

# Poster Papers

A feature of the Conference was the invited poster papers on display. Of their nature, such papers cannot be reproduced in the written proceedings. Instead, the scope of their coverage is indicated in the abstracts which follow, grouped under four subject areas.

## Environment

### **The influence of peatland afforestation and water quality**

**H Anderson & J Miller**

*Macaulay Land Use Research Institute (MLURI)*

Afforestation in the peatlands of Caithness and Sutherland has caused considerable controversy. In 1988, the Forestry Commission established experimental plots on a deep peat at Bad a' Cheo, Rumster Forest, to investigate the consequences of current forest practices on water quantity and quality in collaboration with MLURI. The site can be regarded as free from anthropogenic pollution, but with large marine inputs, leading to a high S content in the peat. Cultivation and draining of the organic soil have led to increased outputs of organic matter, in the form of colloidal particles and soluble components. Mineralisation of N and S has led to increases in both ammonium and sulphate in the drainage, but nitrate concentrations have remained small. These changes occurred rapidly, but fertilizer losses have been slower, being dependent on whether drainage is across, or through, the peat.

### **Growth and utilisation of heather under contrasting managements**

**J P Byrne, J Wildig & S P Rushton**

*MAFF/ADAS Redesdale EHF, Pwllpeiran EHF & Dept of Agriculture & Environmental Science, University of Newcastle upon Tyne*

The influence of the grazing animal on loss of heather (*Calluna vulgaris*) and its regeneration is being investigated at Redesdale and Pwllpeiran Experimental Husbandry Farms. Trial design at the two sites is similar. The main treatments are Normal Farm Stocking Rate (NSR), contrasted with a reduction of 30% on that figure (RSR). Plot and farm scale experiments are in place. Results from the first year's studies of the utilisation of heather at Redesdale indicate differences between the two treatments for this factor. However, only at the January assessment date was the difference significant (NSR 26% vs RSR 13.5% utilisation). These preliminary results suggest that regeneration of heather is possible under sensitive management. There is hope, therefore, that in the future environmental and agricultural needs can be integrated successfully. This has relevance to the land use issues being debated at the present time.

### **The environmental effects of blanket peat exploitation in Northern Ireland**

**A Cooper, R Murray & T McCann**

*Dept of Environmental Studies, University of Ulster*

Multivariate land classification has been used to assess the extent and rate of change of mechanical peat cutting on blanket peat in Northern Ireland in relation to other land uses in the uplands. Development of the technology for machine cutting and the dependence of farmers on peat for fuel as part of the farm economy are the driving forces for change. The paper will cover these issues and assess the environmental effects and ecological implications of machine cutting.

### **Establishment of an upland silvopastoral land use system**

**W R Eason**

*AFRC Institute of Grassland and Environmental Research*

As part of a national network trial, a silvopastoral experiment was established in 1987 at Bronydd Mawr Research Centre in south Wales. The effect of tree species and spacing on animal production is being recorded. This poster also focuses on a number of aspects of tree establishment, including tree protection and weed control.

### **Managing conifer forests for nature conservation: Kielder Forest case study**

**J E G Good, T G Williams, A Buse, D Norris & H L Wallace**

*Institute of Terrestrial Ecology, Bangor Research Unit*

Coniferous afforestation disrupts upland ecosystems, altering the range and proportions of different habitats available to plants and animals. A study of the effects of afforestation on flora and fauna at Kielder Forest are described. Proposals for changing forest management to improve plantations for wildlife are discussed.

## **Sediment and solute delivery from agricultural land: a non-point source of river pollution**

**A L Heathwaite**

*Dept of Geography, University of Sheffield*

The effect of changing land use practices on water quality at both the long (90 year) and short (single water year) timescales are discussed. Current annual sediment and inorganic nutrient export, from the arable and grassland Slapton catchment in south-west Devon, is of the order: 6 t NH<sub>4</sub>-N, 282 t NO<sub>3</sub>-N, 2 t PO<sub>4</sub>-P and 1440 t suspended sediment. Rainfall simulation experiments for characteristic land uses suggest that overgrazed permanent grassland is an important source of sediment, total nitrogen and total phosphorus, resulting in 12x, 9x and 16x the load of ungrazed grassland. This is due to increased runoff as a result of surface compaction. Permanent grassland forms over 60% of riparian land use, so its contribution to stream sediment and solute loads may be high. The effect of changing land use in accelerating the eutrophication of Slapton Ley, a 0.8 ha freshwater lake which is the sink for catchment inputs, is discussed.

