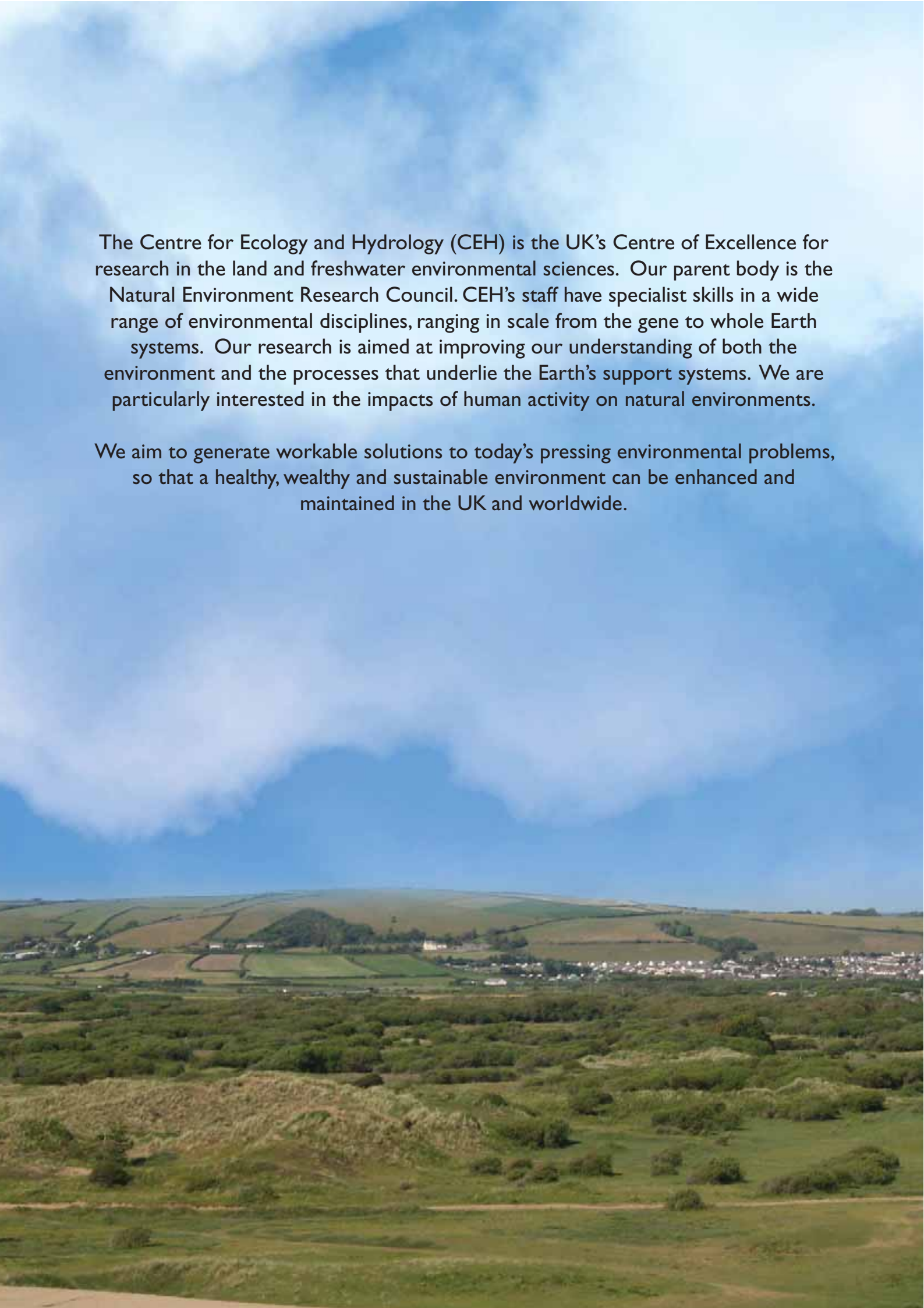

CEH
Centre for
Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL
2005-2006
Science Review



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 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.

Science Review 2005 - 2006

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

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Foreword from the Director, Professor Patricia Nuttall OBE

The year covered by this Report, 2005/06, has been the most significant since the Centre for Ecology & Hydrology (CEH) was formed. We have examined our activities and science portfolio and proposed a new business plan, to deliver a sustainable future for CEH. After detailed examination by our parent organisation the Natural Environment Research Council (NERC), including peer review and a public consultation, our plan was accepted in March 2006 with only slight modifications. Interest from public, media and stakeholders was very high throughout this period, reflecting the value placed by others on our work and expertise.

As I write, we are in the early stages of re-structuring the organisation, a process which will continue for the next four years. Science activities will be concentrated within four research sites; our Wallingford research site will become the headquarters site, providing a single point of contact for external enquiries. More information about the re-organisation is on page 3.

On the science front, CEH's work continues to be widely valued; our expertise is often called upon in times of emergency. For example, when the threat of 'bird 'flu' reaching Britain was causing alarm, we provided expert opinion and advice to Government from two of our researchers, internationally known for their work on avian diseases. CEH also provides scientific advice to Government consultations; this year topics included management of radioactive waste and drought planning measures. We are looking forward to the new NERC science strategy, which will provide opportunities for our expertise in areas such as climate change impacts and the sustainable use of natural resources. Examples of our scientific research and its relevance to real-world problems are provided in this Report, see page 8 onwards.

We continue to take an active part in scientific activities in Europe and beyond, see page 12 & 13. Our links have strengthened with the PEER network (Partnership for European Environmental Research), a network of seven environmental research institutes across Europe. CEH receives an increasing amount of research funding from the European Commission, we are looking forward to the start of the Seventh Framework programme.

