



## **Terrestrial Environmental Change in the Highlands and Islands: From Mountain Summits to Coasts**

**Inverness, 26-28 March 2004**

### **Summary statement**

The Highlands and Islands are changing. Recognising the distinctiveness of the region, and the dynamic interaction of social, economic, and environmental issues, nearly 100 scientists, teachers, councillors and other policy makers met to construct visions for the region's future, to debate the knowledge gaps acting as obstacles to achieving the visions, and to set an environmental research agenda.

The conference agreed that the Highlands and Islands provide an ideal platform for integrated environmental, social and economic research. The conference invited researchers to take advantage of the opportunities and to join the expanding network of active participants who are improving our understanding of the interactions between key processes, leading to an increased ability to deliver improvements for the peoples of the region and our natural heritage.

### **Environmental change in the Highlands and Islands**

A remarkable range of research is being undertaken with regard to environmental change in the Highlands and Islands, over a time period spanning the region's two billion years of geological history to the end of the present century, with major climatic changes predicted. The Highlands and Islands are notable not only for their biological diversity, but for their geodiversity upon which the various ecosystems are superimposed. In turn, these derive from the interaction of native and introduced plants and animals since the Ice Age – and especially over six millennia of human history.

Considering the region's ecosystems, many long-established 'truths' are being challenged. For instance, is the widespread occurrence of blanket peat the result of prehistoric and subsequent agriculture? Recent research suggests that it was already extensive when the first people arrived. Along with agriculture (and grazing by wild and domesticated animals), fire has long been a major agent of change in the uplands. In recent years, there have been particularly high incidences of wildfires. Yet, in comparison to many other parts of the world where fire is an important ecological process, detailed research into the behaviour and impacts of fire is only just beginning – and this is essential to assess whether traditional burning practices will be adequate to achieve management goals in the context of both climate change and new demands driven by environmental and agricultural policy.

In recent decades, much attention focused on the impacts of long-range nitrogen and sulphur pollution ('acid rain') on upland environments. While levels of these pollutants have declined with the introduction of new policies and technologies, levels of ozone pollution, deriving mainly from vehicles, are increasing and are likely to continue to do so. These levels are particularly high in upland areas, where many species may be at risk. Yet predicting such impacts is difficult because of the small number of monitoring stations. The same is true with regard to climate change; in this highly complex region, where air masses from very different sources interact, there are not many of the meteorological stations required to assess present trends and thus to predict the future. However, the trends seem clear – that the climate is becoming warmer, wetter, and windier – and new regional climate models are beginning to be able to give us a better picture of what the future climate might look like.

For the people of the Highlands and Islands, the land and the sea are intimately linked, and changes in patterns of rain- and snowfall will cause changes in runoff patterns, thus influencing the coastal waters, and particularly the sealochs. Such changes are important for those concerned with not only fishing and aquaculture, but also tourism, the region's largest employer. This industry depends on not only a conducive climate (preferably with as few midges as possible) but also an attractive landscape. In the medium-term, climate change may well become the dominant driver of land-use change, but in the short term, changes in policies will probably be at least as important. As part of the European Union, the Highlands and Islands are heavily influenced by EU policies such as the Common Agricultural Policy (CAP) and the Water Framework Directive (WFD). This is particularly because the emphasis of the region's economy is changing from production to consumption, so that more attention is needed as to how landowners can be encouraged to produce public goods such as clean water, attractive landscapes, and recreational facilities.

### **Active organisations and partnership for informed decision-making**

The presentations at the conference showed that a wide range of organisations is undertaking research on environmental change in the Highlands and Islands:

- universities and colleges from within the region, elsewhere in Scotland, and further afield;
- government agencies, such as the British Geological Survey, Centre for Ecology and Hydrology (CEH), Scottish Environment Protection Agency (SEPA) and Scottish Natural Heritage (SNH);
- research organisations, such as the Macaulay Institute;
- non-governmental organisations, such as the National Trust for Scotland and the Royal Society for the Protection of Birds.

While much research is still done within one institution, many partnerships – often between these different groups – were evinced. In a period of increasing uncertainty, organisations need to work together across disciplinary boundaries to develop more integrated, ecosystem-based approaches to management. Decisions need to be based on evidence and reasonable predictive models – and not hearsay and history – and therefore such collaboration is ever more important.

## Strengths of the Highlands and Islands as a focus for research

The environmental agenda at global, European and national levels is driven increasingly by the twin strands of sustainable development and environmental justice. Both of these require much improved public knowledge, understanding and engagement with environmental issues. It is only with public support that fiscal measures can be introduced to reflect true economic prices and values taking account of environmental impacts; response can be made to major global threats such as climate change; products can be developed and marketed that are environmentally sensitive, reducing natural resource usage; and human health can be protected. Increasingly we are realising how much our personal and social health and welfare depends on a robust and fully functional global ecosystem.