## **Climate and land use**

**M N Hough**

*Meteorological Office*

The poster will show the relations of the following to the water balance climate:

1. proportion of farmland under grass
2. the percentage of land sown to winter wheat in autumn

The greatest changes in grassland or wheat areas over the years occur in areas to which they are most climatically suited.

## **Environmental consequences of changes in arable agriculture**

**D S Powlson, K W T Goulding, A J Macdonald & P R Poulton**

*Rothamsted Experimental Station*

Changes in arable farming practice can greatly influence the quantity of residual nitrate in soil at risk to leaching or denitrification. A combination of field experiments and mathematical modelling can help in elucidating such effects. Set-Aside can decrease nitrate leaching, but future ploughing up will produce a pulse of nitrate. Afforestation will almost certainly decrease leaching, but leads to acidification of soil.

## **Nitrate (NO<sub>3</sub>-N) loading and agricultural intensity relationships within Grampian Region river systems**

**G G Wright & A C Edwards**

*Macaulay Land Use Research Institute*

Modern agricultural practices have been strongly linked with increased NO<sub>3</sub>-N loadings. Nitrate leaching increases as land use progresses from forest and moorland, through grassland, to arable

agriculture. There are, within the UK, few studies on a regional scale capable of displaying a relationship between land cover (agricultural intensity) and water quality. This relationship can be investigated using computer manipulation of spatial geographic information, together with conventional river and agricultural census data.

## **Measurement and perception of change**

### **Environmentally Sensitive Areas**

**D Askew**

*Ministry of Agriculture, Fisheries & Food, Leeds*

The display boards give background information on the ESA schemes throughout the country. More detailed information is given on one particular scheme: the Pennine Dales ESA. The ESA schemes provide a vehicle for controlling environmental change and the monitoring of schemes has involved measuring these changes.

### **Land classification for wide area conservation evaluation in strategic planning**

**R Aspinall**

*Macaulay Land Use Research Institute*

A range of detailed climatic, topographic, geological, and edaphic maps provide a comprehensive environmental data base within a geographical information system. These data can be summarised into a series of ecological land classes which describe particular combinations of environmental conditions. Land classes are used here to assess the environmental associations of 28 different semi-natural habitat classes mapped across Grampian Region at a scale of 1:50 000. This analysis allows an objective evaluation of strategic level conservation interest to be made, and provides a framework for incorporating conservation interests into regional planning processes.

### **Countryside Survey 1990**

**C J Barr, R M Fuller & F T Furze**

*Institute of Terrestrial Ecology (ITE) & Institute of Freshwater Ecology*

The Countryside Survey 1990 project centres on a sample-based field survey of land cover, habitats and species, linked with a land cover map derived from satellite imagery. Other components include freshwater biota sampling and a detailed soil survey of sample sites throughout Great Britain. It is funded by the Department of the Environment and Natural Environment Research Council, with support from the Nature Conservancy Council. Results from the 1990 survey will be compared with those from earlier surveys by ITE and others, so that both stock and change statistics can be computed for great Britain and for major planning regions. Mapped information will be digitised and handled using geographical information systems. Results will become available over the next 12 months.

## **National Countryside Monitoring Scheme**

**J T C Budd, K M Sutherland, G Tudor,  
A Giblin & P Holden**

*Nature Conservancy Council, Peterborough &  
Edinburgh*

Changes in the land cover of the 'wider countryside' are quantified for the whole of Scotland, based on a stratified random sample of each Region. Results for the period 1940–70 are now complete, and a pilot exercise for Central Region indicates the continuing trends to the present day.

## **Landsat mapping of Great Britain**

**R M Fuller, G B Groom & A R Jones**

*Environmental Information Centre, Institute of  
Terrestrial Ecology (ITE), Monks Wood Experimental  
Station*

In the summer of 1990, the Environmental Information Centre of ITE was commissioned by the Department of Trade and Industry and the Department of the Environment to produce a land cover map for the United Kingdom. The aims of this study are:

1. to compile a digital map of land cover in Great Britain, based on a hierarchical classification of important major land cover types
2. to make quantitative assessments of accuracy of end products
3. to integrate the map with the field survey data of Countryside Survey 1990 and with other topographic and thematic data in a geographical information system (GIS) environment
4. to produce demonstrator GIS output in vector format.

