

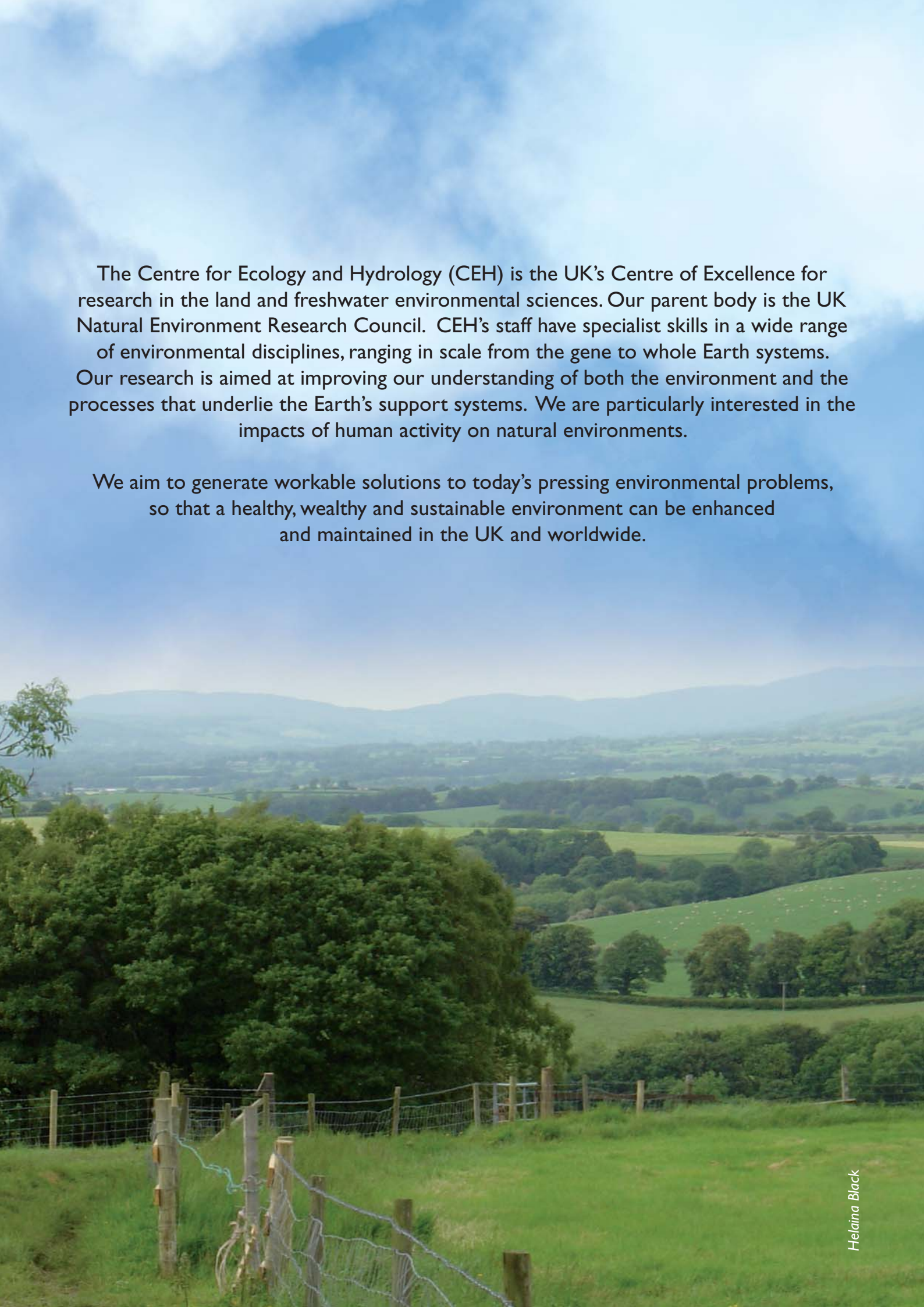


Centre for  
Ecology & Hydrology

NATURAL ENVIRONMENT RESEARCH COUNCIL

# 2004-2005 Annual Report





The Centre for Ecology and Hydrology (CEH) is the UK's Centre of Excellence for research in the land and freshwater environmental sciences. Our parent body is the UK Natural Environment Research Council. CEH's staff have specialist skills in a wide range of environmental disciplines, ranging in scale from the gene to whole Earth systems. Our research is aimed at improving our understanding of both the environment and the processes that underlie the Earth's support systems. We are particularly interested in the impacts of human activity on natural environments.

We aim to generate workable solutions to today's pressing environmental problems, so that a healthy, wealthy and sustainable environment can be enhanced and maintained in the UK and worldwide.

# Annual Report

## 2004 - 2005

The Centre for Ecology and Hydrology is a Research Centre  
of the UK Natural Environment Research Council

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*Cover Photograph of reeds taken by Dr Peter Carey, CEH Monks Wood.*

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# Foreword from the Director, Prof. Patricia Nuttall OBE

This year, 2004/2005, has seen the consolidation of the major changes within the Centre for Ecology & Hydrology (CEH) that were initiated in April 2004. Our five new Science Programmes have 'bedded in' and are now driving CEH forwards (more details on page 5). However, I want first to say a few words about our external activities.

As an organisation we are very aware that our stakeholders' needs continually change and that CEH has to be ready to meet these requirements. One of our major roles is to provide scientific knowledge to underpin policy. For example, the reports from the Farm Scale trials of Genetically Modified crops showed significant and continuing impacts on natural biodiversity within the trial fields. These trials, the biggest of their kind in the world, generated international interest in 2004 and 2005 and provided evidence for the Government's decisions on the growing of GM crops in the UK.

We are very conscious of the need to maintain our international scientific standing. We were delighted to learn (from ISI Essential Science Indicators) that CEH achieved the highest increase in citations in environment and ecology of any science organisation

across the world in 2004. The citation index is a measure of how often our published scientific papers are used by the international research community.

CEH continues to play an active rôle in the PEER network of European environmental research institutes and leads or takes part in many European research projects (see page 36) within the current Framework 6 programme. We are also contributing towards plans for the Framework 7 programme, due to start in 2007.

When we reported on last year's work, our Science Management Audit had recently been completed. This audit, undertaken by an independent international panel, was very complimentary on the high quality of our science. The panel made some helpful recommendations on organisational matters, most of which have now been implemented. A significant item was the need to raise CEH's external profile, which has been addressed by the appointment of a Press Officer in early 2005. Investment in this post has achieved publication of many more articles about CEH's science in newspapers and the media and an improved general awareness of our organization. The interaction between press activities and CEH's new web site (launched June 2005) has significantly added to CEH's profile and wider public perception.

As I write, we are awaiting the reports from two related processes; the approval of our proposals for our science programme for the next four years and a strategic business review, being carried out by independent advisers. The reports will form the basis of our business plan to build a sustainable future and maintain value for the public money that is invested in us.



Pat Nuttall, Director

The plan will be considered by NERC Council in November 2005. Like many other organisations, evolution and flexibility are essential to our long-term success. The coming year will see the implementation of changes to adopt a sustainable business model for delivering our new science programme.



Helaina Black

I would like to thank my Science and Executive Boards for their unfailing support throughout this eventful year, and of course every member of staff in CEH for their hard work and resourcefulness. Our knowledgeable and professional staff are our most valued resource.

I hope you enjoy reading this Annual Report, and shall welcome any feedback you wish to send to me.

*Pat Nuttall*

email: [director@ceh.ac.uk](mailto:director@ceh.ac.uk)  
tel: 01793 442516



PEER meeting, Leipzig

# Our Aims and Aspirations

*CEH has developed Vision and Mission statements, to encapsulate our aims and aspirations. These statements were revised during 2004, to reflect CEH's new structure and revised research portfolio.*

## CEH's Vision Statement:

- ❖ To be the world-leading centre of excellence for integrated science in land and freshwater ecosystems.

## CEH's Mission Statement:

- ❖ To advance knowledge in the processes governing Earth's life support systems through high quality interdisciplinary research, survey and monitoring in water, biodiversity and biogeochemical cycles.
- ❖ To enhance the UK's industrial competitiveness through knowledge and technology transfer.
- ❖ To provide the scientific underpinning for solutions to environmental issues arising from global change and the need for sustainable economies.
- ❖ To exploit the Centre's expertise and facilities to enhance research training in the UK and capacity building overseas.
- ❖ To secure and manage environmental data and provide access to academia, governments, industry and the public.
- ❖ To promote public awareness and understanding through communication of the Centre's activities.
- ❖ To provide the knowledge base for government policies addressing environmental issues.
- ❖ To achieve and maintain the standards of an Investors in People organisation.



# The Role of the Advisory Committee

Neville Hollingworth, CEH Dorset. E: [nth@ceh.ac.uk](mailto:nth@ceh.ac.uk)

CEH's Advisory Committee performs a very important role, it is a link at a senior level between ourselves and our major stakeholders. The Committee also advises on development and forward planning within CEH. The Committee meets twice a year, and each member provides an update on key issues affecting their organisations. This update provides a valuable opportunity for CEH to identify the best ways in which it can transfer its scientific knowledge to assist in the development of national and regional policy.

In this reporting year the Advisory Committee (AC) met at CEH Lancaster in November 2004 and at CEH Dorset in March 2005. The Committee were pleased to see some of the science being carried out at these locations and to meet the staff. The outcome of the

Science Management Audit (March 2004) was discussed and the AC were pleased to note the report of the Audit was very positive, highlighting the key strengths of CEH and the quality of the science it produced.

The Committee also provided valuable inputs into the development of CEH's five-yearly (known as quinquennial or Q1) science programme, submitted to our parent organisation, the Natural Environment Research Council, during the year. The AC have significantly helped CEH in its transformation from a site based organisation to a science programme-led, strategy focussed organisation.

The Committee has also helped CEH develop broader communication and knowledge

transfer opportunities and has identified several potential new linkages with other government departments and funding agencies. These include appropriate Parliamentary and Scientific Committees, also opportunities for staff secondment within their respective organisations. The AC has helped CEH to develop its outreach activities.

Lord Cranbrook, who has acted as Chairman of the Committee since its formation, retired from the Committee in March 2005. We are most grateful for his interest in and enthusiasm for CEH, during the last seven years. We are also very fortunate to have the involvement and time of the other members of the Committee, their support and advice is a real benefit to CEH.

The list of members is below.

Name	Organisation
Lord Cranbrook (Chair)	Independent (to March 2005)
Dr John Holmes	University of Oxford
Dr Havard Prosser	National Assembly of Wales
Mr Steve Bass	Dept. for International Development (to March 2005)
Dr Steven Wilson	Natural Environment Research Council
Mr John Herrmann	Independent
Dr Ian Bainbridge	Scottish Executive
Mr Tony Sangwine	Highways Agency
Prof Rob Marrs	University of Liverpool
Dr John Seager	Environment Agency
Dr Peter Costigan	Dept. for the Environment, Food & Rural Affairs (Defra)
Prof Julian Hunt (Incoming Chair)	University College (from April 2005)
Mr Peregrine Swann	Dept. for International Development (from April 2005)
Prof Pat Nuttall	Director, CEH
Dr Neville Hollingworth (Secretary)	Centre for Ecology and Hydrology

Deena Mobbs

# CEH's Programme Development Group

Heath Malcolm, CEH Edinburgh. E: [hmm@ceh.ac.uk](mailto:hmm@ceh.ac.uk)

The role of the Programme Development Group (PDG) is to maintain an ongoing review of the quality of science undertaken within each of the CEH Science Programmes and to advise on future scientific strategy. During 2004 a single PDG was formed from the three previous groups, to embrace the overall breadth of CEH's science. Following a recommendation from the 2004 Science Management Audit, the new Group now also includes scientists based outside the UK.

The main purpose of the first meeting, held in May 2004, was to provide guidance to CEH during the drafting of Science Theme proposals, which were being submitted to NERC for funding as part of CEH's first five-yearly (quinquennial or Q1) review. A follow-up meeting to discuss Q1 progress was held at Wallingford in October 2004.

The Group meets with CEH's Director and Science Directors approximately twice per year, to evaluate the performance of each Science Programme against its objectives. The PDG will guide the science in each Programme and also ensure that cross-programme links are fully exploited.

The Terms of Reference for the PDG are:

1. Annually, to review the whole and/or selected parts of the Programme;
2. To assess the scientific credibility of CEH Programmes, identifying significant changes required to Programme content and structure;
3. To assess the success in meeting the Programme's specific objectives and to approve Programme targets for the next reporting year;
4. To advise on the scientific strategy for development of

the Science Programmes over three to five years;

5. To provide peer-review of CEH Integrating Fund and Research Fellowship proposals;
6. To report to the CEH Advisory Committee and consider stakeholder needs;
7. To contribute to the strategic developments of the next five yearly cycle of Science Programmes and to report to the Science and Management Audit.

Each PDG member is also affiliated to a Programme College, and is invited to attend at least one full college meeting per year. The chair of the PDG is also a member of the CEH Advisory Committee.

The current PDG members are listed below, together with names of members who have chosen to defer their membership until a later date.

Name	Organisation
Prof Rob Marrs (Chair)	University of Liverpool
Prof Clive Anderson	University of Sheffield
Prof Mike Ashmore	University of York
Dr Guy Fenech	Independent Consultant
Prof Charles Godfrey	Centre for Population Biology (from Oct 2005)
Prof John Grace	University of Edinburgh
Prof Peringe Grennfelt	IVL, Sweden
Prof Alan Hildrew	Queen Mary College, University of London
Prof Ken Kilham	University of Aberdeen (from Jan 06)
Prof Niels Kroer	National Environmental Research Institute, Denmark
Prof Bryan Lawrence	British Atmospheric Data Centre, Rutherford Appleton Laboratory (from Oct 2005)
Prof Jeremy Nicholson	Imperial College (from Oct 2005)
Prof Pat Nuttall	Director, CEH
Prof Tony O'Donnell	University of Newcastle
Prof Geoff Petts	University of Birmingham
Dr Frank Raes	JRC Environmental Institute, Italy
Prof Julia Slingo	Centre for Global Atmospheric Modelling (from Oct 2005)
Prof Robert Smith	University of Leicester
Prof Clive Spash	Macaulay Institute (from Jan 2006)
Prof Kerry Turner	University of East Anglia
Prof Andrew Watkinson	University of East Anglia
Prof Howard Wheeler	Imperial College London
Mr Heath Malcolm (Secretary)	Centre for Ecology and Hydrology

Bill Bealey

# Recent Developments in CEH

As the Director has mentioned, 2004/2005 has seen the newly-functioning Science Programmes underpinning the change from a site based organisation to a science driven structure. New management systems have been operational since April 2004 and are working well, enabling us to deliver research projects on time and within budget. Science and Executive Boards, formed from our Science directors and senior administrators steer the activities and management of CEH. They are helped by input from the Advisory Committee and the Programme Development Group (see pages 3 and 4), formed from external independent scientists and representatives from our major stakeholders. Programme Colleges, formed from the research staff, steer the activities within the Science Programmes.

CEH's five Science Programmes are each managed by a Science Director assisted by a Science Programme Administrator and a Programme office. For more information on the achievements of the Programmes see page 6 onwards. In early 2005 a decision was taken to add a sixth Programme to CEH's portfolio. The Environmental Informatics Programme went live in April 2005, with the aim of providing researchers with access to the co-ordinated data resources and informatics tools required to deal with complex, multidisciplinary environmental questions. These activities will underpin research activities, evidence-based policy development, knowledge transfer and social and legal responsibilities — see page 30 for more information.



Professor Mark Bailey, Science Director, Biodiversity



Dr Peter Cox, Science Director, Climate Change, from December 2004



Professor Alan Jenkins, Science Director, Water

Professor David Fowler, Science Director, Biogeochemistry



Dr Dan Osborn, Science Director, Sustainable Economies



Dr Matthew Stiff, Science Director, Environmental Informatics, from July 2005



During the year, several underpinning activities have been strengthened. Besides the Press officer mentioned in the Director's letter, we have also appointed a Quality Assurance Manager. The work of this post will ensure that our research procedures comply with the Joint Code of Practice for Research now required by Government Department research contracts and the UK Research Councils. An early

success has been the achievement by our analytical laboratories at CEH Lancaster of the ISO17025 quality standard from the UK Accreditation Service, UKAS (further information on page 34). Next year will see the initiation of a rolling programme of audits covering all science projects subject to the Joint Code of Practice for Research.