Within this broad context, the Highlands and Islands are clearly facing changes that are increasingly rapid, complex, and uncertain. These changes are driven by both policy developments and changes in the environment, both regional (e.g., ozone pollution) and global (e.g., climate change). A growing number of sectors of society in the region are committed to a vision: to adopt sustainable management, with involved informed communities, responsive to change and founded on sound economic management. To achieve this vision, some challenges must be addressed, such as conflicts and poor communication between key actors, inflexibility of policies and short-term approaches, and inability to determine true economic costs and benefits.

The participants at the conference identified five key needs for research which would not only be vital to achieving the vision, but would also identify the Highlands and Islands as a region for leadership in research in Scotland and at the European scale. They also stressed that the results of research must be effectively communicated, so that the people of the region, and Scotland as a whole, derive full benefit from it.

- **Conflict management** is particularly relevant in the region. There is a wide diversity of issues, often connected to the many sites designated for conservation. Both within the region and among stakeholders from further afield, there are strongly held views. Yet, even though they are widely dispersed, Highlands and Islands communities are often more active and more exposed to the vagaries of the natural environment than most, providing a good test bed for communication between science and society, using diverse strategies.
- **Understanding bio-physical quality parameters** is essential for monitoring, for better decision-making and modelling. Sites of the UK's Environmental Change Network already exist within the region, and it may be time to expand coverage whilst also creating a coastal environmental change network. The region has the appropriate environment to integrate these sites. It is relatively easy to create demonstration sites, e.g., to demonstrate restoration or manipulation.
- **Accounting for intrinsic value** is critical as the economy shifts from production to consumption, and because tourism is based on non-market goods. The region's economic base is amenable to economic modelling, characterised by the continuing importance of primary industries (agriculture, forestry, and fishing). Increasingly, new ways of exploiting the latent benefits

of valuable environments and habitats are contributing to economic growth through the rise of eco- and mainstream tourism.

- **Sensitivity analysis of fragile environments to external changes** is vital because the region has a relatively high preponderance of fragile habitats, and species ‘on the edge’ with regard to both regional and global environmental change.
- **Realising sustainability** will be key to maintaining vibrant communities and economies in the region. Their bases will be diverse, reflecting the diversity of situations, and could include the creation of local energy solutions, and auditing resource use by businesses to reduce environmental impact and improve profitability and employment. The creation of a sustainable Inverness could be a major research project.

### **Thematic research priorities**

During the conference, the participants spent one day in workshops to identify priorities for research in upland, freshwater, and coastal environments; and on the following cross-cutting themes: climate change, the maintenance of ecological functions and biodiversity, and the sustainable use of natural resources. At the beginning of each workshop, the participants agreed on a vision for research in the Highlands and Islands and then assessed the knowledge gaps that act as obstacles to achieving the vision.

#### ***Upland environments***

Vision: To enhance the diversity of upland environments by capturing their social and economic values and maintaining their sustainability in response to environmental change.

In addition to anthropogenically-induced atmospheric pollution and climate change, the key drivers of change in the uplands were identified as land use policy and legislation (e.g., CAP reform, WFD) and the evolution of markets for products, services, and tourism, linked to external perceptions of the Highlands and Islands. It was recognised that one barrier to achieving the vision is the inability to account for, or ascribe values to, intrinsic values (e.g., perception, opinion). To address these issues requires communication between all stakeholders; the challenge is to develop a common language that furthers understanding, overrides vested interests, and stimulates progress at local, regional, and national levels.

Key research needs were thus identified as:

- accounting for and measuring intrinsic/non-market values;
- relevance to communities: demonstration of approach to problem-solving, communication of the potential of research;
- integrative decision-making systems and support mechanisms for all stakeholders;
- understanding impacts of policy changes (linkages between social, economic and natural systems) through scenario models which combine qualitative and quantitative (process-based) research;
- validation of models with experiments (process-based or case studies) and effective knowledge transfer to all stakeholders.

### ***Freshwater environments***

Vision: A holistic sustainable freshwater environment for wildlife/human interactions, that incorporates strategic catchment management for water and land use, the research and data to underpin its management, and the political/public awareness and funding to support it.

In addition to environmental and climate change, two key drivers were identified: technological change and the need for a holistic political agenda. One barrier to achieving the vision is the behaviour of the underlying system, which is often chaotic. Other barriers relate to conflicts between different interests and the management of competing objectives; and the need for better communication, e.g., defining a common language and functional units for research and management.

Key research needs were thus identified as:

- developing baseline inventories;
- hydrological/hydrogeological variability;
- predictive modelling;
- conflict management;
- cost-benefit analyses.

### ***Coastal environments***

Vision: An integrated approach to the flexible management of coasts, engaging all partners, supported at political level, informed by high-quality science, tuned to informing decision-making.

Environmental change implies increasing threats from coastal flooding and erosion; the status quo 'museum approach' to coastal zone management is no longer tenable. There are therefore needs to move towards more integrated approaches (e.g., through CAP reform and the WFD) and for a commitment to sustainable coastal communities. However, the forces that drive scientific research tend to be inappropriate to the needs for practical management. This barrier to the realisation of the vision is compounded by sectoral interests, legislation that is not integrated, and inflexible policies which are inadequate to address dynamic coastal systems.