This paper describes preliminary aspects of the project and initial results of the survey are presented. The product is an integral part of the Countryside Survey 1990, which aims to provide information on the land use and ecology of Great Britain in 1990, to assess past changes, and is a baseline against which to measure changes in the future.

## **SDD land cover and look-back projects**

**J Gauld, J Bell, W Towers, D Miller  
& R Aspinall**

*Macaulay Land Use Research Institute*

Baseline information on land cover in Scotland is being collected from an aerial photographic census at the 1:24 000 scale. Interpreted land cover types are incorporated into a geographical information system (GIS). These data form the basis for a series of land cover and land cover change monitoring and evaluation projects. For example, land cover data have been photo-interpreted for the Cairngorm area from 1947 and 1966 photography. These historic data sets allow assessment of the extent and nature of land cover change since the late 1940s; changes are evaluated against environmental and land ownership data sets held in the GIS to identify possible policy-related causes of change.

## **Mapping land cover change in water catchments from satellite imagery**

**G Griffiths & C Williams**

*Hunting Land and Environment Ltd*

Landsat multispectral scanner (MSS) and thematic mapper (TM) satellite imagery was used to map land cover change over ten years in two water catchments: the river Exe in Devon and the river Hodder in Lancashire. The project, which was funded by the Department of the Environment at the National Remote Sensing Centre, was undertaken for the Institute of Freshwater Ecology, in support of its research programme to investigate the effects of land use change on water quality.

## **Conflicting trends in Finnish land use policy**

**A Selby**

*Finnish Forest Research Institute*

An aim of Finland's agricultural policy is to reduce agricultural production to the level of self-sufficiency to avoid ever-increasing export subsidies, and bring agricultural policy closer to the requirements of the General Agreement in Tariffs and Trade (GATT). The means to reduce production have included legislation to encourage land use change via grants, fees, and other payments. The afforestation of arable land has been one such means. Since 1969, some 110 000 ha of fields have been cleared for agricultural expansion, while the intensity of agricultural production has increased unabated. The uneven distribution of measures to reduce the area of arable land under cultivation is beginning to threaten both the environment and the socio-economic stability of certain regions of the country. Agricultural, forestry, and environmental land use policies require integration into a unified policy.

## **A cost-benefit analysis of farm forestry**

**R M Willis, C Price & T H T Thomas**

*School of Agriculture & Forest Sciences, University  
College of North Wales (UCNW)*

Achievement of the objectives of farm forestry programmes is measured by three variables: speed of adoption (and therefore of land use diversification), selectivity of proposed schemes (related to environmental objectives), and expenditure. The UCNW project aims to show the trade-offs between the variables by modelling:

1. the economic comparison between agriculture and forestry
2. the costs of imposing environmental constraints, and of infringing them
3. the effects of farmers' attitudes on the uptake of forestry programmes.

By relating economic, environmental and attitudinal attributes to the Institute of Terrestrial Ecology land classes, results of case studies can be scaled up to national level, under a variety of price and policy scenarios.

# Modelling

## Modelling the agricultural and environmental consequences of sheep grazing heather moorland

**H Armstrong**

*Macaulay Land Use Research Institute*

A dynamic mechanistic model has been built which describes the changes in vegetation when heather moorland is grazed by sheep. The model encompasses the growth and defoliation consequences for all the significant vegetation communities associated with heather, as well as heather itself, of foraging by sheep among these plant communities, and the productivity of sheep populations. Examples of the various uses to which the model can be put will be illustrated.

## Modelling soil erosion under future climates

**J Boardman, D T Favis-Mortlock & R Evans**

*Countryside Research Unit, Brighton Polytechnic & Dept of Geography, University of Cambridge*

Data for present-day erosion on agricultural land in Britain are used to predict future rates under 'greenhouse effect' climate, eg +3°C and +10% winter rain. Land use change involving new crops and changed locations for existing crops may lead to increases in erosion.

## Hydrology of soil types (HOST)

**D B Boorman, J M Hollis & A Lilly**

*Institute of Hydrology, Soil Survey & Land Research Centre, & Macaulay Land Use Research Institute*

The HOST classification presents an integrated model of water movement through the soil and substrate capable of predicting a range of river flow parameters for any catchment within the UK. Based on the three main soil characteristics, hydrogeology and proximity to groundwater, this model is applicable at a wide range of geographical scales.