Our staff have had another busy and challenging year. We are delighted that especial recognition was received by:

- ❖ Stuart Dobson (CEH Monks Wood) received an OBE for services to ecotoxicology.



Stuart with his OBE

- ❖ David Fowler (CEH Edinburgh) was awarded the Fellowship of the Royal Society, and a CBE for services to atmospheric pollution.

- ❖ Mike Hornung, (formerly from CEH Merlewood) received the OBE for services to soil chemistry.

- ❖ Bland Finlay (CEH Dorset) was awarded a Fellowship of the Royal Society. Bland's specialism is in protozoan ecology.



Bland Finlay

*People News*

# Top Science A

## Airborne mercury levels detectable for the first time

Mercury is a toxic metal that can accumulate in soils and is transformed into methyl mercury in freshwaters. In humans, chronic doses will cause damage to kidneys and the nervous system and can affect reproduction. For the first time, we can now measure concentrations of mercury across the UK.

As part of a study into air concentrations of heavy metals in the UK, CEH Edinburgh installed equipment during 2004 at 10 sites from Kent to Aberdeenshire. Samples were trapped on gold-coated sand, and sent to Edinburgh every 2 weeks for analysis. Although one of the main local sources of mercury in air is from crematoria, other industrial activities including coal burning are also important.

There is one continuously-operating monitoring site near Edinburgh, which provides hourly data for three different forms of mercury concentration. Usually the concentrations measured are well within exposure limits; for most people the main exposure to mercury is from dental (amalgam) fillings. However,

when the wind blows across the North Sea from central Europe it brings polluted air to eastern Scotland, and we record increased concentrations (still well below dangerous levels). Our measurements will demonstrate whether EU agreements to cut back emissions of mercury and other heavy metals are working as expected.

**Impact:** The information produced by this network will provide, for the first time, data on the distribution of mercury across the UK. It will also satisfy the requirements of European legislation that airborne mercury levels be monitored in EU member states.

Neil Cape, David Leaver, Alan McDonald, Robert Storeton-West, CEH Edinburgh. E: [jnc@ceh.ac.uk](mailto:jnc@ceh.ac.uk)

Peter Wakely, English Nature



## Puffins, sand eel size and climate change

Lesser sand eels are the main food of many birds, mammals and fish in the North Sea during the summer. They are also the target of a major industrial fishery. New research by CEH has shown that sand eels in the outer Firth of Forth have been getting gradually smaller over the last 30 years.

This work forms part of CEH's long-term seabird studies on the island. To estimate the annual size of sand eels we used fish collected from puffins on the Isle of May. We found that both the young-of-the-year and older fish had become smaller and that the nutritional value of a fish at any given date is now 40% less than it was in the early 1970s. There was no evidence that the decline was associated with a sand eel fishery that

operated in the area during the 1990s. Instead it seems likely that changes in the North Sea plankton community, due to climate change, may have affected the timing of breeding and/or growth rates of sand eels. Smaller fish are likely to mature at an older age and produce fewer eggs, potentially making the stock more vulnerable to over-fishing.

**Impact:** Our work has highlighted causes for a long term decline in length of lesser sand eels in an area that is important for natural predators such as seabirds, ecotourism, and a human fishery.

Sarah Wanless and Mike Harris, CEH Banchory. E: [swanl@ceh.ac.uk](mailto:swanl@ceh.ac.uk)

Akinori Takahashi



# Achievements

## Phenology shows it's worth!

Phenology is the recording and study of the timing of natural events such as flowering and leaf drop, or the dates of bird nest-building and migration. Phenology was very popular in Victorian times, then suffered a decline. It has been revived recently when the value of the old records as indicators of change was realised. The link between climate change and its impacts is becoming much stronger in the minds of both public and scientists; much of it due to public perception of change in natural events.

The 'Springwatch' initiative is run by BBC TV and the Woodland Trust with specialist advice from CEH.

The initiative allows anyone to record (via the Web) first sightings of named plants and animals as Spring progresses.

The TV programmes were extremely popular this year (they included live interviews with Tim Sparks) and over 60,000 people across the UK contributed records via the website to this year's recording scheme. 'Springwatch' feeds its records into the UK Phenology network for analysis and record management. The UK Phenology website has won several well-deserved awards.

**Impact:** This year has seen an increased awareness of the UK

*Phenology Network from media, presentations, popular and scientific publications and especially the public.*

Tim Sparks, CEH Monks Wood.  
E: [ths@ceh.ac.uk](mailto:ths@ceh.ac.uk)



Tim Sparks

## National Biodiversity Network Gateway offers 18 million records to all

The National Biodiversity Network's (NBN) Gateway has been recognised as a world leading facility for delivering data on species locations, via the Web. By March 2005, 18 million records for the British Isles had been published. This is a huge resource for scientists, conservationists, decision makers and the public.

design, which has been developed by CEH staff collaborating with national conservation agencies. We have developed unique solutions for controlling access to sensitive datasets or records (and protection to location information of very rare species). Anyone can view, query and download records in different ways according to their needs.

- View species distributions with an on-line equivalent of a species atlas;
- Look for the records of a particular food-plant as a way of finding a species or finding an area where a species might be encouraged to return;
- Download raw data in a simple spreadsheet format.

The data have been provided by professional and amateur recorders throughout the UK. Their co-operation and input has been key to the Gateway's

Users of the Gateway can:

- Find which species of conservation concern have been recorded within named protected areas (such as nature reserves);
- Use an interactive map to investigate where species occur, overlaid on an Ordnance Survey map or CEH Land Cover Map 2000 layers;

**Impact:** This extensive and unique resource is now available worldwide to professionals and public alike.

Richard Ostler, Jon Cooper, David Roy, CEH Monks Wood. E: [ros@ceh.ac.uk](mailto:ros@ceh.ac.uk)



# CEH's New Science Pro

*Since April 2004, CEH has managed its portfolio of science within a discipline led structure as five Science Programmes. A sixth Science Programme has been added during 2005, Environmental Informatics. This structure enables us to answer 'What is it likely to be in the future?' The following pages highlight some of the*

## Water

Water covers about 70% of the Earth's surface, is present in varying amounts in the atmosphere and is an important component of the tissues of most living things. The Water Programme provides insight to processes determining water quality and flows, to assist the sustainable management of catchments and their water resources. Research includes the

short term forecasting of floods and droughts, ecohydrology (relationships between water flows, and plants and animals) and the development of indicators of healthy ecosystems.

Water research also supports the work of other Science Programmes, such as the likely impact of climate change on



Dale Mellor

freshwaters, measuring biogeochemical cycles in catchment ecosystems, and the assessment of aquatic biodiversity.

## Biodiversity

Biodiversity is the variety of life: the totality of genes, species, and eco-



Dan Chambers

systems of a region. It remains a major global issue. New conventions, agreements and legislation (such as the EU Water Framework Directive) mean that local authorities, statutory agencies and industry must assess the impacts of human activities on biodiversity and ecosystem function.

The Biodiversity Programme will provide rapid methods to assess

the state and change of biodiversity, as well as developing novel approaches to reduce threats to biodiversity and restore degraded ecosystems.

Research will focus on improving the molecular science base for genetic diversity and function, understanding the impacts of non-native species and extending long-term data sets for taxonomy across biological scales.

## Biogeochemistry

Biogeochemistry is the study of the chemical, physical, geological and biological processes governing the composition of the natural environment.

Activities affecting the cycling of elements (including carbon and nitrogen) lead to both regional and global environmental problems. Carbon compounds are key drivers of global warming and are important in the assessment of

sustainable development. Human activity now dominates global inputs of fixed nitrogen to the atmosphere, and leads to photochemical smog, effects on human health and crops, and changes in biodiversity.

Our research will focus on fluxes of trace gases and aerosols, recovery from acidification and overloading from high nutrient levels (eutrophication), the threat

to plant and human health from ground level ozone, and the exchange of carbon at the catchment scale.



Colin Lloyd

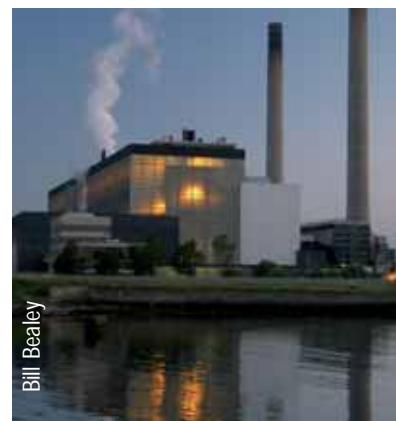
# Programmes - an overview

Science Programmes; Biodiversity, Biogeochemistry, Water, Climate Change and Sustainable Economies. Aims to direct our science to answer two important questions, 'Why is the natural environment as it is?' and 'How can we improve it?' The research carried out within CEH's Science Programmes to address these questions.

## Climate Change

The Earth's climate has varied in the past over many different timescales, but it is clear that humans are changing the climate system. Climate change is the most serious environmental issue that we are facing. Current predictions of the size and speed of global warming suggest that this century will see major global and local impacts on ecology and hydrology. The Climate Change Programme adopts a whole Earth System

approach which takes account of the complicated interactions that control change in ecological and hydrological systems. It will focus research on two key questions: 'How can we reduce uncertainty in our predictions of climate change and its effects?' and 'How can the potential impacts of climate change be accurately predicted and what strategies for adaptation need to be developed?'



Bill Bealey

## Sustainable Economies



Marcel van Oijen

The Sustainable Economies Programme deals with the way people manage their interactions with their environment, in such a way as to achieve sustainable development.

By surveying, monitoring and conducting experiments, the Sustainable Economies Programme

aims to find solutions to important environmental problems. These have to be socially acceptable and economically viable ways of reducing any risks. These risks may be associated with sustainable energy production and use, changing land use and management practices, as well as ecological and hydrological risks.

## Environmental Informatics

Informatics comprises the sciences concerned with gathering, manipulating, storing, classifying, retrieving and analysing recorded information. The CEH Science Strategy addresses the pressing need for greater knowledge of how to manage scarce environmental resources in a sustainable and integrated manner.

The Environmental Informatics Programme will address this fundamental requirement by

providing an integrated research resource in support of the whole CEH Science Programme. The Programme will address the security, compatibility and controlled access to all CEH's environmental data and information. This will underpin science activities, evidence-based policy development, knowledge transfer, and social and legal responsibilities. CEH's unique and diverse data resources will be combined in ever more innovative

and complex ways to help answer challenging environmental questions.



Landcover Map, Birmingham

# Biodiversity

## 'Stealth parasite' threatens European fish

CEH scientists, working with the Centre for the Environment, Fisheries & Aquaculture Science (CEFAS) have found an infectious disease carried by the topmouth gudgeon which is the most invasive fish species in Europe.

The disease stops the European sunbleak, an endangered species in mainland Europe (although not native to the UK) from spawning, leading to its rapid decline and possible eventual extinction. The new disease is already affecting other freshwater fish such as the fathead minnow and may affect native UK fish species. The parasite does not harm the topmouth gudgeon, but could threaten

commercial fisheries, including salmon farms.

Topmouth gudgeon have been recorded in several rivers and lakes in England and Wales. In Europe, sunbleak populations have declined rapidly since topmouth gudgeon were introduced in the 1960s.

Researchers believe the parasite is closely related to Rosette Agent (first identified in the United States in 1986) which kills both farmed and wild salmon and similar species. Work is in progress to determine any differences between the present parasite and Rosette Agent.



**Impact:** A new deadly parasitic disease, carried by an invasive fish species, is threatening some freshwater fish species in Europe. This discovery has major biological implications and may have economic implications.

Rodolphe Gozlan, CEH Dorset.  
E: [reg@ceh.ac.uk](mailto:reg@ceh.ac.uk)

## What impacts are GM plants likely to have on soil ecology?

The microscopic organisms in soil and water play key roles in sustaining life on Earth through their natural functions, which include nutrient cycling (carbon, nitrogen etc), breakdown of organic matter and essential interactions with plants and animals. Therefore it is important that we understand whether plants that have been genetically modified (GM) to resist disease and pests have a significant

impact on soil micro-organisms. This project undertook a risk assessment of the likely impact of GM crops on soil micro-organisms and biological processes in soils. The available published data strongly indicates that of the GM plants tested, none significantly affected soils by the measures used. Changes in soil ecology are greater when different non-GM plant species are grown in the same soil,

than they are when non-GM and GM plants of the same species are compared.

**Impact:** Our broad conclusions are that GM crops are less likely to affect soil ecology and functioning than the introduction of a non-native agricultural crop would do.

Andrew Lilley, CEH Oxford.  
E: [akl@ceh.ac.uk](mailto:akl@ceh.ac.uk)



# biodiversity...

## How winter foraging affects seabirds' breeding times

In temperate regions, winter presents animals with a number of challenges, including decreased food abundance, increased daily energy requirements, higher frequency of

extreme weather events and shortened day-length.

Overcoming these is critical to surviving the winter and getting the best timing for spring breeding. Achieving this is likely to depend on a combination of environmental

conditions and the abilities of individuals to exploit those conditions. CEH scientists have collected a unique data set enabling them to test a range of hypotheses relating to the interaction between the various factors affecting winter foraging performance.

We found that the European shag *Phalacrocorax aristotelis*, a marine predator, greatly increases foraging time to a peak of over 90% of available daylight at mid-winter. The seasonal patterns of foraging time appear to be driven by a combination of light levels, weather conditions and the availability of the shag's principal prey, the lesser sand eel *Ammodytes marinus*. Efficient foraging time just before breeding

is critical in determining the timing of breeding; birds that spent less time foraging were more efficient in their catch and bred earlier. There was no evidence that shags dispersed south in winter to increase potential foraging time.

**Impact:** Our work has demonstrated that seabirds greatly increase foraging effort to overcome the challenges of winter, and their success is critical in determining the timing of future breeding and reproductive success. This work is central to understanding the implications of climate change.

Francis Daunt and Sarah Wanless, CEH Banchory. E: [frada@ceh.ac.uk](mailto:frada@ceh.ac.uk)

Richard Bardgett



## Historic land cover change – how does it affect biodiversity?

As part of the EU BIOPRESS project (Linking Pan-European Land cover change to Pressures on Biodiversity), changes in land cover from the 1950's to the present have been analysed across Europe. BIOPRESS is a major three-year EU project which started in January 2003 and is being managed and led by CEH.

The work involves the acquisition, preparation and analysis of thousands of aerial photographs

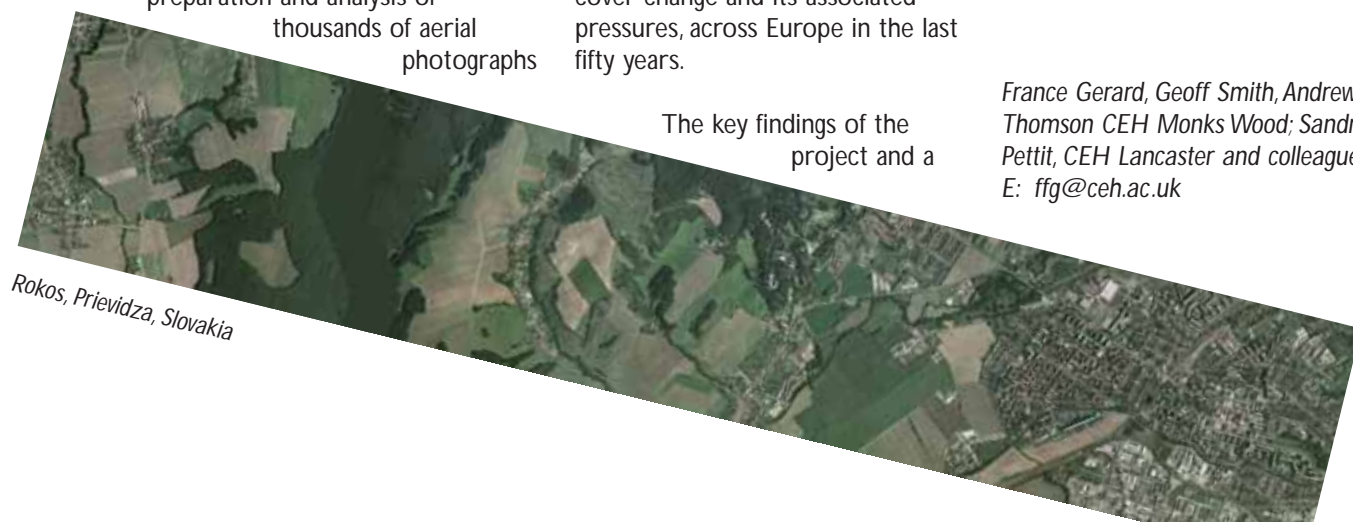
(under strict quality control measures) for 75 windows and 59 transect areas in all the biogeographical zones across Europe. The sample areas are all based on a Natura 2000 protected conservation site extending out from the site into the countryside, they cover a total of 69,270sq km. The unique dataset produced by this project will be used to assess the impact on biodiversity of land cover change and its associated pressures, across Europe in the last fifty years.

copy of the dataset will be presented to the European Environment Agency in December 2005.