Key research needs were thus identified as:

- developing a Coastal Thematic Research Programme;
- implementing a Coastal Environmental Change Network with leading indicators of coastal change;
- informing the Scottish Coastal Tourism Strategy, to be published in June 2004.

## ***Climate change***

Vision: An improved ability to respond to climate change threats and opportunities through greater understanding and quantification of key issues and processes.

Climate change may lead to new opportunities, which should be identified and exploited, rather than focusing exclusively on coping strategies. A better understanding of climate change requires an effective environmental monitoring network, which might be achieved at least partly through the expansion of existing networks. This implies a need for funding that recognises long-term needs, supported by knowledge transfer and dialogue. At present, however, there is a lack of funding for long-term research/monitoring, compounded by human inertia and lack of information flow. Responding proactively to climate change is particularly critical in the Highlands and Islands because of the condition and limited resilience of certain communities and species, and the risk of disasters due to extreme events, such as heavy rain-and snowfall, high winds, and floods.

Key research needs were thus identified as:

- undertaking sensitivity analyses of the social, economic and environmental impacts of climate change
- ensuring the collection of observational data on climate trends from strategically-located sites;
- undertaking data audits (climate, ecological) leading to better models and identification of gaps and thus to definition of new research needs;
- evaluating the intrinsic values of landscapes etc.;
- identifying economic and social opportunities from climate change and coping strategies

Two complementary non-research needs were also identified:

- the use of networks for sharing of data and methods, leading to wiser investment;
- better communication of knowledge relating to climate change to and from broad audiences

## ***Maintenance of ecological functions and biodiversity***

Vision: A combination of protected areas and wider countryside measures, informed by regionally-specific research and education, which secures the diversity of ecological functions in the region.

In addition to climate change and pollution, two key sets of drivers of change were identified: CAP reform, and biodiversity policies and plans at all levels, deriving ultimately from commitments under the UN Convention on Biological Diversity. Barriers to achieving the vision include a poor knowledge base with regard to species, habitats, and ecological processes; introduced species and exotic genotypes; and inadequate definition of, and agreement on objectives, e.g., precision, priorities, restoration to what?

Key research needs were thus identified as:

- how to restore systems (e.g., heather moorland);
- ecosystem response to interaction of drivers: e.g., climate change and restoration;
- the management of wild herbivores;
- defining the vision: dynamic and large-scale.

### *Sustainable use of natural resources*

Vision: The scientific community will contribute to Scotland being a better place.

Two overarching objectives were identified:

- for scientists to tell the public what they already know; make data accessible to outsiders; and affordable;
- to renegotiate relationship between science and society, through widening the forum for debate with the wider public, e.g., through:
  - educating lay people on the effects of resource use, e.g., 1) environmental damage and its causes 2) understanding uncertainty;
  - encouraging lay people/teachers/politicians to attend scientific conferences;
  - ensuring that scientists attend lay meetings (e.g., council meetings).

One key means to achieve these objectives is technology transfer, including:

- linking advisory services back to scientists;
- ensuring that scientists engage with farmers, landowners and their managers, and crofters, and also with the outdoor education/recreation sector - and practising what they preach;
- science festivals, and involving the media.

A key element of ensuring the sustainable use of resources may be a greater focus on the community ownership of resources, leading for example to:

- local solutions for energy production and storage;
- successful catchment and coastal zone management;
- conservation without nature reserves.

It was proposed that one key project could contribute enormously to achieving sustainability in the Highlands and Islands, and that this should focus on the capital city, Inverness, with the aim of making this the first sustainable city by 2020. Key elements could include:

- aiming for the Highlands to have the lowest footprint per GDP in Scotland;
- 100% waste recycling;
- linkages between the natural and built environment, and between the environment and health;
- a revolutionised and sustainable transport system;
- enviro-socio-economic forecasts for Scotland, for public consumption;
- natural resource audits (actual and potential) by industry;
- assessing the ecological footprint of golf courses.

## Taking the visions forward

The organisations represented at the conference recognised that, while much research that can contribute to deepening our knowledge of environmental change in the Highlands and Islands is underway, there is much to do in order to take the visions forward.

All participants agreed that a conference on similar themes should take place in 2006, to evaluate the state-of-the-art, assess progress, and again provide opportunities for interaction not only between scientists, but also educators and decision-makers. The UHI Millennium Institute looks forward to convening the 2006 conference in collaboration with its partners in organising this conference: Scottish Natural Heritage, the Scottish Environment Protection Agency, the Macaulay Institute, and the Centre for Ecology and Hydrology. We recognise the support of all of these partners, and also Highland Council and Highlands and Islands Enterprise.

For further information, or to indicate interest in attending the 2006 conference, contact the Centre for Mountain Studies, Perth College, UHI Millennium Institute, Crieff Road, Perth PH1 2NX, UK; tel. 01738-877317; [info.cms@perth.uhi.ac.uk](mailto:info.cms@perth.uhi.ac.uk)