This year brought recognition to some of the outstanding achievements of our researchers: Dr Stuart Dobson and Prof. Mike Hornung received OBE's for services to ecotoxicology and soil chemistry respectively; Prof. David Fowler received a CBE for services to atmospheric pollution and Prof. Bland Finlay became a Fellow of the Royal Society. Drs Jeremy Thomas, Peter Cox, Brian Reynolds and Sarah Wanless were all awarded Professorships at UK universities.

Finally, I should like to say a big thank you to all the staff in CEH and NERC who have worked so hard on the strategic review and business plan for the new CEH. The road to achieving approval of the plans has been long and sometimes rocky, but together we have produced a solution which will provide CEH with a sustainable long-term future. All of CEH's staff have had a difficult year dealing with uncertainty, I must thank everyone for their patience and understanding as we undergo radical change. Some staff will be leaving us in the near future, my good wishes go with them and thanks for their loyalty and commitment to CEH. For those who remain, we have a demanding and exciting future ahead, as we build the new-style Centre for Ecology and Hydrology.

Pat Nuttall

Our Aims

CEH has developed Vision and Mission statements to summarise the aims and objectives of our work

CEH's Vision Statement:

To be a world-class centre of excellence for integrated Earth system 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 provide the scientific underpinning for solutions to environmental issues arising from global change and the need for sustainable economies.
- To secure and manage environmental data and provide access to academia, governments, industry and the public.
- To provide the knowledge base for government policies addressing environmental issues.
- To enhance the UK's industrial competitiveness through knowledge and technology transfer.
- To exploit the Centre's expertise and facilities to enhance research training in the UK and capacity building overseas.
- To promote public awareness and understanding through communication of the Centre's activities.
- To achieve and maintain the standards of an Investors in People organisation.

Restructuring CEH

CEH now has approval for the new business plan and the implementation is beginning

CEH's Business Plan:

In last year's Annual Report, the Director mentioned the proposed restructuring of CEH. After extensive consultation, NERC Council approved the business plan in March 2006, and we are now starting on long-term processes to implement it.

CEH will have:

- Four research sites, at Wallingford, Lancaster, Edinburgh and Bangor.
- CEH's Director and infrastructure staff located together at Wallingford.
- Four major research programmes and two cross-cutting themes (see page 4).
- A headcount of approximately 440 staff.

The re-organisation will provide many benefits such as:

- Further integration of CEH science by drawing research teams together.
- New opportunities for collaborative initiatives with other research centres and universities.
- New, state-of-the-art lab facilities at Wallingford and Edinburgh.
- Centralised science, analytical chemistry and workshop services and facilities.
- Improved stakeholder liaison through a new Business Coordination Team.
- Reduced running costs and improved cost-efficient administrative processes.
- Longer term sustainability.
- Modernised office spaces and meeting facilities

In the coming year (2006-07) we shall be starting a four year change programme which will see us transferring key science staff, services and infrastructure to the four retained sites. Over the next few years four of our research sites (at Monks Wood, Banchory, Oxford and Winfrith in Dorset) will be closing; most of their research will be transferred to the retained sites.

CEH will continue to deliver high quality ecological and hydrological science throughout the period of change. The re-structuring will be managed to agreed standards by a project team, the Transition and Integration Unit.

Science Programmes

Our six programmes bring together multi-skilled teams to tackle complex problems

CEH's Science Programmes:

In 2005-06 CEH carried out its science within five science programmes: Biodiversity, Water, Biogeochemistry, Climate Change and Sustainable Economies. A sixth cross-cutting Environmental Informatics programme was established, devoted to interlinking knowledge resources within the organisation and managing our extensive data holdings. Research from each Programme is integrated with the five other CEH research areas allowing us to bring together multi-skilled teams to tackle complex problems.

The Biodiversity Programme, led by Prof Mark Bailey aims to understand all aspects of biological diversity, from the smallest microbes to the largest plants and animals. This includes how different species are distributed, how they interact and function with each other and with their habitat, and how they are threatened by local or global change.

The Water Programme, led by Prof Alan Jenkins provides scientific understanding of the processes that determine water flows and water quality. The work underpins the maintenance of healthy freshwaters for humans and natural habitats, reduction of flood risks and the sustainable management of catchments and water resources.

The Biogeochemistry Programme is led by Prof David Fowler. Biogeochemistry is the study of the processes and reactions that govern the composition of the natural environment. The Programme's objective is to identify the cause of changes in atmospheric composition, the ecological effects of pollutants and to identify cost-effective control measures.

The Environmental Informatics Programme is led by Dr Matthew Stiff, applying the techniques of information science to environmental data. Environmental Informatics employs these skills to work with CEH's data holdings, many of which are unique and are of national and international importance.

The Sustainable Economies Programme, led by Dr Dan Osborn provides strategic environmental science supporting the wise use of natural resources; and also supports government decision-making. Work focuses on: sustainable land use and management practices; sustainable energy production and use; and ecological and hydrological risks.

The Climate Change Programme, led by Prof Peter Cox is a multidisciplinary research area and harnesses CEH's expertise in biogeochemistry, water and biodiversity to tackle the key environmental issue of climate change.

Each Programme has a 'Core College' formed of its senior researchers, who discuss and determine the programme content and search out new links and collaborative work both inside and outside CEH.

Dr Dan Osborn and Prof Peter Cox will be leaving CEH during 2006, they have played key roles in building CEH's expertise in these important and highly topical themes; our thanks go with them. Climate Change and Sustainable Economies will become cross-cutting themes of the core science programmes.


Mark Bailey


Alan Jenkins


David Fowler


Matthew Stiff


Dan Osborn


Peter Cox

Top Science Achievements

Each year we identify the scientific achievements that best illustrate our expertise and also have a practical application. Here are this year's successes:

'Junk food' and seabird breeding failures

UK seabird colonies have had poor breeding success in recent years. As part of CEH's long-term seabird studies, we observed that common guillemots appeared to be bringing in plenty of food for their chicks. However, many of the chicks were dying, apparently of starvation.