**Impact:** The analysis will provide European decision makers with quantitative information on how changing land cover/use has affected the environment and biodiversity. Our work will assist planning by policy-makers for the future.

France Gerard, Geoff Smith, Andrew Thomson CEH Monks Wood; Sandrine Pettit, CEH Lancaster and colleagues. E: [ffg@ceh.ac.uk](mailto:ffg@ceh.ac.uk)

The key findings of the project and a



Rokos, Prievdza, Slovakia

# biodiversity...

## Rodents, reindeer and regeneration: the impact of arctic herbivores

Although we know quite a lot about the effect of grazing animals (herbivores) on specific plants and plant communities, little is known about the relative impact of large and small vertebrate herbivores and how it might vary among different habitats.

Working with collaborators from Umea University, Sweden, we established exclosures with two different mesh sizes in both the forest and nearby tundra at three different sites, in four contrasting locations in northernmost Sweden and Norway. Reindeer (*Rangifer tarandus*) were the most abundant large vertebrate while Norwegian lemmings (*Lemmus lemmus*) and grey-sided voles (*Clethrionomys rufocanus*) were the most common small vertebrates.

The study reveals that voles and lemmings have greater effects on the vegetation than reindeer, in

both habitats in all four locations. This held true even though densities of reindeer differed between locations and only two locations experienced lemming peaks during the period of the experiment. Our results suggest that intense and localised selective foraging by small mammals may have a more marked effect on vegetation than short-duration feeding by reindeer.

By examining how plants re-colonised areas of experimental disturbances, the study also revealed that herbivores influenced the abundance of plants, but not the species composition of regenerating vegetation. Gaps were colonised by the dominant species in the surrounding vegetation. However, in contrast to the established vegetation, significant effects of grazing were only detected when both small and large herbivores were excluded.



Rene van der Wal

**Impact:** This is probably the most comprehensive study of vertebrate herbivory in the European Arctic and has highlighted the important role of rodents and disturbance on the vegetation dynamics of tundra ecosystems

Phil Hulme, CEH Banchory.  
E: [pehu@ceh.ac.uk](mailto:pehu@ceh.ac.uk)

## Investigating persistent baculovirus infections in Lepidoptera

A baculovirus is a virus that infects insects. We found that persistent infections of Cabbage moth (*Mamestra brassica*) nucleopolyhedrovirus (MbNPV), when established in another caterpillar, Beet armyworm (*Spodoptera exigua*), could persist for at least five generations. We also found that effects on the host were limited to a reduction in fertility for the infected insects in the first generation after their exposure. Further work determined that the triggering of persistent MbNPV infections was

affected by the dose of another, closely related virus.

Evidence suggests that only very large doses of the second virus can outcompete the persistent infection, but survivors may harbour both viruses.

**Impact:** We have achieved a greater understanding of the mixed transmission strategies of baculoviruses.

John Burden, Rosie Hails and Bob Possee, CEH Oxford.  
E: [jbur@ceh.ac.uk](mailto:jbur@ceh.ac.uk)

Cabbage moth  
(*Mamestra brassica*),  
Mark Skevington



# biodiversity...

## Protecting a population of rare fish within reservoir management plans

A population of the rare schelly fish (*Coregonus lavaretus*), a species of great national biodiversity importance, lives in the reservoir of Haweswater in north-west England. These fish exhibited a marked decline in abundance during the 1980's.

A population model based on a modified Leslie matrix was developed, incorporating egg mortality induced by falls in water levels.

We successfully simulated patterns in whitefish abundance, inferred from capture records from 1973 to

2003. This model is the first to be produced for an unfished population of this species. The model was also used to predict that future frequencies of occurrence of egg mortality (due to water level falls of 50% and less) would allow varying degrees of population recovery.

If water levels are managed sympathetically by the reservoir operators, as they have been since the mid 1990s, and predation by cormorants (*Phalacrocorax carbo*) is successfully controlled, then a recovery of the schelly population can be achieved that is compatible

with operation of this reservoir. The reservoir is a site of great importance for biodiversity and is a strategically important source of potable water.

**Impact:** Development of this model allows conservation bodies and the operator of the reservoir to make informed, objective judgements on the future management of reservoir levels at Haweswater.

Ian Winfield, Janice Fletcher and Ben James, CEH Lancaster.  
E: [ijw@ceh.ac.uk](mailto:ijw@ceh.ac.uk)

## How to predict the effect of environmental change on wading bird species

European coastal mudflats provide extensive feeding grounds for wading birds, especially during the winter, but are also exploited intensively by humans. Conflicts

often arise between how to balance the needs of birds with the needs of people. In the past it has proved extremely difficult to predict the effect of environmental change on these birds.

which track the behaviour of individual birds as they attempt to meet their daily energy requirement by feeding in the most profitable places. The models predict the overall population survival rate from the fates of all individuals in the population.

The technique was originally developed for a single wading bird species, the oystercatcher, but was extended this year for multi-species situations. Two models were developed to predict the effect of habitat loss and creation on several wading birds on the Baie de Seine, France and the Humber estuary, UK. Species studied were: dunlin, ringed plover, knot, redshank, grey plover, black-tailed godwit, bar-tailed godwit, oystercatcher and curlew. These were important

demonstrations that the modelling technique was not limited to the single species for which it was originally developed. The Baie de Seine model was also used to advise local policy makers on the likely impact of a new port development, and how the impact could be reduced by minimising disturbance to the birds and creating new habitat to replace that which will be lost.

**Impact:** The new model provides a unique way of predicting how environmental change affects wading birds, and is being used to advise policy makers.

Sarah Durell, Richard Stillman, Andrew West and Richard Caldow, CEH Dorset. E: [sld@ceh.ac.uk](mailto:sld@ceh.ac.uk)

CEH has developed a novel modelling technique to make these predictions. Models are developed



original drawing by Lucy Hulme

# Water

## Benchmark Models for the Water Framework Directive

This multi-national collaborative research programme has developed tools to aid the use of models in support of the implementation of the EU Water Framework Directive.

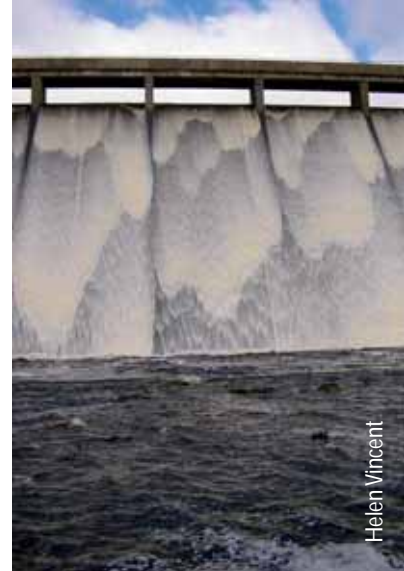
The tools comprise:

- a web-based, detailed and searchable inventory of models to support water management,
- a model selection and assessment protocol to guide dialogue between modellers and water managers with the objective of achieving successful outcomes of modelling studies;

- case studies of model applications, including multi-domain applications (using linked, chained and Bayesian approaches), together with sensitivity and uncertainty analyses.

**Impact:** *Our work will guide better use of models in the field of water management, to support implementation of the European Union's Water Framework Directive.*

David Boorman, Richard Williams, Michael Hutchins, Amelie Deflandre, CEH Wallingford. E: [dbb@ceh.ac.uk](mailto:dbb@ceh.ac.uk)



Helen Vincent

## Dependence between sea surge and river flow

A sea surge is the difference between the total observed sea level and the predicted astronomical tide. Both high sea surges and river flows may be caused by the passage of mid-latitude cyclones.

Dependence between surge and flow around the coasts of Great Britain was estimated using a measure especially suited for extremes, which was applied to daily measurements of surge and flow, 1963-2001. Although a low level of dependence may be found at catchments spread along much

of the coastline, higher dependence is generally found in catchments in hilly areas with a southerly to westerly aspect, which receive greater precipitation. The sloping catchments may respond quickly to the abundant rainfall, and the flow peak may arrive in the estuary on the same day as a large sea surge is generated by the low atmospheric pressure and strong winds associated with the cyclone.

The first part of this study, for the British east coast, was completed in 2000. The current study has extended the analysis to encompass

the remaining coasts of Great Britain.

**Impact:** *Water levels in estuaries are influenced by both river flows and sea levels. Even a small amount of dependence between the two will affect the estimated return period for a particular water level, and will need to be taken into account for design of structures in the fluvial-tidal river reach.*

Cecilia Svensson, David Jones, Jeff Parker, Alison Kay, CEH Wallingford. E: [csve@ceh.ac.uk](mailto:csve@ceh.ac.uk)



Deena Mobbs

# water...

## Development and application of functional tests for freshwater dissolved organic matter

Dissolved organic matter (DOM) is the complex collection of organic compounds present in solution in surface waters, soil waters and ground waters. DOM has a number of important ecological and geochemical functions. These include light absorption, acidity buffering, binding of heavy metals and organic contaminants, adsorption onto suspended mineral particles and photochemical reactivity.

In order to apply laboratory-based knowledge about these properties to predict the biogeochemistry of

the natural environment, we need to know about the variability in DOM properties among different environments. We have developed 11 reproducible tests for freshwater DOM, and applied them to explore its variability in four differing freshwaters.

**Impact:** *Our work is providing valuable results for scientists working to interpret and predict freshwater chemistry.*

Ed Tipping, Sarah Thacker,  
CEH Lancaster. E: [et@ceh.ac.uk](mailto:et@ceh.ac.uk)



Helaina Black

## Effect of trees on water resources of the chalk aquifer

A controversy has raged for many decades as to the impact of forest on water resources in the UK. A major experimental study has compared the evaporation and water movement in forest and grassland on the chalk aquifer (the major source of water supply in southern England).

This study was one of the first to make direct measurements of evaporation simultaneously over woodland and grass. Results showed that during certain seasons the two different land cover types used different amounts of water but overall the woodland did not use more water than the grassland.

The study also provided further insight into controls of water use by woodland and the behaviour of water in chalk soils. It showed how chalk holds large amounts of water which can move upwards to the roots during dry periods. This property might provide a buffer for

the vegetation during droughts, which are predicted to increase with future climate change.

A comparison with previous studies suggests that small patches of forest and trees at the forest edge might use much larger amounts of water. This result may have

implications for forest management practice in the future.

**Impact:** *These are important results which will inform land and water resource management in the future.*

John Roberts and Paul Rosier,  
CEH Wallingford. E: [jro@ceh.ac.uk](mailto:jro@ceh.ac.uk)



Kate Friend

# water...

## The DIVERSITAS crosscutting programme on freshwater biodiversity

DIVERSITAS is an international programme under the umbrella of the International Council for Science, which aims to promote conservation and sustainable use of biodiversity. The main aim of the cross-cutting network on freshwater biodiversity is to develop methods to fully account for impacts on biodiversity of social choices and incorporate this information into the decision-making processes. CEH has interest and experience in this work and provided a member of the scientific committee for the programme. Previous work has included economic valuation of forestry and water issues and ways to

incorporate these into decision making. Uptake of this will lead to more sustainable outcomes in land and water management.

**Impact:** *CEH's work is promoting the incorporation of environmental economics with biophysical sciences to develop more integrated approaches to decision making.*

Caroline Sullivan, CEH Wallingford.  
E: [csu@ceh.ac.uk](mailto:csu@ceh.ac.uk)



Helen Vincent

## Understanding wetland hydrology

New conceptual models of wetland hydrology have been produced to aid understanding of the hydrological functioning of wetlands. The models are supported by guidelines for hydrological impact assessment.

The project aims to help non-specialists understand the hydrology of any wetland for which they are undertaking impact assessments. The guidelines aid them to draw a schematic diagram of the wetlands labelled with water inputs from different sources, such as rivers, rainfall and groundwater.

**Impact:** *Our models and guidelines have been taken up and applied by the UK Environment Agency and the Convention on Wetlands (Ramsar)*

Mike Acreman, CEH Wallingford.  
E: [man@ceh.ac.uk](mailto:man@ceh.ac.uk)



Peter Carey

# water...

## An insight into the effect of climatic variability on spring flow from the Chilterns

The 'Wendover Series' dataset is unique in that it provides over 90 years of spring flow data for the Chilterns. It is of particular value in describing the effect of climatic variability on spring flow during the latter half of the 19th century, and allows recent events to be put in historical context. The multi-year

droughts of the early and mid-1990s caused water resource problems and environmental stress. However, compared with the drought of late 1800s that saw depressed spring flow recorded for a period of more than 15 years, the droughts of recent times are mere interludes.

**Impact:** Our work provides a new benchmark of drought severity for water resource planning.

Adrian Bayliss, CEH Wallingford.  
E: [acb@ceh.ac.uk](mailto:acb@ceh.ac.uk)

Adrian Bayliss



## Restoration of Hungary's Oxbow Lakes

The Tisza river in Hungary is bordered by more than 150 oxbow lakes which became separated from the main river channel by flood protection embankments built in the 19th century. Since then the oxbows have been experiencing excessive enrichment by nutrients (eutrophication) and infilling from sedimentation. One way of restoring the ecological status and water supply and to remove pollutants may be to reconnect these lakes to the Tisza river.

A monitoring project on one of these oxbows was undertaken to determine the present ecological and hydrological status of the oxbow, and to determine

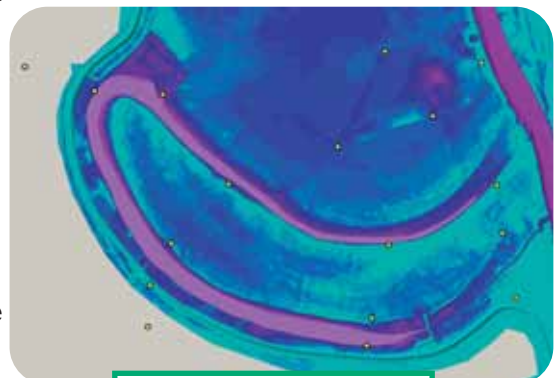
ecological, water quality and hydrological outcomes if the lake was to be reconnected to the main river.

Issues such as the role of the oxbows in flood protection and their risk from river pollution were also investigated. As a result, a model has been developed which will predict the hydrological, water quality and ecological outcomes of different management techniques on oxbows in the Tisza Basin, Eastern Europe.

**Impact:** Our model will be used by SHMU (Hydrology research institute,

Slovakia) and VITUKI (Water research institute, Hungary).

Jane Fisher and Charles Stratford,  
CEH Wallingford. E: [jafi@ceh.ac.uk](mailto:jafi@ceh.ac.uk)



Location of boreholes which were used to monitor groundwater movements.

# Biogeochemistry

## Investigating Nitrogen Oxides emissions from European forest ecosystems (NOFRETETE)

This major EU collaborative project was completed after three years of activity. It brought together nine European groups to investigate nitrogen oxide emissions using:

- a combination of field and laboratory experiments;
- further development and application of a biogeochemical process-oriented model for the prediction of nitrogen(N)-trace gas emissions from forest soils;
- coupling of the biogeochemical process model to a multi-layer tree canopy model to get reliable estimates of the N-trace gas exchange at the ecosystem level;

- linkage of the combined model to a GIS database, containing information about land-use, climate, soil properties and atmospheric N-deposition.

At the end of the work N-oxide emission inventories and scenarios for European forests were calculated.