## Modelling land allocation to farm forestry on upland farms

**C S Butcher & A R Sibbald**

*Macaulay Land Use Research Institute*

The physical resource base of a farm or estate is used to predict production for a range of crops (arable, livestock and trees), in a series of submodels which generate output as employment opportunities, conservation values, or financial returns. Land is allocated to different patterns through a hierarchy of decision rules which can represent different objectives. These rules are clearly articulated and the order can be changed according to the priorities of the user.

The model will help evaluate the medium- to long-term consequences of changes in land use at the management unit level.

## The integration of geographical information systems and process-based water quality models

**R Ferrier, D Miller & J Morrice**

*Macaulay Land Use Research Institute*

The sensitivity of water quality models is dependent upon the scale of input information. During an investigation of water quality in the river Feshie, Cairngorm, parameterisation of the MAGIC model used soils information at medium (1:63 360) and small (1:250000) scales. Three spatial analyses were undertaken:

1. soils information weighted by area over the whole catchment
2. proximity analysis of soil units surrounding the stream
3. flow pathway analysis identifying the last soil unit that 100 random point sources of deposition encounter before reaching the stream.

Discussion will centre on model response to parameter selection. Optimum parameterisation has been used to model predictions on the effects of land use change within the catchment.

## Modelling the consequences of land use on water resources in part of the Fenland

**J Gowing, E O'Connell, J Lingard**

**R Wadsworth**

*University of Newcastle upon Tyne*

Our aim is to present an outline of the interlinked microcomputer-based simulation models that were developed to investigate the impact on water resources of land use and irrigation policy within the Middle Level. We will describe the agrohydrological model, agro-economic model, and water resources model, and the way in which they were integrated to produce predictions on which policy-making could be based.

## Modelling and predicting the effects of land use change on bird distributions

**D Hill, D Gibbons & R Fuller**

*British Trust for Ornithology (BTO)*

This new three-year project aims to relate bird distributions (3 BTO Atlas data sets) to land use and environmental factors using generalised linear interactive modelling and ordination/classification to determine changes in distributions over a 20-year period, and to predict effects of proposed land use changes.

## A functional interpretation of botanical surveys

**J G Hodgson, J P Grime, F Sutton, S Hillier & S Band**

*NERC Unit of Comparative Plant Ecology*

The Unit has pioneered an approach known as FIBS (Functional Interpretation of Botanical Surveys) in an

attempt to understand why areas differ in their species composition. The approach has been used in an analysis of floristic changes between 1965 and 1990 in the semi-natural grassland over a 3000 km<sup>2</sup> area of central England around Sheffield. Worked examples for four sites are included on the poster to show how FIBS analyses are actually carried out.

### **Modelling stream chemistry in response to afforestation/deforestation**

**A Jenkins**

*Institute of Hydrology*

A model of the combined long-term effects of acidic deposition and forest growth has been developed. The model indicates that afforestation can increase the strong mineral acidity of streams in areas receiving high levels of acidic oxides from the atmosphere. Deforestation promotes a rapid decrease in acidity, although the soil base saturation recovers slowly.

### **Modelling the impact on water quality of land use change in an agricultural catchment**

**P J Johnes & T P Burt**

*School of Geography, University of Oxford*

An export coefficient model was applied to the 350 km Windrush catchment, a tributary of the upper Thames, in order to predict nutrient and sediment loads, with particular reference to nitrate. A land use survey was used to calibrate the model, and the results of a three-year field work programme, together with archival material provided by the National Rivers Authority, were used for validation. The model was then used to predict water quality for a range of possible changes in land use; these included the changes in farming practice outlined within the new Nitrate Sensitive Area scheme. The approach allows identification of export zones and evaluation of strategies for control of pollution from agricultural land.

### **Environmental assessment – landscape impacts of land use change**

**D Miller & A Law**

*Macauley Land Use Research Institute*

Objective protocols for assessing impacts of land use change on landscape are presented. Scales of assessment range from Scottish national to observer-based scene analysis using digital terrain and land cover data. Orthogonal measures of terrain variation over a local area are combined with observer-based censuses of land visibility to target the assessment of impact on tourists. Changes in land cover provide a basis for retrospective impact assessment for the district of Badenoch and Strathspey in Scotland.