We analysed the nutrient content of the fish brought in, mainly sand-eels and sprats, and found that the fish were small and had unexpectedly low fat levels. The chicks were getting an inadequate, very low fat, 'junk food' diet, and were unable to thrive. The low fat reserves in the fish indicate that they were starving too, the distribution and/or abundance of their plankton food source has changed, which may be due to climate change.

Impact: Besides affecting the seabird colonies, the North Sea fishery will be affected by the reduction in the fat and oil content of sand-eels – which reduces the value of the catch.

Sarah Wanless, Mike Harris, Francis Daunt & Morten Frederiksen, CEH Banchory. Contact: *swanl@ceh.ac.uk*

Can new UK agri-environment schemes benefit declining arable species?

The UK has recently replaced subsidies for intensive food production with agri-environment schemes, intended to protect and enhance biodiversity alongside less intensive farming.

Research into the effects of similar agri-environment schemes on biodiversity across Europe, (the EASY project), concluded that only widespread and mobile species benefited from the schemes. But recent monitoring carried out by CEH in the UK found that rare species of arable plants and bumblebees did indeed benefit from the new generation of agri-environment schemes. This success was because management plans were based on the latest knowledge of the preferences of these rare species, and targeted to their preferred areas. The use of local Project Officers to encourage uptake of the schemes by farmers also helped to achieve a higher rate of success.

Impact: We have shown the first evidence of the effectiveness of UK agri-environment scheme options for conserving rare bumblebees and arable plants.

Richard Pywell, Kevin Walker, Lucy Hulmes, Liz Warman, Sarah Hulmes, Peter Nuttall & J Owen Mountford, CEH Monks Wood. Contact: *rfp@ceh.ac.uk*

A protein derived from ticks may relieve human respiratory problems

Acute respiratory distress syndrome (ARDS) kills many people each year, but sadly conventional drugs can do little to alleviate the problem. We have discovered a histamine binding protein made by parasitic ticks; the protein was found to protect mice in a model of the ARDS disease. This discovery has been developed by the spin-out company Evolutec plc.

When ticks bite, they produce a variety of proteins that prevent certain processes in the host animal, such as inflammation. We have discovered the nature of the proteins produced by the tick and it is now possible to make synthetic copies in the laboratory which have the same effects. Synthetic protein production can be scaled up to provide enough material for clinical trials.

Impact: This is the first demonstration of a tick protein that can modulate an immune response (an 'immunomodulator') and may be useful for treatment of the human disease ARDS - for which there is currently no available effective therapy.

Guido Paesen, CEH Oxford.
Contact: *gcp@ceh.ac.uk*

A new pathogen affecting fish biodiversity across Europe

We have recently discovered the presence of an exotic disease agent, which could cause potentially catastrophic effects on fish biodiversity in Europe. The sunbleak fish (*Leucaspius delineatus*) is declining and becoming endangered. The fish's decline appears to be linked to the spread of topmouth gudgeon (*Pseudorasbora parva*) which originated from China during the 1960s. Topmouth gudgeon are apparently healthy carriers for a pathogen which causes a chronic disease preventing the spawning of wild fish (such as the sunbleak) and eventually kills them. The pathogen, known as 'rosette-like agent' (RLA) is similar if not identical to the "rosette agent" *Sphaerothecum destruens* affecting North American salmon. The presence of RLA in England poses a big risk to our native fish.

Impact: There is real potential for the pathogen to spread as alien fish species colonise European rivers. Damage to commercial fish-farming and angling sports is also likely.

Rodolphe Gozlan, Sophie St-Hilaire, Stephen Feist, Paul Martin & Michael Kent, CEH Dorset. Contact: *reg@ceh.ac.uk*

Rosette–like agent in sunbleak fish

Science In Action

Our science is applied in many different ways, here are two of the most important:

Science that informs policy:

Managing Dorset's heaths

The Dorset heathlands are one of the largest remaining groups of heaths in England. Many of the heaths have international and national conservation protection, they support a large number of specialised plant and animal species only found here. The 2005 Dorset Heathland Survey was carried out by 6 surveyors between May and August. A total of 4,500 recording units, covering a total land area of 18,000 ha were surveyed in detail, recording heathland and other vegetation types, heathland management, rare heathland species, invasive species, heather age and damaging activities such as fly-tipping.

The data from this survey will be compared with information from the previous three surveys; analysis will enable us to assess recent rates of heathland vegetation change. It will also enable us to predict how future vegetation may change resulting from a range of different management techniques and intensities.

Impact: Our results will be used as an indicator of the effectiveness of recent heathland management projects. It will also provide guidance for future management plans for lowland heathland both in Dorset and throughout the UK.

Robert Rose, Caroline Boffey, Kathy Hodder & Ibby Moy, CEH Dorset. Contact: *rjr@ceh.ac.uk*

Identifying releases and removals of greenhouse gases in the UK

CEH provides annual estimates of changes in stocks of carbon in forests and soils within the UK to Defra (Dept. for Environment Food & Rural Affairs) each year. These figures are included in the United Nations Framework Convention on Climate Change (UNFCCC) Greenhouse Gas Inventory. This year, 2005/6, the data have been incorporated directly into the internationally agreed Common Reporting Format database system. We are currently working towards producing estimates on a 20km grid scale, so that we can map variations in annual carbon stock changes right across the UK.

These will be fundamental in providing information relevant to the UK in achieving its Kyoto Protocol emission target.

Impact: As a result of our work, the UK is a international leader in the field of producing Greenhouse Gas Inventory data for the Land use, Land Use Change and Forestry sectors and fully meets requirements for reporting to the UNFCCC.

Amanda Thomson & Deena Mobbs, CEH Edinburgh. Contact: *amath@ceh.ac.uk*

Science in business:

How can we estimate toxic metals in soils?