**Impact:** *The project has greatly improved our understanding of the processes involved in generating emissions of nitrogen oxides from forest ecosystems across Europe.*



Andrew Sier

Ute Skiba, Jan Dick, Sim Tang, Robert Storeton-West, CEH Edinburgh.  
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## How is Snowdonia changing?

Snowdonia is one of the most studied areas of the UK. It contains the highest mountain in England and Wales and occupies a unique place in the hearts of many including conservationists, naturalists, walkers and climbers. However, a recent synthesis project of monitoring activities within the Snowdonia candidate Special Area of Conservation (for Countryside Council for Wales [CCW]), led by CEH with the University of Wales, Bangor, has revealed some impressive biases in the way people have studied the changing face of the area over the years.

Measurements of lake chemistry, some dating back to 1962, have been taken at 118 lakes at various times over the last 40 years whilst routine monitoring of soil chemistry only started in 1995 at the Snowdon Environmental Change Network Site, (the only such site in Snowdonia and the only site in Wales). A lot is known

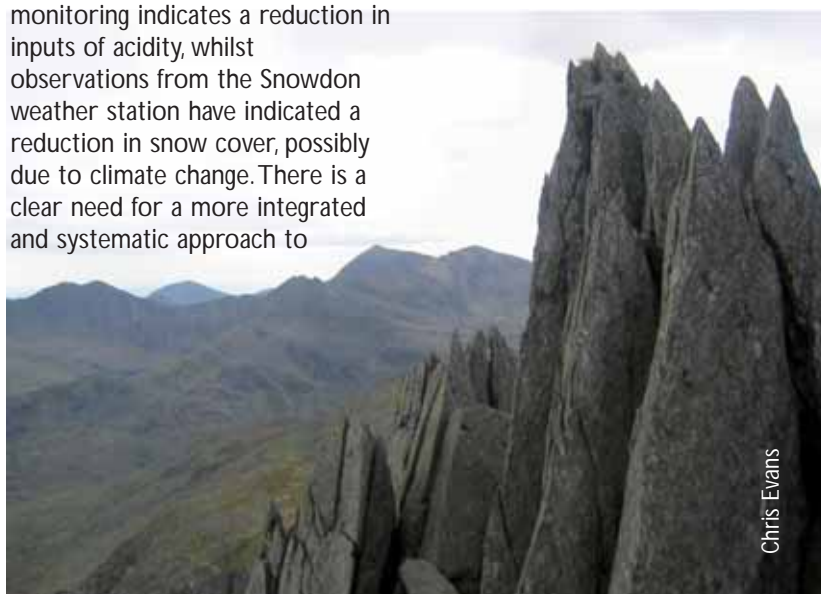
about rare and montane species but mostly from *ad hoc* studies by academics and amateurs, who have focussed on their specific interests.

Therefore we have little idea about overall trends in biodiversity over time. Information on climate and air pollution is a little clearer as monitoring indicates a reduction in inputs of acidity, whilst observations from the Snowdon weather station have indicated a reduction in snow cover, possibly due to climate change. There is a clear need for a more integrated and systematic approach to

monitoring not only in Snowdonia but for Wales as a whole.

**Impact:** *CEH is now leading a project to review all monitoring activities in Wales for CCW.*

Brian Reynolds CEH Bangor.  
E: br@ceh.ac.uk



Chris Evans

# biogeochemistry...

## Simulation of long-term variations in heavy metals in soil and water

We have investigated the rates of accumulation and release of heavy metals, deposited from the atmosphere to UK uplands. Using a computer model (CHUM-AM), we have examined the period 1500 AD to 2500 AD.

Loadings of nickel, copper, zinc, cadmium and lead from human activities were high during the 19th and 20th centuries, but have fallen in recent decades. We calculate that by 1998, the soils of water catchments in the Lake District had retained more 90% of previously deposited copper and lead, whereas retention of nickel, zinc and cadmium was between 5% and 60%, depending upon soil acidity. Computer models of future metal behaviour suggest that weakly-

sorbing metals (nickel, zinc, cadmium) will respond on timescales of between ten to hundred year periods to changes in metal inputs or acidification status. More strongly-sorbing metals (copper, lead) will respond over hundred to thousand year periods.

**Impact:** Our work is informing Defra's policy with regard to metals emissions and timescales of change. Defra is the Department for Environment, Food and Rural Affairs.

Ed Tipping, Alan Lawlor,  
Stephen Lofts, CEH Lancaster.  
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Darren Evans

## Recovery after Foot and Mouth used to test models of ammonia emission from farm animals

This project, funded by Defra (Dept. for Environment, Food & Rural Affairs) and run jointly with the Institute of Grassland and Environmental Research, monitored and modelled the changes in ammonia concentrations in air as

animals were reintroduced into Cumbrian farms after the UK Foot & Mouth epidemic in 2001.

By comparing areas which had been affected and unaffected, and by making measurements in many

locations over two years, we showed that ammonia concentrations, which had decreased by about a third after the Foot and Mouth outbreak, increased again. It was notable that if

measurements had only been made in affected areas this would not have been sufficient to detect the change against the background of local and seasonal variability. Only the use of multiple sites paired with unaffected areas, was able to demonstrate the 'recovery' in ammonia emissions in line with the modelled predictions.

**Impact:** The data and model outputs can be used to predict the effects of changing agricultural practice on UK emissions of ammonia.

Mark Sutton, Ulrike Dragosits, Sim Tang, Massimo Vieno and others, CEH Edinburgh. E: [ms@ceh.ac.uk](mailto:ms@ceh.ac.uk)



Farm in Cumbria,  
Simon Ledingham,  
NW Gyroplane Club

# biogeochemistry...

## Can tree shelter belts on agricultural land reduce flood risk?

Agricultural practices have come under increased scrutiny since the heavy and widespread UK flooding of 2000 and 2001. Although the impact of land use on runoff and flood risk is of growing concern, there are few reliable measurements available.

A preliminary study was undertaken on grazing land within the Nant Pontbren catchment in the upper reaches of the river Severn, mid-Wales. In this area ten families have come together to change their farming practices, developing a more sustainable approach to farming. They have been increasing the cover of trees, reducing stocking rates, protecting stream banks and restoring wetlands.

One management practice of particular interest has been the establishment of small strips of trees, known as 'shelter belts', which provide shelter for sheep.

The farmers noticed that these shelter belts seem to reduce the amount of rainwater flowing over the land.

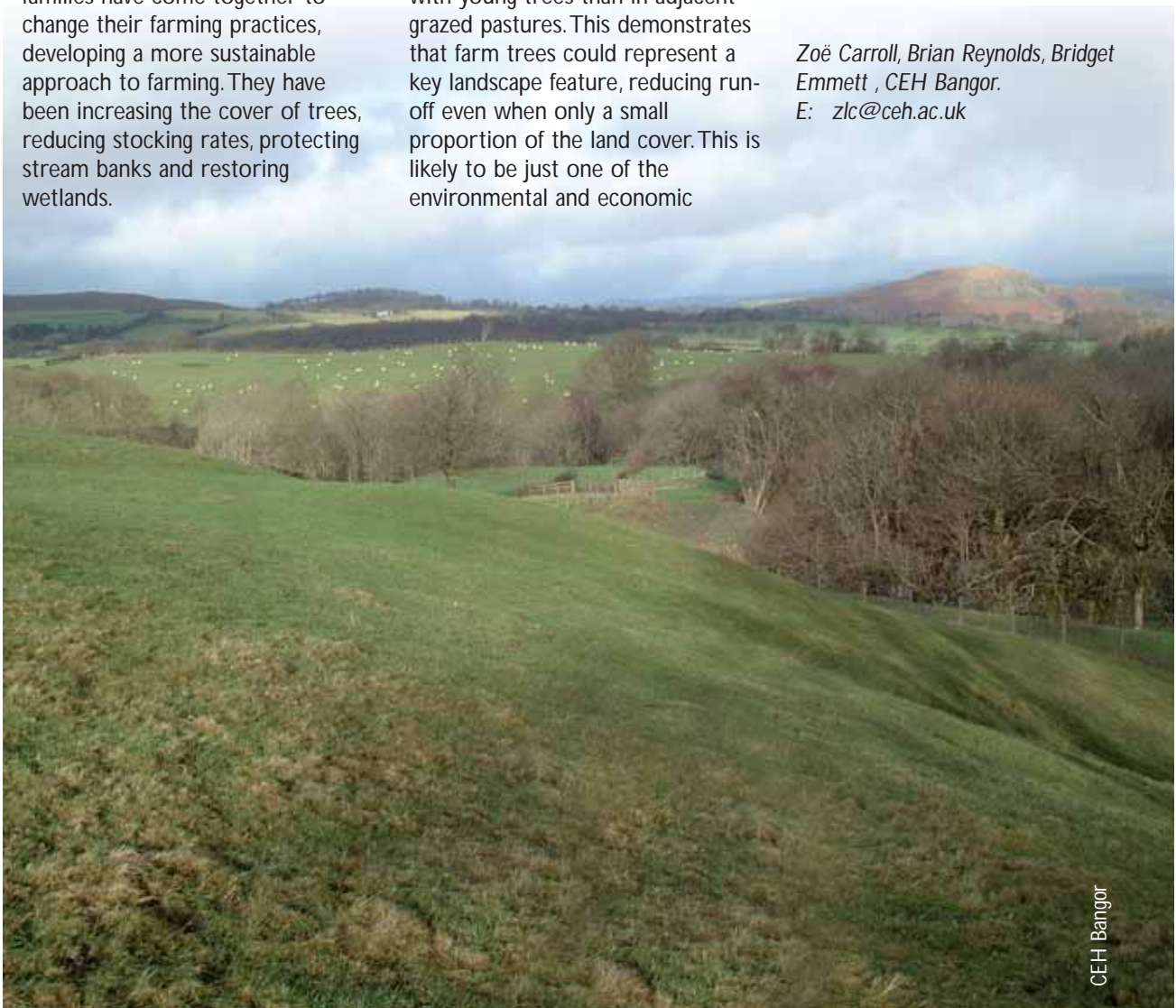
Research showed that water could move through the soil at a rate sixty times higher in areas planted with young trees than in adjacent grazed pastures. This demonstrates that farm trees could represent a key landscape feature, reducing runoff even when only a small proportion of the land cover. This is likely to be just one of the environmental and economic

benefits of planting trees to recreate a more diverse agricultural landscape.

Research is currently taking place to investigate this further and to establish the impacts at the catchment scale.

**Impact:** *Small strips of trees, strategically placed within the catchment, can slow down the flow of water to local streams and reduce the flood risk.*

Zoë Carroll, Brian Reynolds, Bridget Emmett, CEH Bangor.  
E: [zlc@ceh.ac.uk](mailto:zlc@ceh.ac.uk)



CEH Bangor

# biogeochemistry...

## What is the permissible level of toxic metals in soils and water?

CEH staff, in collaboration with the University of Bradford and colleagues in several European countries, have developed a method to express the maximum permissible levels of toxic metals in soils and waters. This was described in terms of fundamental chemical variables, and software was also provided to perform the necessary calculations. Our method has been adopted by Dept. for Environment, Food and Rural Affairs (Defra) for mapping metal Critical Loads in the UK, and is the procedure recommended for Europe under the Convention on Long Range Transboundary Air Pollution.

**Impacts:** Our work will influence metals emission policy in both the UK and Europe.

Ed Tipping, Stephen Lofts, CEH Lancaster. E: [et@ceh.ac.uk](mailto:et@ceh.ac.uk)



Peter Wakely, English Nature

## Too much ammonia reduces the floral diversity of our acid bogs

The release of concentrated ammonia in short or extended episodes, as would happen downwind of an intensive livestock unit, can quickly destroy large areas of semi-natural acid bog vegetation. Experimental manipulation of the nitrogen (N) deposition to a

blanket bog has shown that reindeer lichens growing in relatively unpolluted areas will be very sensitive to the appearance of local sources of N pollution, particularly as ammonia gas. Such lichens appear to have damage thresholds for ammonia between

100 and 200 kg N per hectare per year, depending on the concentration of ammonia experienced. This suggests that building new poultry farms or their equivalent, will very quickly produce lichen 'deserts' in the vicinity. The susceptibility of sphagnum moss and

heather was also shown to be high, whereas cross-leaved heath appears to be thriving.

Effects of wet deposited nitrogen, at dose levels found in the uplands, were also found to damage reindeer lichens. In the uplands, annual inputs are smaller and at lower concentrations than in areas close to intensive agricultural sources, so effects on the vegetation take longer to emerge.

**Impact:** Our findings have direct relevance for the agencies who advise on planning applications for livestock units.

Lucy Sheppard, Ian Leith, Alan Crossley, Jennifer Carfrae, CEH Edinburgh. E: [ljs@ceh.ac.uk](mailto:ljs@ceh.ac.uk)



Peter Wakely, English Nature

# climate change

## ALTERNet: a lead role in pan-European Network of Excellence on Long-term Ecosystem Research for Biodiversity

CEH is leading a partnership of 24 organisations from 17 European countries which will develop durable integration of biodiversity research capacity at a European level. Starting in April 2004, the EC is contributing 10 million euros over the next 5 years to the Network.

The work will:

- Create a network for European long-term terrestrial and fresh-water biodiversity and ecosystem research, based on existing facilities;

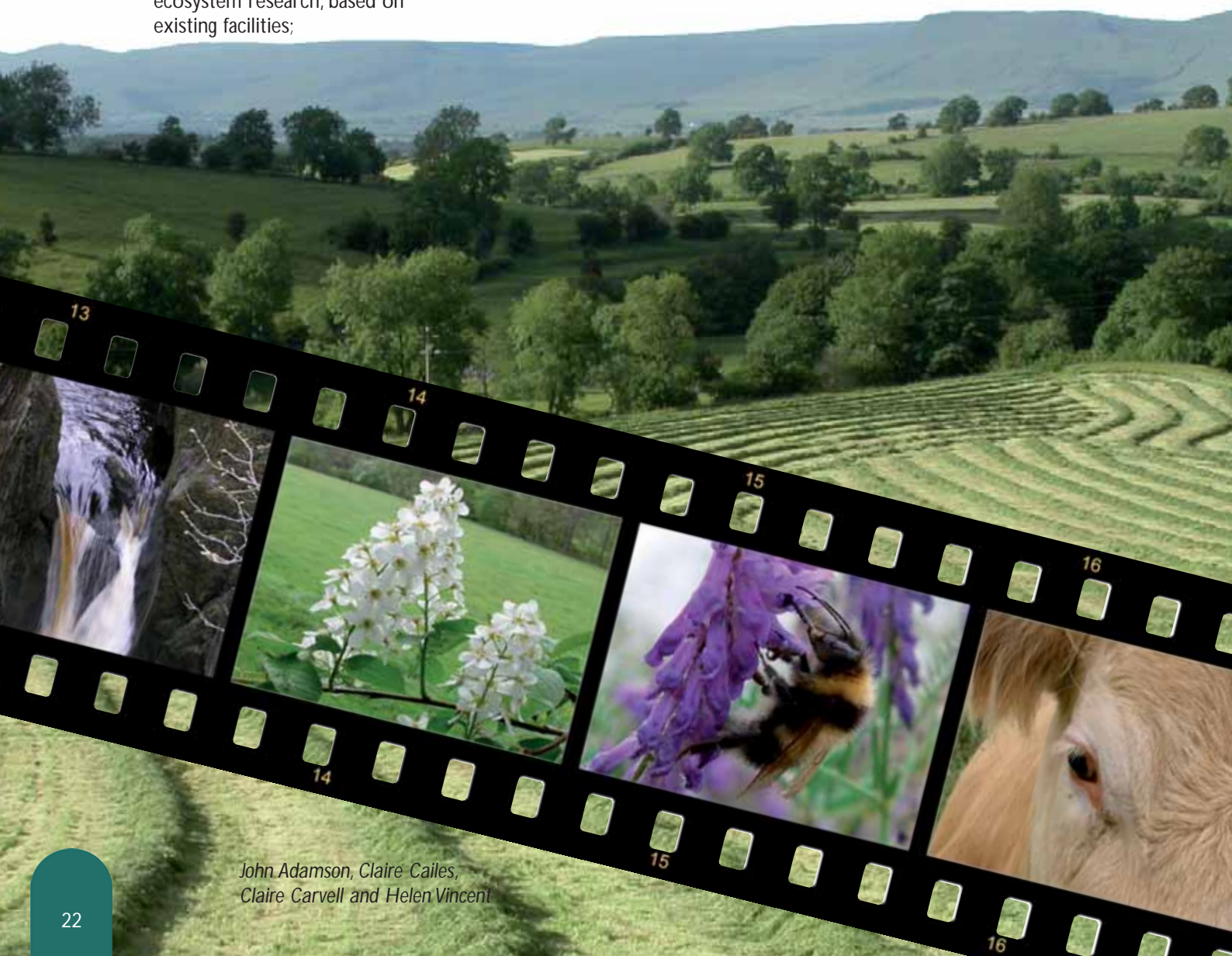
- Develop approaches to assess and forecast changes in biodiversity, structure, functions and dynamics of ecosystems and their services;
- Consider the socio-economic implications and public attitudes to biodiversity loss.

