem because the funding is not available for a wholesale clean-up. The remediation activity at the moment is targeting the areas most at risk, where, for example, people can't even grow much in their gardens because of the level of soil contamination.

FUTURE COUNTRYSIDES: Workshops for schools.

Or why do Macaulay staff enjoy going back to the classroom?

The 'Future Countrysides' workshops, which are delivered on-site in schools in and around Aberdeen, are an important component of our outreach programme. They have developed from our experiences at the Edinburgh Science Festival and Aberdeen's Techfest and the subsequent production of our interactive computer programme 'Dr Miller's Toolkit for Countryside Change.' The workshops are designed primarily for S1-S2 Geography classes and have been developed with advice from local teachers. To date, we have run the workshops as part of Aberdeen's Techfest schools outreach programme.



Experiences at science festivals from 1998 onwards has helped us to develop our skills at interfacing with the public of all ages

The objectives of the school workshops are:

- To raise awareness of changes in the countryside - are there any? Where? Why are they important?
- To demonstrate how the Macaulay can help answer these questions. What data do we use? How do we use it?
- To develop an understanding that there are often trade-offs, in terms of environmental, social or economic impacts, associated with any land use change.
- To tailor the content of the workshops so that it 'dovetails' into the 5-14 guidelines for environmental studies, but also extends beyond them.
- To develop a format for the workshops which engages the student and encourages interaction, and is also fun!
- To show that scientific research is relevant and to promote the work of the Macaulay Institute.

Engaging the class

The format of the workshop is modified to suit the class that we are visiting. We have actually presented to S1 - S4 Geography, S2 Biology and S4 physics! We normally start with a lively multi-media presentation which examines what are the causes of countryside change and introduces the class to the Cairngorms as our study area. We attempt to find out as much as possible about our audience - whether they live in the city or the countryside; whether they have any relatives or know anyone whose work is connected with the land; whether they can identify any local changes in land use which have taken place recently. We use historical and present-day aerial photos to show some significant landscape changes such as the building of the Forth Road Bridge and we also have excellent aerial photography of Aberdeen, which allows the pupils to consider more recent changes.

Now it's your turn

The second part of the workshop is an exercise which looks at two options for land use change: restoring native woodlands by planting or natural regeneration and building wind farms. It is based on the 'Windfarms and Woodlands' games which are part of the 'Toolkit' programme. Working in pairs or small groups, the students are asked to consider a table of data about different areas of land in the Cairngorms (altitude, slope, soil type, existing land use and so on), and then match the land resource information to another set of data about the requirements for planting native woodlands or building wind turbines. The fun part comes in the feedback session when we find willing volunteers to use the Toolkit game on the computer to check the answers from their colleagues in the class. This year, we ended the workshop with a quiz, which was enthusiastically received.

Feedback from the schools, which has been obtained by the 'Techfest' office, has been very positive. Here are comments from some of the schools we visited this year:

"Very relevant to geography curriculum"
- *Harlaw Academy*

"Interesting and informative presentation - good exercises on windfarms and forestry"
- *Bankhead Academy.*

"Pupils were involved in discussions about a local area which was familiar to them" - *Albyn School for Girls.*

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We soon realised the need for a 'stand-alone' interactive component of any science festival exhibit

The workshops are delivered by Macaulay scientists David Miller and Willie Towers, supported by Jane Lund, Sue Bird and David Riley. All members of the 'Toolkit' team have found the interaction with local schools to be a worthwhile, enjoyable and challenging experience.

"Our visits to local schools have really added another dimension to my work at the Macaulay," said Willie Towers. "The pupils are a very different 'end-user' from the type of audience I usually interact with. I have definitely improved the range of my presentation skills. You need to gauge the ability, responsiveness and backgrounds of the class very quickly at the start of the workshop and adapt your presentation accordingly; for example, things which work well at one school, say a rural school, may not necessarily work well with city pupils."

Over the last two years we have visited nine local schools and presented to around four hundred pupils. We are now in the process of considering potential options for the next stage in our schools outreach programme, and intend to hold a workshop at the Institute in December with some of the teachers who we have visited, to help us plan for the future.



Selection of photographs from the schools the Toolkit Team visited



For further information contact Dr Sue Bird, Public Relations Manager,
The Macaulay Institute, Craigiebuckler, Aberdeen AB15 8QH.

Tel: 01224 498235, Fax: 01224 311556, email: s.bird@macaulay.ac.uk website: www.macaulay.ac.uk