Soil organisms are essential for a healthy productive soil, but they can be seriously affected by metals in the soil. The degree of damage varies according to the chemical properties of the soil, such as its acidity (pH) and organic matter content. Previously we have applied this knowledge to four metals in soils: copper, zinc, cadmium and lead.

We can predict the threshold concentration of each metal, above which the toxic effects would be unacceptable.

We have now extended this work so that the toxic effect of any metal concentration in a certain soil can be estimated. We can also estimate which of the metals might be having the biggest toxic effect when they are present together, and what the combined effects of a mixture of metals would be. We have shown that the toxic effect estimated in this way is related to the numbers of an important group of soil invertebrates (nematode worms) found in the soils.

Impact: An effective and reliable method has been developed that can be used to assess the risks of potentially toxic metals in soils.

Steven Lofts, CEH Lancaster.
Contact: *stlo@ceh.ac.uk*

Isolation of a therapeutic protein from the horse fly

When an insect such as a horse fly bites its target to obtain a blood meal, a range of proteins are used by the fly to ensure that the interaction is successful.

One of these proteins has been isolated (by isolating the gene encoding the protein) and we have been able to synthesise large amounts of the protein artificially. Analysis of the product showed that it is a 'Kazal' type protein, affecting the dilation or constriction of blood vessels. When produced by the fly, it acts to increase blood supply to the feeding site and ensure that the meal of blood is taken rapidly.

Impact: This protein has potential for use in human medicine and is currently in the development pipeline with the NERC spin out company, Evolutec. It is about to enter pre-clinical development and testing.

Miles Nunn,
CEH Oxford.
Contact:
amn@ceh.ac.uk

Photographer: Joe Pase, Texas Forest Service

Collaborating with Others

Using multi-skilled teams to achieve far-reaching results

Much of our research is carried out by multi-skilled teams, drawn from within the UK or from Europe or worldwide.

Knowledge transfer: A Genetic Diversity Workshop on Trees

Results from a series of international collaborative projects, co-ordinated by CEH Edinburgh, were made available to policy makers, researchers and others at an open forum in Costa Rica. The Workshop featured presentations of studies carried out over the past five years by researchers from the UK (CEH), France, Brazil, Costa Rica and Belgium and included detailed new information on threatened tree species, on potential new commercial applications for tree species and a question & answer session.

The Workshop was attended by members of the Costa Rican government's Biodiversity Commission, the body responsible for controlling conservation, exploitation and access to the country's biodiversity. As one of the most biodiverse regions in the world and a leading light in biodiversity conservation, Costa Rica has a large global influence on progress in biodiversity conservation. The Biodiversity Commission intend to apply the project's findings in biodiversity conservation.

Impact: We have contributed significantly to biodiversity conservation and sustainability policy in Costa Rica and directly communicated scientific results.

Andrew Lowe, Stephen Cavers, Sam Davies, Katherine Walker & Robert Munro, CEH Edinburgh. Contact: *scav@ceh.ac.uk*

New ways of assessing the national flood risk

We have developed a new method to tackle the problem of assessing flood risk.

This prototype method is based on a 1 km gridded hydrological and routing model (Grid-to-Grid) and information on river networks, derived from a digital terrain model. The new model is driven using outputs from a regional climate model, making possible the assessment of both current and future flooding.

The work has been done within the Joint Centre for Hydro-Meteorological Research (which incorporates both Met. Office and CEH staff), using some science budget funding and a contract with the Hadley Centre.

Impact: The work represents a major advance in the national assessment of flooding in the UK.

Vicky Bell, Alison Kay, Simon Dadson, Helen Davies & Nick Reynard, CEH Wallingford. Contact: *vib@ceh.ac.uk*

Photographer: Paul Glendell, Natural England

How will atmospheric pollution affect future plant diversity?

Since the 1980's sulphur emissions have been greatly reduced, but nitrogen pollution is a continuing problem, giving vegetation an 'overload' of nutrients and slowing its recovery from acidity. Two of CEH's major projects, Countryside Survey and the Plant Atlas, have confirmed these impacts on UK vegetation. We are losing low-growing and shade-intolerant plants that normally live in nutrient-poor environments. The Countryside Survey also combines plant species data with soils data at the same location and same time.

Our analyses have enabled us to set up robust models showing which species are likely to occur at a given combination of soil acidity, moisture, nitrogen status and shading. Further work, with Dutch, Swedish and German groups has allowed us to improve the accuracy of predictions of which plant species will occur under reductions of pollution and the resulting soil changes. We are working towards use of such dynamic modelling approaches to set emissions targets within the UN's Convention on Long-range Transboundary Air Pollution.

Impact: Forecasting the impacts on plant diversity of atmospheric pollution is providing a better scientific basis for achieving international agreements to limit pollutant emissions.

Chris Evans, Simon Smart, CEH Lancaster; Ed Rowe & Bridget Emmett, CEH Bangor.
Contact: *cev@ceh.ac.uk*

Ozone Damaged Plants

Setting water quality targets for European freshwaters

The European Commission's Water Framework Directive requires new water quality targets to be set for phosphorous and chlorophyll levels. In order to do this we collated data from more than 500 undisturbed European lakes, working with European collaborators. These data were then used to develop models for predicting water quality targets at impacted or disturbed sites. The policy implications of the uncertainty in phosphorus-chlorophyll relationships were also highlighted

Impact: This work is central for setting new water quality targets for European freshwaters, the levels of which will have major implications for the water industry and agriculture in Europe.