More information on the Network can be found at:

<http://www.alter-net.info/>

**Impact:** ALTERnet's research and monitoring programme will help the EU meet its commitment to 'Protect and restore habitats and natural systems and halt the loss of biodiversity by 2010'.

Terry Parr and Andy Sier,  
CEH Lancaster;  
Allan Watt, CEH Banchory.  
E: [twp@ceh.ac.uk](mailto:twp@ceh.ac.uk)



John Adamson, Claire Cailles,  
Claire Carvell and Helen Vincent

# climate change...

## Impact of the North Atlantic oscillation on lakes

The North Atlantic oscillation (NAO) is a large-scale pattern of climatic variability that affects winter temperature, rainfall and wind over much of Europe.

We used long-term data for four adjacent lakes in Cumbria to study possible effects of the NAO on lake function. We found that processes controlled by air temperature, such as winter water temperature and winter concentrations of nitrate were strongly controlled by the NAO in all four lakes.

In contrast, the winter concentration of phosphate and the timing of a dominant spring phytoplankton, *Asterionella formosa*, was only affected by the NAO in the two smaller lakes. These two lakes had a relatively short retention time, which made them sensitive to changing precipitation.

The results show that the NAO can have a major effect on lakes,

and studies with colleagues in Europe have shown that these effects occur for some features over a wide area. However, some characteristics of lakes are differentially sensitive to the NAO.

**Impact:** Lakes across Europe are shown to be sensitive to the impact of

*the North Atlantic Oscillation. Lakes with a short retention time will show particular sensitivity to the changing winter rainfall associated with the NAO.*

Glen George, Stephen Maberly, CEH Lancaster. E: [dgg@ceh.ac.uk](mailto:dgg@ceh.ac.uk)



Roger Pickup

## Prediction of climatic effects on water quality improves

A regional climate model and a plant plankton (phytoplankton) community model were successfully linked in order to make projections of likely future changes in water quality. The models produced realistic simulations of 20 years of present day phytoplankton in a lake in North West England. The models

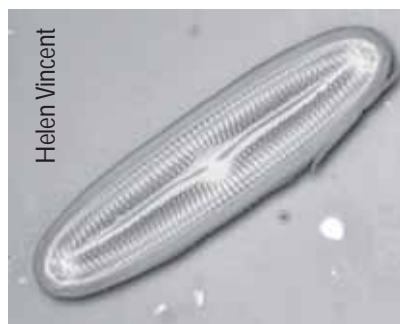
were then run for another 20 years representing the last two decades of the 21st century. Through comparison of these present and future simulations, we showed that the timing of the current annual seasonal blooms were affected, as well as the total amount of potentially toxic (blue-green) cyanobacteria. We showed that in spring, the algae-dominated bloom occurred earlier in the year and that in the summer, the cyanobacteria-dominated bloom persisted for longer in the year and produced 10.8% more biomass.

The models predicted that there would be a 25% increase in the estimated number of days when

cyanobacteria exceeded thresholds set by the World Health Organisation. The coupling of climate and impacts models in this way represents a major advance in our ability to understand and predict the likely effects of climatic change.

**Impact:** The results of this study are of economic importance for lake and reservoir managers. There are also implications for recreational use of these waters.

Alex Elliott, Stephen Thackeray, CEH Lancaster; Chris Huntingford, CEH Wallingford. E: [alexe@ceh.ac.uk](mailto:alexe@ceh.ac.uk)



# climate change...

## Patterns of river flow formation in Northern Eurasia

CEH has collaborated with the Russian Sukachev Research Institute in order to investigate

Neil Cape



climatic and geographic factors in river flow formation for three Siberian and three European rivers. Siberian rivers are of global

importance as they impact on the freshwater budget of the Arctic Ocean, which affects the thermohaline circulation in the North Atlantic Ocean (the 'North Atlantic Conveyor'). Siberian rivers, in particular the tributaries to the larger rivers, are under-represented in the international river-regime databases. The run-off of three Russian rivers in Central Siberia (Kureyka, Karabula and Erba) was modelled to analyse the relative influence of climate. In addition three rivers (Rhine, Maas and Odra) in western Europe were similarly assessed as a control.

The formation of Siberian river run-off appears to be influenced by periodically thawing top horizons of permafrost soil. For the Erba the onset of spring-time agricultural land use in the catchment coincides

with a drop in run-off. A similar causal relationship is suggested for the Maas. We found generally that the precipitation, temperature and river flow of the previous year explained 60-80% of the current year's river flow, except for a certain influence of melting permafrost in Siberian rivers. The residual variance is thought to be driven by land use change.

**Impact:** Land use can change run-off formation, which in turn can be used as an environmental indicator for sustainable land use. The project has provided comparative insights into river flow formation in Europe and Russia.

Heiko Balzter, CEH Monks Wood,  
Eleanor Blyth, CEH Wallingford.  
E: hbal@ceh.ac.uk

## Development of a new system for measuring the fluxes of carbon dioxide and water

The development of a new system for measuring the fluxes of carbon dioxide and water has been completed in the last year.

The new system has a number of advantages over previous systems used world-wide. They include: very low power consumption enabling measurements in places never before possible; a coincidence of measurements, which should provide more robust data and integrated software.

A unit has been successfully deployed in northern Sweden through the winter of 2004/05 and has performed remarkably well, despite temperatures below minus 20°C and total darkness.

A licence for the commercialisation of the design is currently being negotiated with a small UK company.

**Impact:** Over 200 flux towers are operated worldwide to help quantify the global carbon budget, these systems will provide a cheaper and more robust measurement network.

David McNeil,  
Jonathan Evans, David Cooper and  
Colin Lloyd, CEH Wallingford.  
E: ddm@ceh.ac.uk



Colin Lloyd

# climate change...

## Arctic Oscillation impacts on Siberian forest fires

Russia's forests play an important role in the global carbon cycle. Because of their scale and variability, forest fires can change the direction of the net carbon flux over Eurasia. Under the accelerating fire regime that is likely to result from climate change, this could lead to a positive feedback mechanism.

2002 and 2003 were the first two consecutive years in the atmospheric record in which the carbon dioxide content rose by more than 2 parts per million per year (using records since 1958 from Mauna Loa). Northern Hemisphere fires could have contributed to this rise. By using


new measurements of the burned forest area in Central Siberia (derived from remote sensing) we showed that 2002 and 2003 were the two years with the largest fire extent in Central Siberia since 1996.

There were huge forest fire outbreaks in Central Siberia in 2003, burning about 3 million hectares of northern forests. This area may take between 200 and 500 years to regrow in the harsh conditions of continental Siberia. To quantify the relationship between Siberian forest fires and climate variability, we compared these measurements with time-series of large-scale climatic indices for the

period 1992-2003. We found that there were significant relationships between the annual burned forest area, the Arctic Oscillation, summer temperatures, precipitation and one of the indices of El Niño. The Arctic Oscillation may play a more important role in the Earth system than previously thought.

**Impact:** The longest available time-series of forest fire statistics of Central Siberia from remote sensing will be integrated in a carbon accounting system.

Heiko Balzter, Charles George, France Gerard, Clare Rowland and SIBERIA-2 team, CEH Monks Wood.  
E: hbal@ceh.ac.uk



MODIS (Moderate Resolution Spectroradiometer - flown on 2 NASA spacecraft, Terra and Aqua) images of fires and smoke in Russia. Red dots indicate real-time fires, white cloudy areas represent smoke.

# Sustainable economies

## Radioactive fallout: predicting environmental effects in rivers

In most potential nuclear explosions and accidents, radiocaesium and radiostrontium are the elements which would cause the most significant long term environmental contamination. These radionuclides were deposited in small amounts all over the earth's surface during US and Soviet testing of nuclear weapons in the 1960's. Parts of Europe were also contaminated by the accident at the Chernobyl nuclear power plant in 1986.

We studied levels of radioactivity over a 40-year period in 25 rivers spanning an area from the South of Italy to Siberia. In the study, we

used data (including land cover obtained from orbiting satellites) to assess the influence of environmental factors on the transfer of radioactivity to the rivers. We found that the mobility of these radionuclides was the same after both the nuclear weapons testing and Chernobyl fallout events.

**Impact:** *The results of our investigation shows that we could use data from remote sensing to help predict the long-term consequences of future radioactive fallout, based on our experience from Chernobyl and the weapons testing era.*

Jim Smith, CEH Dorset; Simon Wright, CEH Lancaster and colleagues.  
E: [jts@ceh.ac.uk](mailto:jts@ceh.ac.uk)

Jim Smith

## How do water-borne hormones affect young sticklebacks?

Newly hatched sticklebacks were exposed for 2 weeks to water-borne oestrogens (female hormones) at concentrations they might encounter in the wild. After being reared to maturity in uncontaminated water the exposed fish (and separate control groups), were allowed to spawn naturally in large outdoor rearing enclosures. A wide range of measures of reproductive performance was assessed.

During the 6 weeks over which spawning occurred, males exposed to oestrogen as juveniles built significantly fewer nests than control group males. In addition, the number of eggs found in each nest was lower in exposed than control group males. There was also evidence that the 'attractiveness' of the exposed males to females may have decreased - photographic analysis of the intensity of the male's red

throat colouration indicated that the colour was less intense in exposed than control group males.

The reproductive output of the fish exposed as juveniles to oestrogens was significantly affected. A larger scale study is being run in 2005 to confirm and expand upon these findings.

**Impact:** *These findings lend weight to the (supposed but not yet proven) assumption that hormone disrupting chemicals in freshwater environments affect reproduction among fish populations.*

Tom Pottinger, Richard Maunder, Peter Matthiessen, CEH Lancaster.  
E: [tgp@ceh.ac.uk](mailto:tgp@ceh.ac.uk)

Richard Maunder

# sustainable economies...

## Monitoring Environmentally Sensitive Areas in Scotland

As part of the monitoring of the Environmentally Sensitive Areas agri-environment scheme in Scotland, several hundred farms were revisited in 2004 and over 1000 permanently marked vegetation plots were recorded for the final time.

Monitoring of vegetation change began in 1995 in the 10 areas of Scotland that are supported by the scheme. The aim is to show if the scheme can successfully maintain or

enhance the biodiversity of land entered into the scheme. As well as recording changes in plant species occurrence and cover on about 2000 plots, detailed mapping of plant communities on some 230 one kilometre squares was completed, to record changes in areas of vegetation types. Final counts of breeding pairs of farmland wading birds (lapwing, oystercatcher, curlew and redshank) nesting on farms in the scheme were also made. This completes the

10-year data collection phase of this Scottish Executive funded contract.

**Impact:** The results from this work will be used by policy makers in the Executive and in Europe, to judge the success of this agri-environment scheme in Scotland.

David Scott, Imogen Pearce, Ann Marie Truscott and many colleagues, CEH Banchory. E: [dsko@ceh.ac.uk](mailto:dsko@ceh.ac.uk)



Claire Carvell

## CORINE Land Cover 2000 for the UK

The CORINE Land Cover 2000 map (CLC2000) provides a digital map of the stock and change since 1990 for land cover and use in Europe. CLC2000 has a scale of 1:100 000 and a minimum mappable unit of 25 hectares; it records changes in land use of greater than 5 hectares.

Each EU member state provides its own contribution to the project. In the UK, CLC2000 is produced by generalising the national land cover product, in order to retain the link to national databases. The CLC2000 has identified that just

over 1.5 % of the UK land area had changed in the ten-year period, and of this change 85% was due to rotations in coniferous forest.

**Impact:** We have provided the UK contribution to a pan-European product which monitors and drives a broad range of EC policies.

Geoff Smith, Nigel Brown, Andrew Thomson, Ross Hill, CEH Monks Wood. E: [gesm@ceh.ac.uk](mailto:gesm@ceh.ac.uk)

Western Isles of Scotland centred on the Isle of Mull (about 1:100 000)



# sustainable economies...

## Can Chernobyl-related restriction areas now be safely reduced?

We have developed and applied a statistical model to calculate the probability of post-Chernobyl restriction on the movement and slaughter of sheep in north Wales and west Cumbria.

The statistical model (a spatially implemented Monte-Carlo model) includes the transfer of radiocaesium from soil to vegetation, based upon soil organic matter and time, and from vegetation to lamb meat.

The model uses spatial measurements of soil organic matter and the total amount of post-Chernobyl deposition of radioactive Caesium isotopes

( $^{137}\text{Cs}$  and  $^{134}\text{Cs}$ ). An estimate of the ratio of the deposition of these two isotopes has been used to differentiate post-Chernobyl and pre-Chernobyl  $^{137}\text{Cs}$  deposition.

We found that predicted radiocaesium transfer from soil to vegetation and the spatial variation in lamb  $^{137}\text{Cs}$  activity concentrations, matched observed values. Areas with the greatest probability of requiring restriction (according to the model) compare well to actual restricted areas as set by the UK Government.

Predictions were used to try to identify areas which could be removed from Government

restrictions, and the potential impact of changing the intervention limits were also examined.

**Impact:** *The results from this project can be used by the Food Standards Agency and Welsh Office in the management of restricted areas in west Cumbria and north Wales, targeting areas where restrictions may no longer be required.*

Simon Wright, Nick Beresford and Andy Scott, CEH Lancaster.  
E: [smw@ceh.ac.uk](mailto:smw@ceh.ac.uk)

Sheep on St Kilda



# sustainable economies...

## Initiation of 'Green Faradays' network and an environmental round table

FIRSTFARADAY, together with the mini-Waste Faraday Partnership, has initiated the Green Faradays network. This will bring together all the Faraday Partnerships engaged in activities around the sustainability agenda. The network will enable

contaminated land to be viewed in the wider context of regeneration and waste/manufacturing issues. In addition, an environmental round table, led in conjunction with CL:AIRE (Contaminated Land: Application in Real Environments:

English Partnerships-supported public/private partnership to promote the demonstration and uptake of technologies for contaminated land remediation). This partnership brings together key stakeholders including the Department for the Environment Food and Rural Affairs, Office of the Deputy Prime Minister, English Partnerships, the Environment Agency, CIRIA (construction

industry), Environmental Industries Commission and the Soil & Groundwater Technology Association. The group addresses issues relating to the contaminated land community, including researchers, policy makers and industry.

**Impact:** Research and development in environmental remediation is linked to the broader sustainable community agenda both at an industrial level through Faraday Partnerships and through engagement with policy makers, funders and other stakeholders.

Simon Jackman, CEH Oxford.  
E: [saja@ceh.ac.uk](mailto:saja@ceh.ac.uk)



Peter Wakely, English Nature

## Bioavailability of radionuclides in soils: the role of soil microorganisms

Many studies have measured the uptake of radioactive particles (radionuclides) by organic soils, but the role of soil micro-organisms may have been masked by the presence of very small amounts of clay minerals occurring in these soils. The fraction of radionuclides linked to soil organic matter and soil micro-organisms may be relatively small in proportion to the amount bound to the mineral constituents. But this fraction is of great importance as it remains readily exchangeable and so is available for plant uptake.

We have carried out a series of innovative experiments using a biologically active, 'mineral-free', organic soil produced under laboratory conditions, to determine the potential of soil micro-organisms to accumulate

radionuclides (the caesium isotope Cs-134 and strontium isotope Sr-85). Biological uptake and release was differentiated from non-living processes by comparing experimental results with inoculated and non-inoculated sterile organic material. We have investigated the role of different clay minerals, competing potassium and calcium ions, and changes in temperature on the retention of caesium and strontium isotopes. This project was carried out in collaboration with international partners.