### **Macauley Land Use Information and Modelling System**

**C Osman**

*Macauley Land Use Research Institute*

Baseline environmental, biological, and land resource information for Scotland, often collected through detailed field survey, is integrated with planning and other administrative designations, as well as a wide range of socio-economic data from census returns and survey, into a comprehensive information system structured around a geographical information system and relational data base. The information has application to land use issues from local, through regional, to national and international scales, and may be applied to a wide variety of land use questions. The Macauley Land Use Information and Modelling System provides a highly flexible capability and is currently used for resource management and assessment, scientific research, and land use planning.

### **A geographical information system (GIS) for Dorset heaths**

**G L Radford & N R C Webb**

*Institute of Terrestrial Ecology, Monks Wood Experimental Station & Furzebrook Research Station*

Records in the form of maps of the distribution and extent of heathland in Dorset dating back to last century have been brought together in a GIS, using a modern base map. The rate and extent of fragmentation are clearly evident from the map series; the severe reduction in viability of the characteristic ecological communities in the scattered remnant areas points to the need for restoration as well as protection. The results of ecological survey over the last 25 years are being incorporated into a GIS to help identify which of those areas recently lost to heathland are likely to respond best to restoration, and give the best chance of success in terms of extending heathland viability.

### **Modelling lowland farms and farm forestry decision-making**

**K J Thomson & J F Atkins**

*Dept of Agriculture, University of Aberdeen*

This paper will outline the farm modelling work being carried out in the Department of Agriculture as part of the Joint Agriculture and Environment Programme. The modelling approach used to assess farm forestry options and the criteria used to evaluate various land use scenarios will also be presented.

## **Socio-economics**

### **Environmental accounts for the primary land use sector**

**N Adger, K Brown, D Rimmer, R Shiel & M Whitby**

*University of Newcastle upon Tyne*

Prevalent measures of aggregate welfare, such as Gross National Product, do not accurately reflect the standard of living in an economy because they do not

include those elements of the economy not traded in markets. Neither household production, the use of non-renewable resources nor environmental goods are in conventional accounts. This study produces a framework and attempts to estimate the importance of environmental 'goods' and 'bads' in aggregate welfare produced from the primary land use sectors, with a view to extending this for the whole UK economy.

## **Forestry planning**

**R Aspinall and D MacMillan**

*Macaulay Land Use Research Institute*

Planning forestry demands an understanding of tree crop growth in relation to environmental and management conditions, an assessment of the comparative economic position of forestry and alternative land uses, and an appreciation of a wide range of land use and socio-economic constraints which influence decision-making. Here, an economic model of forestry and alternative agricultural land uses, which incorporates a model of tree response to site environmental conditions, is used to calculate forestry investment potential. The analysis is presented within a geographical information system environment, and results are set within the framework provided by a Regional Indicative Forestry Strategy. This provides a model of possible future location and uptake of forestry, the analysis being presented for Grampian Region, north-east Scotland.

## **Diversification – the potential role of alternative animal enterprises**

**A J F Russel**

*Macaulay Land Use Research Institute*

To be economically viable, alternative animal enterprises must concentrate on quality products which can command significant

price premiums. Quality venison production has been shown to be feasible and the prospects for cashmere production are promising. Other enterprises which merit investigation include superfine wool production and fibre production from guanacos. Information will be provided on production systems, their costs and the prices of products required to make such systems profitable.

## **Environmental valuation**

**K Willis & G Garrod**

*Countryside Change Unit, Dept of Agricultural Economics & Food Marketing, University of Newcastle upon Tyne*

Examples of environmental valuation using the travel-cost and hedonic-price methods are presented for forestry, inland waterways and countryside characteristics. Such valuations are increasingly being used by agencies such as the Forestry Commission and British Waterways in appraising new projects, and by the Treasury to ensure value for money in public investments.

## **Gates, pillars and posts**

**H Gracey**

*Dept of Agriculture for Northern Ireland, Belfast*

Field boundaries, particularly hedgerows and dry stone walls, are outstanding and characteristic of the Northern Ireland countryside. Frequently associated with these are fine examples of gates, pillars and posts.

Such features are a real asset to the landscape and a small but significant part of our farming heritage. They are certainly well worth retaining and maintaining.