Laurence Carvalho, Bernard Dudley, CEH Edinburgh.
Contact: *laca@ceh.ac.uk*

Working in Europe

CEH is increasingly working in collaboration with scientific institutions across Europe

Completion and delivery of the STAR project and its 18 project deliverables

The European Union's Framework 5 project STAR (STAndardization of River classifications) was co-ordinated by CEH and involved collaboration between 22 partners from 14 countries. The aim was to support the implementation of the Water Framework Directive and to answer some specific scientific questions. 263 sites were sampled in 11 countries for attached algae, larger water plants, larger invertebrates and fish. The physical form and shape of the river and riverbed were also recorded.

Project outputs included recommendations for use of specific plant and animal groups to detect the impact of particular stresses in particular stream types and regions. The recommendations were integrated into a decision support system. National sampling protocols were compared and new protocols developed to enable standardised assessment of the ecological status of rivers in different countries. Free-to-download databases and software were developed for calculation of biological measurements and the allocation of classes of quality for waterbodies.

Impact: The project findings and outputs (such as software tools) are being used to develop three new European standards for the biological assessment of rivers. The project has resulted in one book and numerous papers for refereed publication.

Mike Furse, Ralph Clarke, John Davy-Bowker, CEH Dorset, & 22 collaborators. Contact: *mtf@ceh.ac.uk*

How can we measure the emissions of 'solvent' molecules from a city?

Gases such as methanol and acetone are found in vehicle exhausts and are also given off in industrial processes. For the first time, we have directly measured the emissions and deposition of these gases above a city.

As part of an international project, we used a new 'proton-transfer mass spectrometer' to measure gas concentrations in upward and downward moving eddies of air from the top of a high building in Gothenburg, Sweden. This allowed us to map out areas of the city where emissions were highest - which corresponded to major roads and industrial areas. The new instrument allows us to measure not just the concentrations of trace gases in the atmosphere, but also the magnitude and direction of their fluxes.

Impact: It is now possible to directly measure or map the emissions and deposition of trace gases to complex source or sink areas, and greatly improve on previous methods and models. The information could be used in local air quality planning and policy.

Eiko Nemitz, Emily House & Neil Cape, CEH Edinburgh. Contact: *en@ceh.ac.uk*

Photographer: Peter Wakely, Natural England

Working Worldwide

Many staff are involved in projects in developing countries, safe-guarding natural resources or enabling their sustainable use

How will climate change affect water flows in glacier-fed rivers?

Many millions of people worldwide rely on meltwater from the world's mountain glaciers, so climatic warming has potentially serious consequences. There is particular concern at the present rate of glacier loss in the Himalayas. It has been suggested that Himalayan glaciers could vanish within 40 years, leading to drastic reductions in river flow and widespread water shortages for the inhabitants of the Indus, Ganges and Brahmaputra basins.

To investigate this situation, CEH has developed a new hydro-glaciological model capable of estimating how climatic warming might affect the retreat of Himalayan glaciers and river flows, across the region. This is a significant departure from the traditional approach of fine-tuning models for individual glaciers in a single, specific catchment. Results from the new CEH model have received wide exposure in the region, and are changing the way people, politicians and scientists, think about glacier shrinkage and river flows. Such forecasting is of immense importance for livelihoods all over the world as mountain glaciers continue to retreat.

Photograph: www.photo.antarcica.ac.uk

Impact: This work has widespread implications; not only in Asia. Interested prime ministers and the World Bank have requested details of the work, which has also been followed globally by the media.

Gwyn Rees, CEH Wallingford.
Contact: *hgrees@ceh.ac.uk*

Population genetics of tropical trees

The vast tropical rain forests of Central and Southern America contain a huge diversity of tree species. Such diversity means that species are often present in low numbers in any one place. To cope with this, tropical trees have evolved a wide range of ways to reproduce and disperse their seed and pollen.

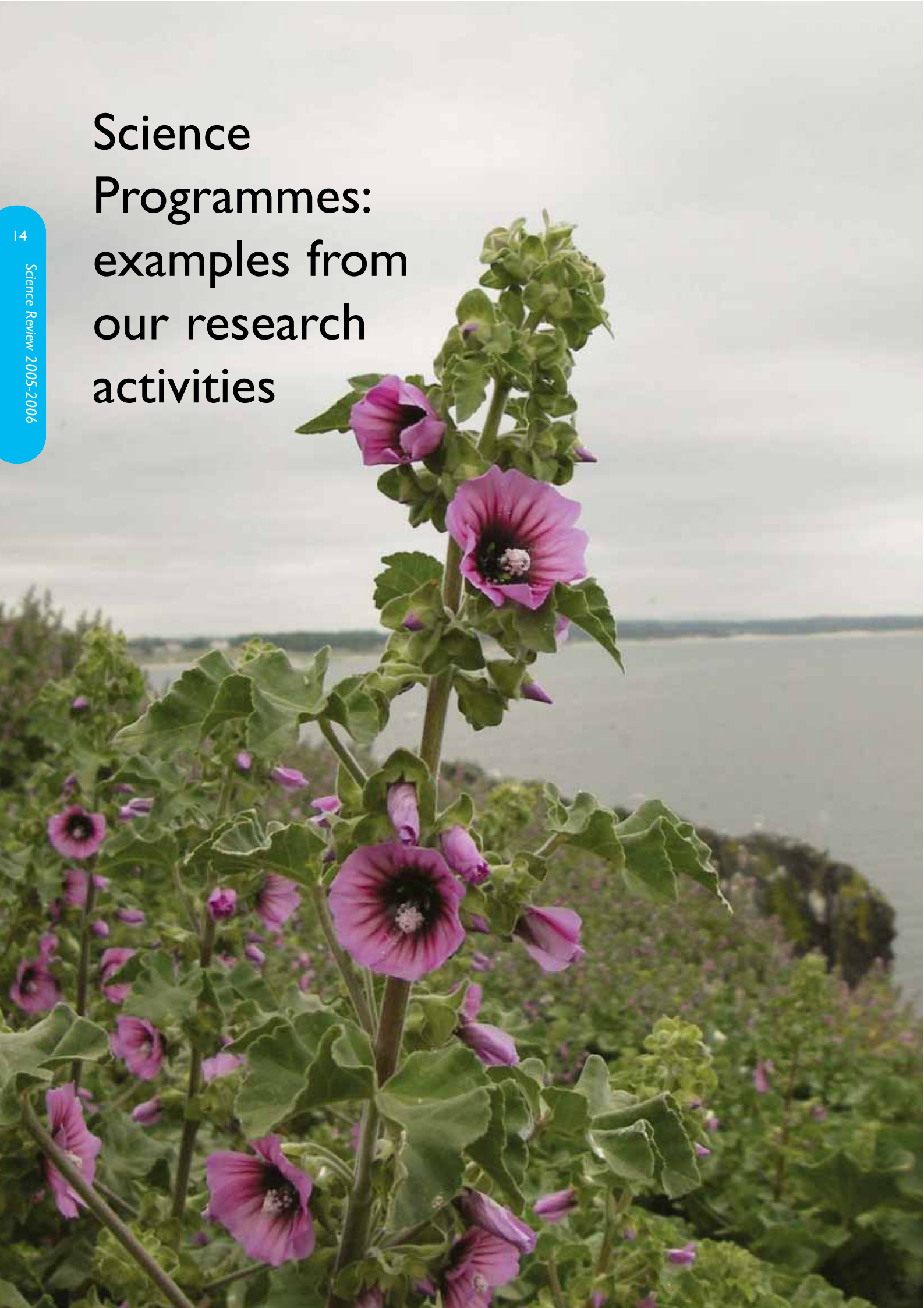
DNA 'fingerprinting' of individual trees has allowed us to establish which trees are related to each other, also to detect the dispersal processes and the patterns of genetic diversity that they produce vital knowledge for ensuring sustainable use of the forests. With our collaborators, we have published a special collection of seven scientific papers focussed on the population genetics of tropical and subtropical trees in the Americas.