**Impact:** The results from studies so far show conclusively that living components of soil systems are of primary importance in the uptake of radionuclides in organic material. Micro-organisms also influence the importance of chemical factors

(eg adsorption to clay minerals), which may play a secondary role in these highly organic systems.



Helaina Black

Nisha Parekh, Simon Wright, Elaine Potter and colleagues, CEH Lancaster.  
E: [nisha@ceh.ac.uk](mailto:nisha@ceh.ac.uk)

# ENVIRONMENTAL

During this reporting year, we have seen CEH's Data Management scientific programme, Environmental Informatics, which 'went live' in 2004 and building capacity for this programme. So

## Completion of heavy metal critical loads maps and databases for the UK

The development of methods for calculating critical loads for heavy metals (lead and cadmium) continues to be funded by Defra (Department for the Environment, Food & Rural Affairs). CEH

carries out this work in association with York University. The end of 2004 saw the completion of updated maps of critical loads for lead and cadmium for sensitive habitats in the UK.

These UK data sets were submitted to the Co-ordination Centre in the Netherlands for European-scale mapping and modelling activities, under the United Nations Economic

Commission for Europe's Convention on Long-Range Transboundary Air Pollution.

**Impact:** This work contributes to the development of effects-based policies for the abatement of heavy metal pollution in the UK and Europe.

Jane Hall, Joseph Fawehinmi, CEH Monks Wood and colleagues across CEH. E: [jrha@ceh.ac.uk](mailto:jrha@ceh.ac.uk)



Kevin Walker

## HarmoniRiB database

CEH has led the development of the first version of the HarmoniRiB database, designed to hold monitoring data required for the implementation of the Water Framework Directive. The design is entirely generic and can hold

almost any data that varies in either or both space and time.

The novel feature of the database is its ability to record 'uncertainty' at the level of the individual data point

**Impact:** The project is a first step on the way to incorporating uncertainty in day to day operational decision making.

Roger Moore, CEH Wallingford. E: [rvm@ceh.ac.uk](mailto:rvm@ceh.ac.uk)

## Air Pollution Information System launched

The Air Pollution Information System (APIS) is a web-based source of data on the environmental impact of air pollution.

This site ([www.apis.ac.uk](http://www.apis.ac.uk)) provides a searchable database and information on pollutants and their impacts on specific habitats and species. Search criteria include: pollutants, habitats and species, issues, location and biomonitoring

methods, for which details are provided. The work was funded by a wide range of environmental agencies in the UK and will be updated regularly.

**Impact:** This web site provides a unique 'one-stop-shop' for information on air pollution and its effects.

Bill Bealey & many colleagues, CEH Edinburgh. E: [bib@ceh.ac.uk](mailto:bib@ceh.ac.uk)



# AL INFORMATICS

ent activities continue and evolve into the preparations for a new  
n early 2005. Work carried out this year has contributed to scoping  
me examples of activities over the past year ....

## Progress of the Environmental Genomics Thematic Programme Data Centre

Our data catalogue has been  
launched this year and

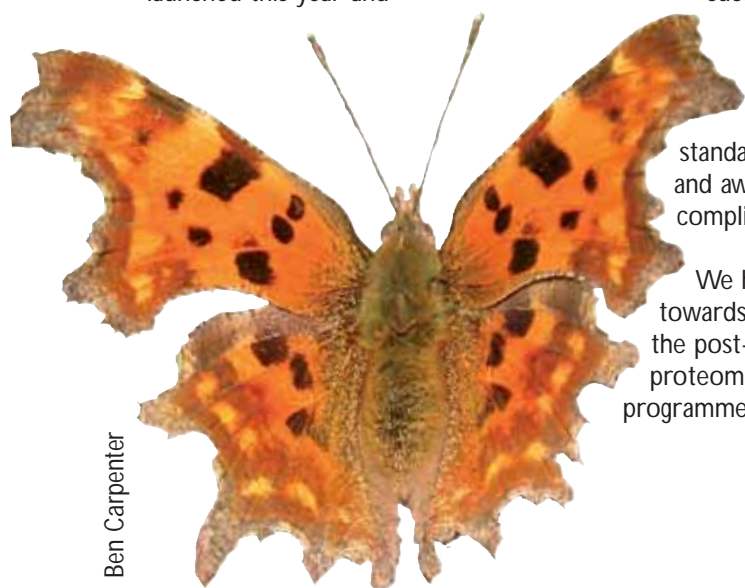
Bio-Linux version 4.0 has been  
successfully released.

**Impact:** NERC now has  
environmental genomics data  
cataloguing capacity and a variety of  
bespoke tools to aid researchers  
working in the area of 'omics'.

Dawn Field, Bela Tiwari, Dan Swan and  
colleagues, CEH Oxford.  
E: [dfield@ceh.ac.uk](mailto:dfield@ceh.ac.uk)

We have shifted  
our focus towards  
provision of data  
standards development  
and award-holder  
compliance.

We have made headway  
towards expanding to serve  
the post-genomic and  
proteomic science  
programme.



Ben Carpenter

## Coupling scheme improves flood forecasting and climate change assessments

The CEH grid-based flow routing  
scheme, when coupled with a  
Meteorological Office system,  
allows river flow forecasts to be  
made for any location in the UK. It  
has also been integrated with the  
Hadley Centre's Regional Climate  
Model to provide river flow data  
across Europe. Outputs are used in

climate impact studies and to  
estimate river discharge to oceans  
for coupled ocean models.

**Impact:** When used for forecasting,  
the new scheme provides a flood-alert  
warning for 1½ days ahead. When  
used with a Regional Climate Model, it  
can be used to explore how river flows

over Europe are affected by climate  
change.

Vicky Bell, Bob Moore, Alison Kay,  
Richard Jones, CEH Wallingford.  
E: [vib@ceh.ac.uk](mailto:vib@ceh.ac.uk)



# ENVIRONMENTA

## Why do we need the Environmental Informatics Programme?

Matthew Stiff, Director of the Environmental Informatics Programme E: [mastiff@ceh.ac.uk](mailto:mastiff@ceh.ac.uk)

The study and management of our environment increasingly needs an integrated, cross-sector approach. CEH's unique and diverse data holdings must be combined in ever more complex ways to answer the environmental questions set out in our Science Strategy, and addressed in our Quinquennial (Q1) Science Programme. To develop the science required to support this important need, CEH researchers and the wider community need easy access to CEH data holdings as a unified research resource.

The Environmental Informatics Programme (EIP) has been established alongside the five existing Science Programmes. The objective of the programme is:

- To provide researchers with access to co-ordinated data resources and informatics tools; in order to deal with complex, multidisciplinary environmental questions.

The scope of the Programme will include digital and paper information holdings and archival collections. EIP staff will put in place organisational structures and mechanisms to ensure sound stewardship of CEH's information assets, allowing us to realise their full potential. The result will be a consolidated approach to information management.

It will:

- bring together information on our digital and physical information holdings;
- develop a coordinated network of expertise embracing data and archival management, librarianship, information services and rights management.

By ensuring close links with computing services and the

science programmes, EIP will ensure that CEH and its stakeholders have access to the information they need in order to further the aims of environmental science. The interlinking of knowledge resources within the organisation will extract maximum benefits for everyone.



## Physical and Digital Collections Care

CEH generates and manages huge volumes of data from its scientific research and monitoring activities. EIP will take action to consolidate our extensive digital and paper archives and to achieve recognised standards of collections care. We will utilise existing expertise in

CEH and other NERC-funded research centres, as well as other acknowledged centres of excellence such as the National Archive, the Joint Information Systems Committee and the UK Office of Library and Information Networking.

EIP will encourage the concept of an information life-cycle, identifying the long-term future of data and information in data management plans that address the curation or disposal of information as appropriate.

## Data Licensing and Provision

A new post of CEH Data Licensing Manager has been established to centrally co-ordinate the activities handling the licensing of CEH data

sets. This role will examine the structures and procedures required to improve the quality of our services to external and internal

stakeholders. The post will manage licensing for our external customers, as well as third-party data sets for use within CEH.

# AL INFORMATICS

## The EcoGrid Project

The EcoGrid project is developing Grid-based data services for CEH compatible with the NERC Data Grid (NDG) project run by CCLRC\*. Emerging DataGrid technology has the potential to support full interoperability of diverse and distributed data collections, to allow scientists single-context access to the wealth of environmental data held by CEH/NERC or other linked systems. EcoGrid, by participating in the NDG, intends to enable this by providing users with a seamless access mechanism to data from

distributed sources. EcoGrid is developing common metadata models and other data management structures for some of the environmental monitoring databases managed by CEH.

EcoGrid has:

- developed the existing meta-data structures and tools to allow improved discovery and data access within these test-bed databases.
- defined security requirements for the test-bed databases and implemented a schema.

EcoGrid will:

- establish an electronic dictionary to hold a defined vocabulary describing data content in the immediate ecology and hydrology domains

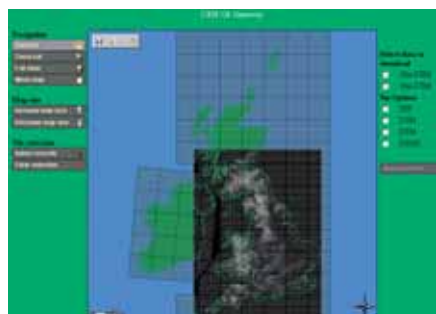
Rod Scott CEH Lancaster.  
E: [rjsc@ceh.ac.uk](mailto:rjsc@ceh.ac.uk)

\* CCLRC = Council for the Central Laboratory of the Research

Laurence Jones

## The CEH Geographic Information (GI) Gateway

The CEH GI Gateway will simplify discovery of and access to spatial data for scientists from inside and outside CEH. The system will enable users to browse CEH spatial data sets via the Web.



CEH staff will be able to browse datasets held under license from third parties (e.g. Ordnance Survey, digital terrain models and national soil survey data). Extraction of data for a particular region will then be facilitated with on-line licensing of CEH spatial data to external users, eg Land Cover Map 2000, for commercial or academic use. There will be one-stop access for CEH staff to third-party data sets licensed by CEH.

Behind this interface, the issues of translation of spatial data between

referencing systems and visualisation on common projections will be resolved; non-expert users will have access to powerful spatial operations. This will enable comparison of the coverage and suitability of different spatial data sets for particular applications. This development will be carried out in collaboration with the development of similar facilities by the NERC Earth Observation Data Centre.

Mike Brown, CEH Lancaster.  
E: [mjbr@ceh.ac.uk](mailto:mjbr@ceh.ac.uk)

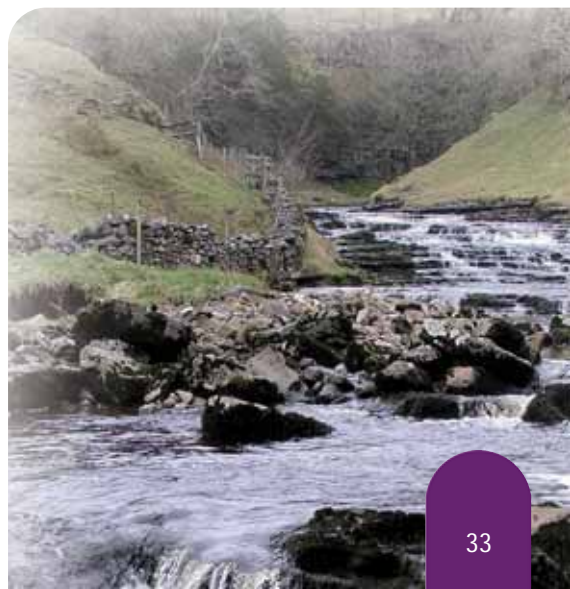
## The Intelligent River Network

A crucial aim of the new Programme is to enable combination of environmental data and knowledge to create appropriate information which will allow users to address complex environmental issues. By using the Intelligent River Network users can access and explore data within the context of ecological and hydrological concepts. For example,

tools will be developed allowing data sets to be discovered through relationships within river networks, catchments and ecological habitats. These developments will build on existing expertise and tools such as the Intelligent River Networks.

John Hilton, CEH Dorset.  
E: [jhi@ceh.ac.uk](mailto:jhi@ceh.ac.uk)

Claire Calles



# APPLYING O

## Setting up of EcoGene Labs

The molecular genetic laboratories at CEH Edinburgh have been modernised to a design permitting professional processing of commercial DNA 'fingerprinting' cases. Operating standards, including standardised protocols and case recording, were put in place to create a legally credible service. The laboratory successfully processed a series of cases for the insurance market, dealing primarily with subsidence claims.

**Impact:** *The professional service that can now be offered by the laboratory has attracted significant customer interest and provides a basis for future development of the commercial potential of this operation.*

Stephen Cavers, Katherine Walker, CEH Edinburgh.  
E: [scav@ceh.ac.uk](mailto:scav@ceh.ac.uk)



Marcel van Oijen

## Achieving national Accreditation standards

In 2005, three Groups within the Environmental Chemistry and Pollution Section at CEH Lancaster were awarded accreditation to the ISO17025 Quality Standard by the United Kingdom Accreditation Service (UKAS) for their chemical, radiochemical and stable isotope analytical activities. The Schedule of Accreditation is available on

the UKAS website: [www.ukas.org](http://www.ukas.org)  
This achievement is the culmination of two years effort by the groups involved.

All analytical methods used had to be validated and documented in detail. Quality systems were put in place, complying with ISO17025.

The accredited testing laboratories are the Environmental Analysis Group, the Radiochemistry laboratories and the Stable Isotope Facility, which together comprise UKAS Testing Laboratory No. 2506.

**Impact:** *This accreditation means that we can now offer numerous different quality assured analytical methods to a recognised international standard. Customers, both within CEH and externally, can therefore be confident in the data supplied.*



Darren Sleep, Peter Matthiessen, CEH Lancaster. E: [dsleep@ceh.ac.uk](mailto:dsleep@ceh.ac.uk)



Darren Sleep

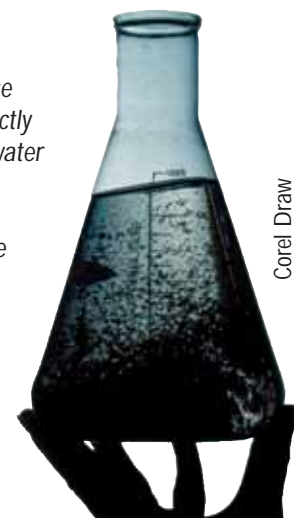
## First Demonstration of AHL effects in complex bacterial communities

Cell to cell signalling is a method that bacteria use to communicate, through chemical 'languages'. We were the first to demonstrate that signalling with AHL (Acyl homoserine lactones) is an important criteria for the efficiency of wastewater treatment communities, and pinpointed which was the most common 'language'

being used. Field trials with multiple 'languages' are now being carried out to see how we can modify microbial effectiveness. Previously AHL signalling has only been recognised as a phenomenon occurring in laboratory cultures. Our findings show that it is also found in the natural environment.

**Impact:** *A better understanding of these processes can be directly applied to the wastewater treatment industry.*

Andrew Whiteley, Mike Manefield and Rob Griffiths, CEH Oxford.  
E: [aswhi@ceh.ac.uk](mailto:aswhi@ceh.ac.uk)



Corel Draw

# OUR SCIENCE

## Conserving endangered montane forests in Vietnam

CEH staff spent some time in Vietnam, training Vietnamese technical staff in mycology, vegetative propagation and flower induction techniques.

A total of 109 species of fungi (including 36 edible species) were collected and identified and stored in a special herbarium. Over 5000 cuttings of endangered conifers

(*Cupressus*, *Taxus* and *Calocedrus*) were successfully propagated.

**Impact:** We were able to increase Vietnamese expertise in mycology and propagation of rare and endangered Vietnamese conifers.

Jan Dick, Kevin Ingleby,  
CEH Edinburgh. E: jand@ceh.ac.uk



*Ganoderma* spp.,  
by Paolo Mazzei,  
[www.leps.it](http://www.leps.it)

## Development of a Knowledge Transfer Network in Marine and Freshwater Microbial Biodiversity



FIRSTFARADAY has spent 2 years working with the NERC Marine & Freshwater Microbial Biodiversity Thematic Programme to

Protozoan activated  
sludge  
Genoveva Esteban

develop technology transfer into a number of industry sectors.

The success of this activity has led to the identification of a number of potentially exploitable areas of science, which will now be followed up through a Knowledge Transfer Network.

This has been funded for 2 years from December 2004, in collaboration with University of

East Anglia, Heriot-Watt University, University of Newcastle, Plymouth Marine Laboratory and the Freshwater Biological Association.

**Impact:** Potential exploitation routes for NERC science will be opened up and mechanisms put in place to ensure uptake of science into technological development.

Chris Knowles, Simon Jackman,  
CEH Oxford. E: cjkn@ceh.ac.uk

## Rainfall and flood forecasting

CEH provides rainfall runoff, snowmelt, channel flow routing and error predicting updating scheme models to the Environment Agency for use throughout England and Wales. They are now in operational use within the Agency's new National Flood Forecasting System.

We have also provided methodology and a PC tool for the Agency to monitor the performance of the Meteorological Office's Daily Weather Forecast and Heavy Rainfall Warning products, which are used in support of flood warning. New methods for

comparing and assessing the performance of rainfall forecasts are now in use.

**Impact:** Scientific models, developed within CEH, form an important part of national flood and rainfall forecasting.



Bob Moore, David Jones,  
Kevin Black, Anne Jones,  
Alice Robson,  
CEH Wallingford.  
E: rm@ceh.ac.uk

Corporation Road, Carlisle,  
January 2005,  
by Ian Britton, freefoto.com

# SCIENCE INTO EUROPE

## CEH's European Activities

During the year CEH has continued its strong participation in the research programmes of the European Commission, with success in several significant areas.



*The Netherlands,  
North Sea Coast  
Marcel van Oijen*

CEH, as one of Europe's largest environmental research organizations, has played a leading role in many of the new and larger "instruments" of the 6th Framework Programme. We are continuing to develop our expertise in working with the larger Integrated Projects and Networks of Excellence.

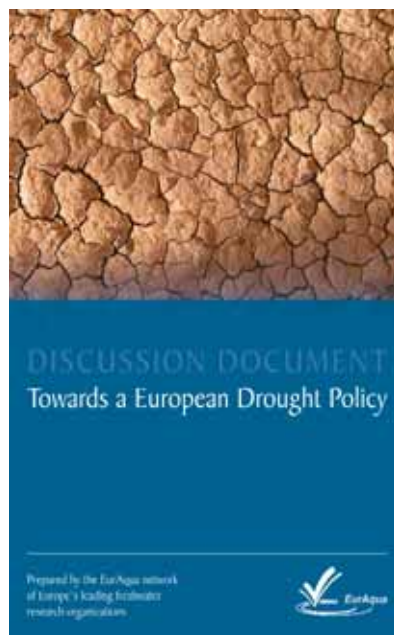
CEH has strengthened its role in a number of the most powerful European research networks including PEER (Partnerships in European Environmental Research), the EurAqua Network of European freshwater research organizations and the CONNECT Network of biodiversity research.

We have been involved in bi-lateral discussions with several European research partners, including RIZA (Institute for Inland Water Management and Waste Water Treatment) in the Netherlands, and Cemagref (France). CEH has provided both the Chairperson (Prof Alan Jenkins) and the Secretariat for the EurAqua Network for 2003-2005. An important outcome was EurAqua's document "Towards a European Drought Policy", drafted and edited by CEH. For more information, see: <http://www.euraqua.org/download/Drought%20brochure%20992kb.pdf>

We have won a number of flagship projects in FP6 including AlterNet, one of only two Networks of Excellence in the Global Change and Ecosystems Sub-priority (GCE). CEH has been particularly successful in the Climate area of GCE and has also performed strongly in the biodiversity area. We continue to be successful in other areas such as radiological protection (EurAtom Programme), and in FP6 international cooperation programmes. CEH's Earth Observation scientists have

been very active within the Global Monitoring for Environment and Security (GMES) programme of FP6; this places CEH in an excellent position for the expansion of research in this area in the forthcoming Framework 7 (FP7).

CEH has led a number of the major projects of Framework 5, which are now reaching their conclusion. They range from those with strong commercial relevance, for example HarmonIT, (developing an IT standard model interface), to those supporting the implementation of European policies and Directives such as CATCHMOD (Cluster supporting the Water Framework Directive).



As FP7 approaches, CEH staff are taking a leading role in the development of scientific and organizational structures. As a direct result of our actions, water research has been included in FP7 as a possible topic for a special initiative.

*Neil Runnalls, European Liaison officer,  
CEH Wallingford. E: [nrr@ceh.ac.uk](mailto:nrr@ceh.ac.uk)*

# TRAINING THE NEXT GENERATION



# TRAINING THE NEXT

## The PhD Student Scheme

CEH, as part of its mission statement, has a commitment to provide research training via PhD studentships. This provides training, primarily through research, in advanced techniques relevant to the environmental sciences. More than 200 PhD students are supervised by CEH staff at our eight research sites across the UK.

CEH aims to:

- Deliver excellent research training to students;
- Equip students with key communication and interactive skills;
- Offer opportunities for students to become adaptable and to gain information;
- Maximise the probability of students securing appropriate employment.

CEH is funded to run a certain number of PhD studentships by our parent organisation, the Natural Environment Research Council (NERC); these are for 'blue skies'/non-thematic research. Other NERC funded PhDs may also be awarded, under directed research

and they will have both a CEH and a university supervisor. CEH can also act as an academic or industrial partner to other organisations in joint supervision of students, e.g. CASE studentships (Co-operative Awards in the Sciences of the Environment). The proportion of time spent at CEH and the university varies and is agreed at the outset by the supervisors and students; some spend most of their time at CEH and others visit according to research requirements. CEH provides excellent laboratory and field resources with historical datasets, library and computing facilities available to support student research. Supervisors work together in multi-skilled teams and offer considerable experience and knowledge to advise and assist students throughout their training.

Students draw upon a structured framework of additional study, which ensures that each student assembles a balanced portfolio of transferable skills, specialist knowledge and research achievements, in line with the

Research Councils' Joint Skills Statement. Personal progress is carefully monitored and recorded via a comprehensive student handbook, which also provides information on a range of facilities and opportunities

available. Training workshops and courses are provided too, either by CEH and the Research Councils, the university with which the student is affiliated, a university near the CEH site at which the

student is based or by the ukGRADprogramme.

Students are selected for these PhD studentships via a competition announced annually on CEH's Web site. Besides the obvious benefits to students there are benefits to CEH's research programmes too.

*Judith Wardlaw, Scheme Supervisor, CEH Dorset. E: [jcwa@ceh.ac.uk](mailto:jcwa@ceh.ac.uk)*

Dr Karsten Schönrogge,  
Population and Conservation  
Ecologist, Biodiversity  
Programme.

“PhD studentships are an opportunity to have a researcher that is able to concentrate on one project only. Good PhD students can develop fresh views and ideas on subjects and through the university link studentships and collaborations between CEH and University.”

Dr Rodolphe Gozlan, River  
Ecologist, Water Programme.

“CEH PhD students have proved to be key players in initiating and consolidating fundamental research within CEH, some of which has proved to be vital for the more applied aspects of CEH research and has significantly helped in attracting new contracts (EU & NATO grants).”



Students and Supervisors, pictured at CEH Dorset

programmes. CEH is not itself a degree-awarding body, so all students have to be registered with a university in the UK or abroad

# EXT GENERATION

## Students at Work

Many other students spend shorter periods of time at CEH doing work experience as part of a recognised scheme, a Nuffield science bursary, undergraduate and Masters dissertations or participating in international mobility programmes such as Leonardo da Vinci and IAESTE.

Jessie Baeten is an undergraduate student doing a work placement at CEH Dorset for 6 months (February-July 2005). She is in her third year of her Bachelor's degree course in Environmental Technology at Saxion University, IJsseland, in the Netherlands. Her course involves studying policy for nature

management and conservation and learning about methods used in research to protect and restore nature, the Dutch landscape and environment.

During her work placement with the Fish Ecology group at CEH Dorset she investigated the

spawning movements and strategies of fast and slow growing pike in the River Frome using radio and passive integrated transponder telemetry. Her results will be used for a project which sets out to establish the nature, timing and significance of off-river habitat use by lowland river fishes. This work is important in developing effective management and conservation of these habitats.



Jessie Baeten with Pike

### Jessie said

“ I really wanted to get involved in an organisation which carried out research into the natural environment so working at CEH was a great opportunity for me. I had a really good time working at CEH Dorset and enjoyed mixing with other students working there ”

### Grieg said

“ I wasn't sure what to expect coming to work for the first time within an environmental organisation. From the start I was surprised about how relaxed and friendly the working atmosphere was. ”

Grieg Davies is an MSc student whose final semester thesis and industrial placement are at CEH Dorset. He is studying Restoration Ecology at the University of Liverpool. His master's thesis involves using Geographical Information Systems (GIS) to map

historical data (1968-1970) from a chalk stream, and then comparing the results with data taken from the same stream in 2005. He will analyse the results and propose restoration and/or management practices that will restore parts of the stream.

# COMMUNICATION

## The Royal Welsh Show

CEH Bangor exhibited their science to the public at the Royal Welsh Agricultural Show in July 2004. The centenary show, held at Builth Wells, was visited by HM Queen Elizabeth, the Prince of Wales and the Duke of Edinburgh. Over the 4 days almost 250,000 people flocked to see a variety of events covering the whole of farming and rural life in Wales. CEH had a stand in the 'Countryside Care Area', alongside organizations such as the Institute of Grassland and Environmental Research, Environment Agency Wales, Countryside Council for Wales, the National Parks Authority, Wildlife Trust and the RSPB.

A wide variety of people visited our stand, we welcomed Welsh Assembly Government Ministers, policy makers, farmers, conservationists and the general public. The stand had a great response from all visitors and from the organizers, as it demonstrated CEH experiments and ideas at first hand to the public.

CEH's stand featured:

- A tree shelter belt planted outside the stand was filled with pictures of all kinds of bird, animal, plant and insect species. A competition to see who could find and name all the animals was very popular with the children.
- Plans for the new 'Environment Centre, Wales' which will be the new home for CEH Bangor and some staff from University of Wales, Bangor. The Centre will be housed in a new purpose built, environmentally friendly building, to be completed by July 2006. The building demonstrates many aspects of environmental and sustainable construction including use of locally sourced materials (Welsh oak and slate), and energy saving systems such as photovoltaic panels, and geothermal heat pumps.
- A demonstration of how rising ozone levels can injure growing plants, and where the areas of highest risk in Wales are located.

Bronwen Williams and  
Gareth McShane, CEH Bangor.  
E: [bpu@ceh.ac.uk](mailto:bpu@ceh.ac.uk)

Dr Bridget Emmet, Head of site  
at CEH Bangor

“It was a baptism  
of fire for us and a huge  
amount of  
work—but a  
great success”

- The Pontbren project - how planting tree shelter belts to protect sheep in upland hill farms, contributes to the biodiversity of the area and the uptake of water by soil.

*The CEH Stand: Prince Philip visiting the Royal Welsh Show; child taking part in the “find the animals” competition; some of the information on display.*



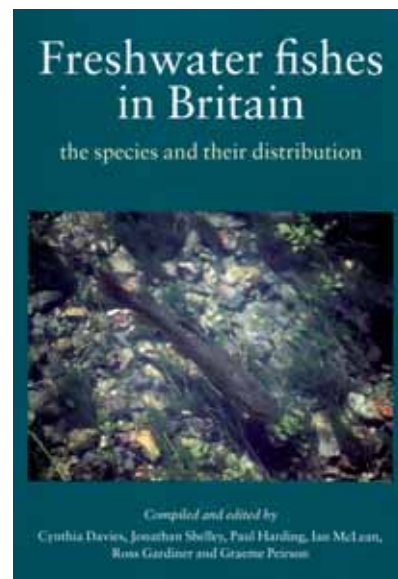
# NG OUR SCIENCE

## Freshwater fishes in Britain: the species and their distribution

This atlas, written by a team of 32 authors, is the output of several years work and is based on the creation of a freshwater fish database for Britain. It is designed to appeal to anglers, research scientists and those concerned with managing water bodies. The new atlas documents where fish species now occur, and how individual species have spread or retreated. The authors' intention was to make the fish species better known and

to raise awareness of the vulnerability of some of our rarer native species. The book is the first national overview of our fish fauna since 1972. The underlying database is publicly available to search via the National Biodiversity Network's Gateway facility. See [www.searchnbn.net](http://www.searchnbn.net)

*Cynthia Davies, editor, CEH Dorset.*  
E: [cd@ceh.ac.uk](mailto:cd@ceh.ac.uk)



## Science Week, March 2005

CEH supports this annual nationwide event sponsored by the British Association (BA) by organising local events for schools and the public.

CEH Lancaster held a Science Discovery Day for a hundred 13/14 year olds from local schools. The students chose from various activities on offer, including soil variation with depth and between ecosystems, making a soil core and discovering the microscopic animals and worms that live in soils. Building a 3-D model of DNA and extracting DNA from onions was a popular activity, as was the isotope

analysis of hair samples from students and teachers. Water food webs in lakes and ways of assessing fish stocks in lakes were on offer too. A media artist helped the students to explore climate change using data from the Environmental Change Network

CEH Wallingford hosted about 500 schoolchildren for their Water Detectives event, exploring the water cycle with CEH and BGS staff. 16 sessions were held over 6 days for children in the 8-12 ages and a public open day was held too. Students explored how we measure weather and collect water from the ground. They looked at microscopic life and explored how we test for pollution, using interactive displays and hands-on activities.

CEH Dorset hosted two 'Science in a Pub' events, in Dorchester and in Bournemouth. 23 members of staff were joined by 78 members of

the public plus some invited guests from Defra, English Nature, Butterfly Conservation and Bournemouth University and other local organisations. Questions discussed included 'Conservation: is it just large-scale gardening?' and (based on studies near Chernobyl) 'Are humans worse for the environment than radioactive fallout?' A birthday cake was presented to "Einstein" in honour of Einstein Year.

At the Houses of Parliament, Hazel Watson (a sandwich student at CEH Dorset) had a poster accepted for the House of Commons Young Scientist event held in Science Week. Hazel presented her poster on 'Sexing

Oystercatchers using DNA from feathers' and greatly enjoyed the event.