Results have been obtained from a series of projects co-ordinated by CEH and funded by the European Commission.

Impact: We have provided new understanding of genetic diversity in tropical forest trees and new methods for analysing this diversity, our findings are now available to the wider scientific community.

Andrew Lowe, Stephen Cavers, Sam Davies & Robert Munro, CEH Edinburgh.
Contact: *scav@ceh.ac.uk*

Science Programmes: examples from our research activities



Biodiversity

"The variety and abundance of species, their genetic composition and the natural communities, ecosystems and landscapes in which they occur."

Some examples of CEH's work on Biodiversity:

How do grazing animals affect bird egg sizes?

Livestock grazing can have major effects on natural ecosystems, and has been linked with significant decreases in various bird populations, worldwide. In Britain, there is particular concern that grazing pressure is seriously affecting vegetation and birds in upland regions – but the mechanism by which grazing affects birds is unclear.

We investigated the relationship between sheep stocking density and the reproductive success of a common upland bird, the meadow pipit. Using experimental plots with different sheep stocking densities, we found that plots with the highest number of sheep contained nests with the smallest eggs. The plots with lowest number of sheep contained nests with the largest eggs. We found no significant effect on fledging success, but our studies indicate that egg size may affect chick survival (as seen in other studies). This could partly explain declines in upland birds.

Impact: We have demonstrated for the first time that sheep grazing pressure affects the egg size of a common upland bird, giving a partial explanation for the observed link between increased grazing pressure and declines in grassland birds in both North America and Europe.

Darren Evans, Stephen Redpath, Sharon Evans, David Elston, CEH Banchory; Peter Dennis and David Elston.
Contact: *smre@ceh.ac.uk*

How ants and seeds benefit one another

Some plant seeds have nutrient rich attachments (called elaiosomes) which attract certain ants to carry away the seeds. The ants eat the elaiosome and disperse the seed, so both ants and the seed benefit. The benefits to plants of dispersal of their seeds in this way have been well documented, but we wished to investigate the benefits to the ants, using a red ant and seeds of gorse plants.

We found that ant colonies fed with elaiosomes produced twice as many larvae as those fed with a standard diet, and these larvae were 1.5 times heavier than in the standard group. Chemical analysis of gorse-seed elaiosomes showed the presence of a number of fatty acids and sterols which are essential for ants.

Impact: This study has shown for the first time that there are important benefits to ants from carrying seeds and confirmed that this benefits both ants and the seed-bearing plant.

James Bullock, Nicola Gammans & Karsten Schönrogge, CEH Dorset.
Contact: *jmbull@ceh.ac.uk*

Predicting virus competition within a host

Rapid response methods were developed to measure the growth of viruses that infect insects (baculoviruses). These methods were then used to measure the growth of five different viruses in *Spodoptera exigua*, a pest species of moth known as Beet Armyworm. This host species has been shown to be free from persistent virus infections.

Photograph: Public Library of Science

The growth of the viruses was measured, from inoculation until the death of the host, and the growth of the host was measured at the same time. This is the first time that the dynamics of baculovirus growth within-the-host and its effect on host growth has been measured.

The data that we obtained was used to devise a predictive model of baculovirus growth, which links (for the first time) virus growth and host growth. The model was used to make predictions about virus competition in mixed infections, which can now be tested by further experiments.

Impact: This work provides a powerful new tool for predicting how viruses may compete within a host.