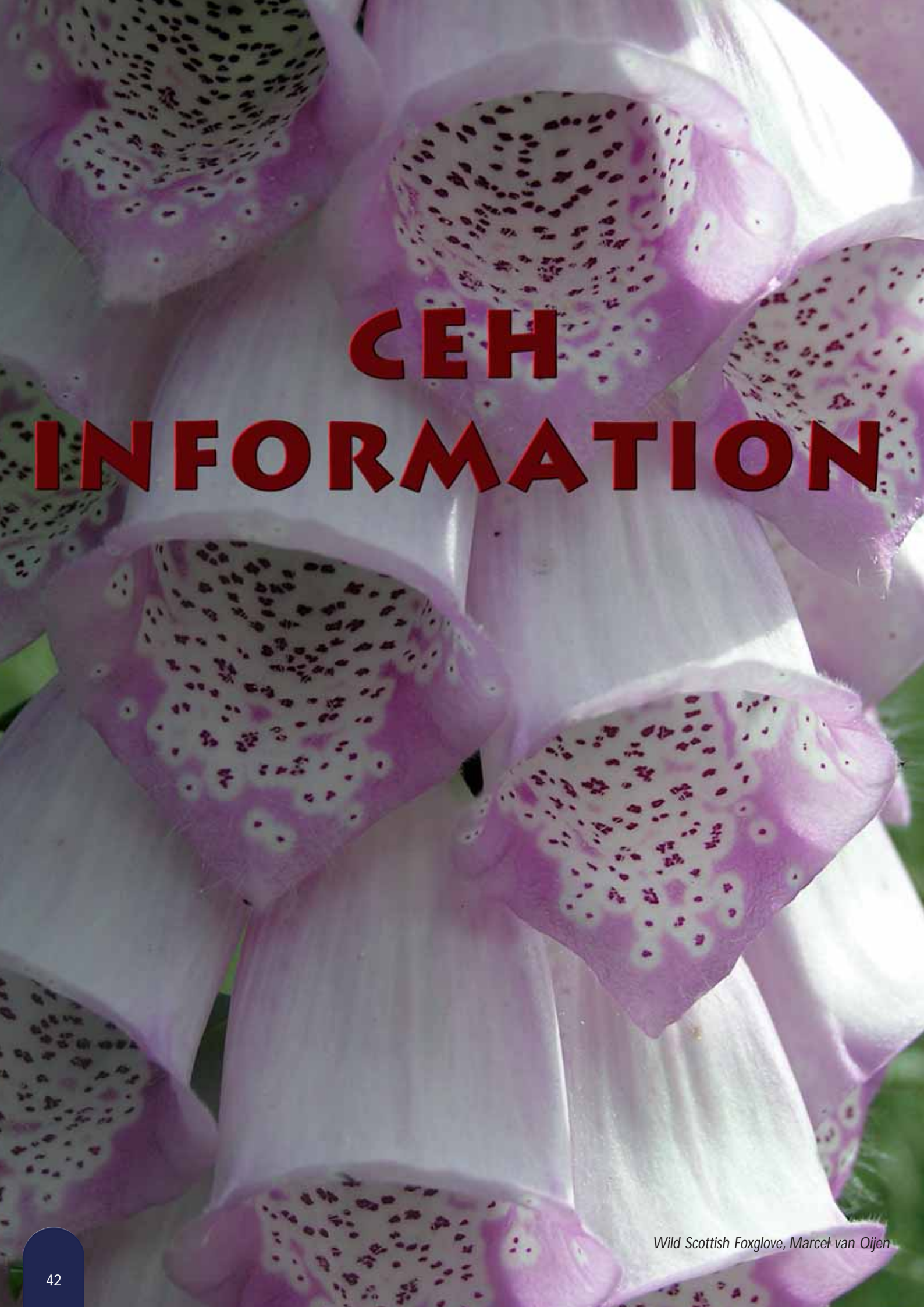


*Hazel Watson,  
Sandwich Student*



*A birthday cake for "Einstein"*

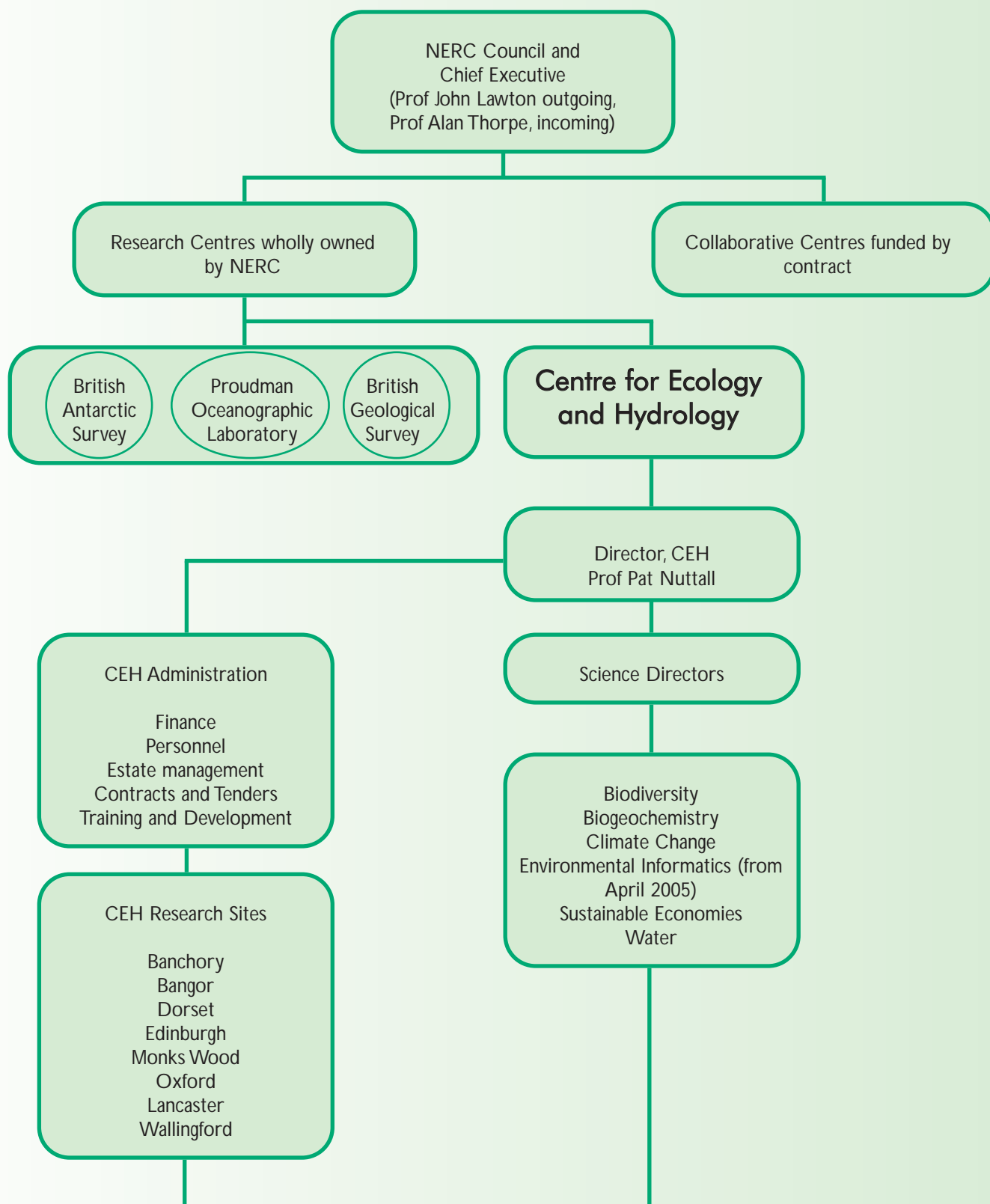
*John Griffin, CEH Wallingford.*  
E: [jhgr@ceh.ac.uk](mailto:jhgr@ceh.ac.uk)



# CEH INFORMATION

*Wild Scottish Foxglove, Marcel van Oijen*

# NERC AND CEH—THE RELATIONSHIP



# MANAGING CEH

*CEH is managed internally by two Boards, the Executive Board and the Science Board, who meet at frequent intervals.*

## Central Management

Director: Professor Pat Nuttall, CEH Swindon. 01793 442516, [director@ceh.ac.uk](mailto:director@ceh.ac.uk)  
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CEH Quality Assurance: Andrea Titley, CEH Monks Wood. 01487 772435, [andt@ceh.ac.uk](mailto:andt@ceh.ac.uk)

## Science Programme Management

CEH's six programmes are each managed by a senior scientist, the Science Director, aided by a Programme Administrator. CEH senior research staff are affiliated to one or more Programmes, and form the Programme College. The Colleges meet regularly to discuss the research direction for their Programme.

## The Six Programmes:

### Biodiversity

Science Director: Professor Mark Bailey (CEH Oxford) 01865 281630, [m Bailey@ceh.ac.uk](mailto:m Bailey@ceh.ac.uk)  
Science Programme Administrator: Dr Sarah Turner (CEH Oxford) 01865 281630, [sltu@ceh.ac.uk](mailto:sltu@ceh.ac.uk)

### Biogeochemistry

Science Director: Professor David Fowler (CEH Edinburgh) 0131 445 4343, [dfo@ceh.ac.uk](mailto:dfo@ceh.ac.uk)  
Science Programme Administrator: Heath Malcolm (CEH Edinburgh) 0131 445 4343, [hmm@ceh.ac.uk](mailto:hmm@ceh.ac.uk)

### Climate Change

Science Director: Dr Peter Cox (CEH Dorset) 01305 213500, [pcox@ceh.ac.uk](mailto:pcox@ceh.ac.uk)  
Science Programme Administrator: Dr Neville Hollingworth (CEH Dorset) 01305 213500, [nth@ceh.ac.uk](mailto:nth@ceh.ac.uk)

### Environmental Informatics

Science Director: Dr Matthew Stiff (CEH Lancaster) 01524 595800, [mastiff@ceh.ac.uk](mailto:mastiff@ceh.ac.uk)  
Science Programme Administrator: pending appointment

### Sustainable Economies

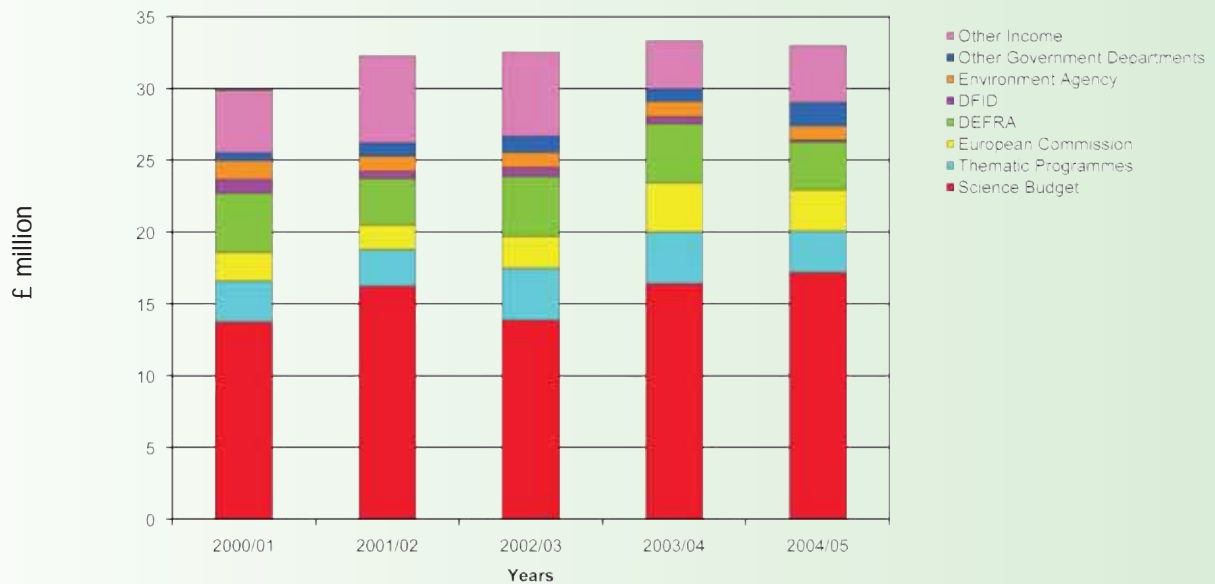
Science Director: Dr Dan Osborn (CEH Lancaster) 01524 595800, [dano@ceh.ac.uk](mailto:dano@ceh.ac.uk)  
Science Programme Administrator: Dr Lucy Ball (CEH Wallingford) 01491 838800, [lball@ceh.ac.uk](mailto:lball@ceh.ac.uk)

### Water

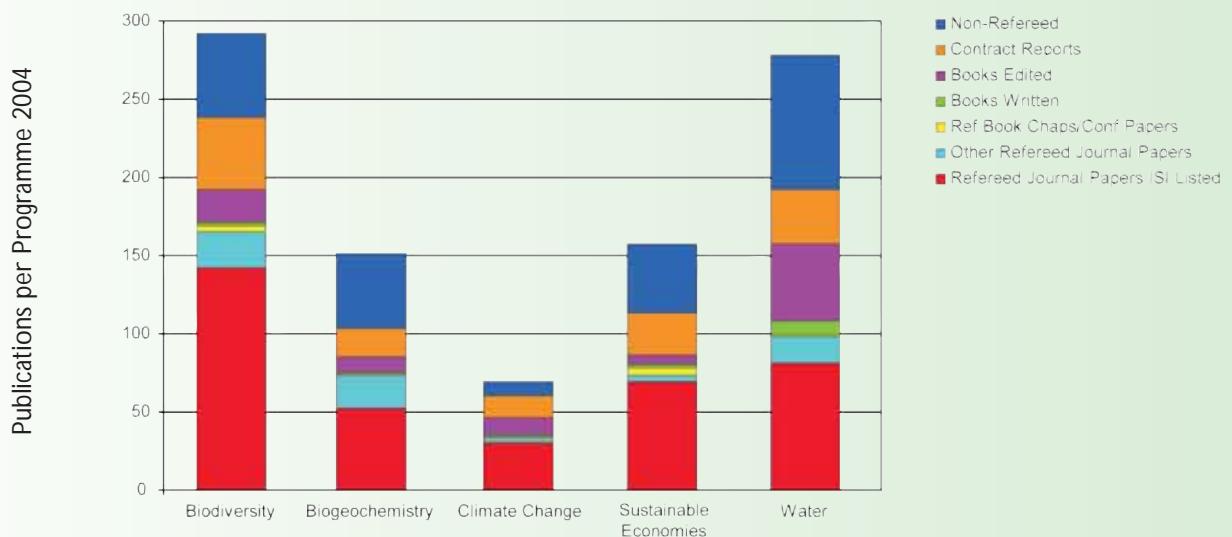
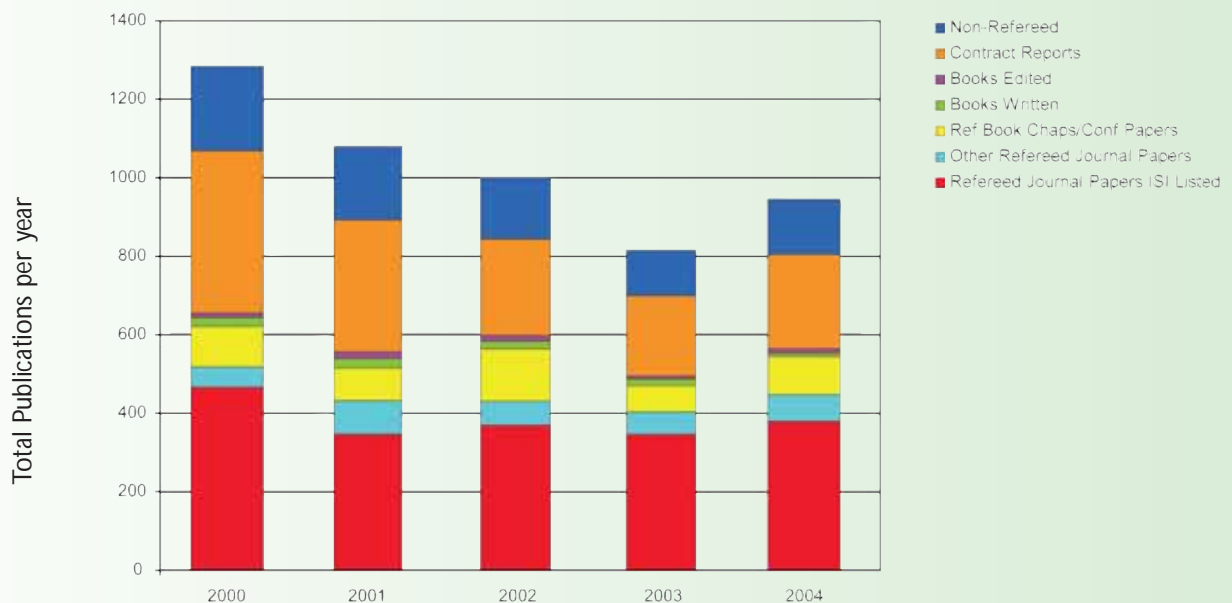
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# CEH STATISTICS

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*Biodiversity Biogeochemistry Climate Change Environmental Informatics Sustainable Economies Water*



For more information on how CEH works and what we do,  
visit CEH's web site at: [www.ceh.ac.uk](http://www.ceh.ac.uk)

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Cover Photograph taken by Dr Peter Carey, CEH Monks Wood. All  
other photographs courtesy of CEH staff (unless otherwise credited).

Edited by Mrs Sue Wallis. Designed and produced by Mrs Julie Gaunt,  
CEH Knowledge Management Team.

This report has been printed on Challenger Offset paper produced from  
sustainable forests. It is totally chlorine-free and recyclable. The inks are from  
the Alpha-eco range which is a new mineral-oil free ink based on vegetable oils.  
Printed by ISO 14001 supplier.

ISBN 1 870393 81 3  
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