Rosie Hails, John Burden, CEH Oxford. Contact: *rha@ceh.ac.uk*

Invasion, Invasion! – the spread of the Harlequin Ladybird

The Harlequin ladybird (*Harmonia axyridis*), see photograph, is a native of eastern Asia. It was first found in England in summer 2004, having arrived from continental Europe where it had been introduced for biological pest control in 1982. This ladybird is a voracious predator and it is expected to become the commonest ladybird here, as it now is in North America. It is predicted to have serious effects on populations of native ladybirds and other aphid-feeding insects. With support from the National Biodiversity Network and Defra (Dept. for Environment, Food & Rural Affairs), we monitored the spread of the species during its first year-and-a-half since discovery, relying on nationwide publicity and the many specimens photographed or sent in by individuals. Already, the Harlequin ladybird has occupied 167 x 10km squares across 28 counties of England, with large concentrations in many parts of London and Derby.

Impact: This is a very rare opportunity to observe a biological invasion at its earliest stages.

David Roy, Peter Brown, Francis Rowland, CEH Monks Wood, and others. Contact: *dbr@ceh.ac.uk*

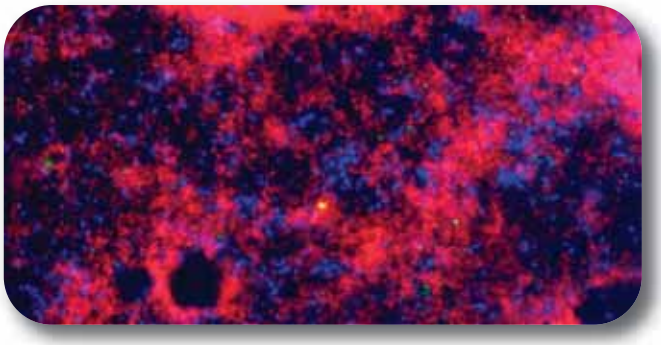
Sequencing the genome of a microbe – a first for CEH

Sequencing the genome of humans has provided us with the "book of life", the genetic blueprint of what humans are and how we evolve. Similarly, genome sequencing can be performed on any other organism, a good candidate being bacteria, since their genomes are relatively small (about 3,000 genes). These organisms, despite having a small number of genes, are the most versatile of life-forms on the planet and contribute significantly to our existence. We are sequencing the first bacterial genome in CEH to see how this organism (*Thauera* sp. CEH) performs its functions - it degrades a wide range of toxic chemicals.

We are also investigating how we may harness its genetic potential to adapt in the future to improve environmental clean-up.

Impact: This is the first microbial genome for CEH. We hope our investigations will show how we can use this information to optimise the organism's natural pollutant breakdown abilities.

Andrew Whiteley, Dawn Field, CEH Oxford. Contact: *aswhi@ceh.ac.uk*



Microbial communities hybridised with species-specific stains, highlighting 3 main species populations

How many alien species are there in England?

The UK Biological Records Centre at CEH Monks Wood has led a project to count or audit all non-native species found in England, including its coastal waters. In total, 2721 species were listed, of which 1798 were vascular plants, which live on land and in freshwaters. By contrast, the most numerous marine group was the red algae *Rhodophyceae*, with 12 species. On land, the most numerous animal groups were bugs and aphids (102 species), beetles (101 species), butterflies and moths (48 species), and non-marine molluscs (43 species).

Himalayan Balsam

The major route of introduction for marine organisms, animals and microbes is accidental transport. Land and freshwater plants, on the other hand, are mostly escapes from cultivation and the horticultural trade. Introduced freshwater and land animals occupy a wide variety of habitats, especially surface waters, woodland, and cultivated land. Non-native plants are concentrated on cultivated, built and derelict land.

Impact: This project has allowed the first overview of the non-native fauna and flora of England and will provide a baseline for future work on 'introductions'.

Mark Hill, Gavin Broad, Cassie Hoyland, Chris Preston, CEH Monks Wood & many others. Contact: *moh@ceh.ac.uk*

Water

"Water flows, water quality and water resources".

Our scientific studies assist the sustainable management of catchments, providing water supplies for business, industry and homes.

Mapping mixtures of endocrine disrupting chemicals in UK catchments

Building on our earlier achievement, which looked at the effects of single steroid oestrogens (female hormones) in river systems, we have now made further progress. A water quality model (GREAT-ER) was used to generate predictions of exposure to four endocrine disrupters (nonylphenol, oestradiol, oestrone and ethinyl-oestradiol). These are substances that stop the production or block transmission of hormones in the body and often interfere with development.

Laboratory studies were available showing the effect of the four chemicals on male fathead minnows at a range of chemical combinations.

Assuming that the effects of these chemicals was additive, we calculated and plotted the likely effects of the individual chemicals and the mixture of chemicals predicted by the model. We clearly demonstrated that if the additive effects of these chemicals were excluded, we would underestimate the risk in a significant percentage of the river network.

Impact: We demonstrated to the Environment Agency the importance of considering mixtures in risk assessments and the usefulness of this catchment scale approach.

Richard Williams, Andrew Johnson, CEH Wallingford.
Contact: *rjw@ceh.ac.uk*

What makes an extreme storm an extreme flood?

A new analysis and modelling framework has been developed to investigate how an extreme flood is shaped from storms of differing kinds and in catchments of varying form.

A 'rainfall transformation tool' is applied to historical storm data, so that we could study what happened if their speed, size, shape and direction of movement was changed. In this way we could 'create' artificial storms of greater frequency. A distributed grid-based hydrological model allowed us to analyse the flood response to storm rainfall, at all locations within a catchment and in catchments of different forms.

Animated images of storm rainfall and modelled flood flows provide insight into the formation of the flood according to the catchment's form and the storm's position. A map of the flood peak revealed its growth or dissipation down a river channel depending on storm position within the catchment.

Impact: We have gained a better understanding of the creation of extreme floods, through improved modelling of storm and catchment controls.

Bob Moore, Steven Cole, Vicky Bell & David Jones, CEH Wallingford.
rm@ceh.ac.uk

New national system for river flood frequency quantification

A new methodology has been developed for countrywide estimation of flood risk. This will tell us how often we can expect river floods of specific sizes. The approach, called 'continuous simulation', applies models of the response of catchments to rainfall to create long series of river flows for further analysis. The major challenge in the new work has been to extend the benefits of flow prediction to any site in Britain, with or without river flow observations.

Photograph: Paul Glendell, Natural England

Where river flow observations are available, new automatic procedures were developed for fixing the parameters of the rainfall-runoff models to match the behaviour of a river's flow response. New methods of 'spatial generalisation' were explored: these allow ungauged catchments (those without flow observations) to be treated too.

We have now developed an improved, integrated methodology for ungauged catchments, including uncertainty bounds for the results concerning how often flooding might occur.

Impact: Next-generation UK flood risk management methodology has been successfully developed.

Ann Calver, Sue Crooks, David Jones, Alison Kay, Thomas Kjeldsen & Nick Reynard, CEH Wallingford.
Contact: *anc@ceh.ac.uk*

How 'healthy' are Scotland's standing waters?

In 2004 CEH's Scottish Freshwater Ecosystems research team were commissioned by Scottish Natural Heritage to survey over 200 standing waters of conservation interest in Scotland. The survey used larger water-plants (aquatic macrophytes) to reliably assess and monitor the environmental condition of the waters. The surveys were based on methods and guidance produced by CEH. In 2005 all the site condition reports (over 200 individual reports) arising from this extensive fieldwork campaign were completed successfully to the customer's satisfaction. These reports formed the basis for assigning condition categories to all the surveyed Scottish designated standing water sites and will provide the benchmark for future comparisons.

The data and methods we developed are now being utilised in the development of classification tools under the Water Framework Directive. The new methods have the potential to be used to help assess biodiversity trends in European lakes.

Impact: This project led to CEH having a major influence on the re-drafting of the Joint Nature Conservation Committee's 'Common Standards Monitoring Guidance', which now informs all future site condition monitoring in UK standing waters.

Iain Gunn, CEH Edinburgh.
Contact: *idmg@ceh.ac.uk*

Biogeochemistry

"The study of the processes and reactions that govern the composition of the natural environment."

These scientific processes may be chemical, physical, geological or biological.

How much ammonia is deposited on natural vegetation?

Ammonia from intensive agricultural activity (e.g. chicken or pig houses) is deposited on surrounding vegetation and can have direct toxic effects. Further away from the sources, more subtle effects are seen - as changes in types of vegetation over time which leads to loss of biodiversity. Until recently, it has not been possible to compare these types of field studies directly with laboratory experiments, because of the difficulty in estimating how much ammonia is taken up by vegetation, especially at high concentrations.

We have run experiments in open-top chambers under controlled fumigation conditions. The results showed that the rate at which ammonia is taken up by plants decreases as the concentration increases. These findings have been used in a major field experiment which simulates ammonia deposition from an agricultural source to surrounding natural vegetation. The effects observed in the field were more closely related to the concentrations of ammonia in the air than to the deposition of the gas on vegetation as accumulated nitrogen.

Impacts: Our findings have implications for the way in which we understand the long-term impacts of agricultural air pollution on natural ecosystems.

Ian Leith, Lucy Sheppard, Mat Jones & Neil Cape, CEH Edinburgh. Contact: *idl@ceh.ac.uk*

A new method to identify acid rivers in the UK

CEH (with funding support from the Environment Agency) has recently developed a new 'biotic index' for assessing the impact of acidity on streams and rivers in England and Wales. Called the Acid Waters Indicator Community index (AWIC), it reveals the biological impact of acidity by allocating scores to individual invertebrate families, based on their tolerance to acidity (pH).

AWIC uses a novel approach, using a statistical package to separate out other physical variables, so that the relationship between invertebrate communities and pH can be clearly identified. AWIC is more effective at identifying sites with differing pH, if compared against an existing biotic index derived by another method.

Impact: This method joins a growing number of tests based on freshwater animals that can help identify the causes of poor river water quality. Once the causes are known, an appropriate remediation plan for the river can be developed.

John Davy-Bowker, John Murphy, CEH Dorset. Contact: *jobo@ceh.ac.uk*

Photograph: Peter Wakely, Natural England

Where does most carbon come from in peatland?

Peatlands are large reservoirs of carbon. Biogeochemical hot spots within peatlands are of particular importance, as they may show accelerated gaseous exchanges of carbon dioxide (CO_2) and methane (CH_4) from the peat soil to the atmosphere. This may occur either for short periods (e.g. flooding events) or for long periods (e.g. gullies, streams, standing water zone).

During the summer of 2005, weekly chamber gas measurements of CO_2 and CH_4 were made at Moor House National Nature Reserve, Upper Teesdale. The measurements recorded gas emissions of CO_2 and CH_4 both in erosion gullies and in the adjacent dominant *Calluna* heather landscape. Within these gullies two types of vegetation were characteristic; *Eriophorum* (cotton-grass) and *Sphagnum* (peat moss). Most significantly, CH_4 emissions from *Eriophorum* plants in the gullies were an amazing 136 times greater than that of the *Calluna* landscape, which was a small source of CH_4. *Eriophorum* species are among a unique group of plants that have a straw-like internal architecture, they are capable of channelling CH_4 produced below the peat's surface to the atmosphere.

Impact: The carbon source and sink functions of a system can be critically influenced by the natural variety or heterogeneity of the landscape.

Eiko Nemitz, Gavin Phillips & Rick Thomas, CEH Edinburgh. Contact: *en@ceh.ac.uk*

Measuring aerosol fluxes above urban areas

A novel flux measurement system was used to measure, for the first time, emission and deposition of individual components of aerosols (such as nitrate, sulphate, organic aerosol), above urban areas of Gothenburg, Sweden, and Edinburgh, U.K.

The measurements reveal that urban areas are strong sources of organic aerosol and, more surprisingly, aerosol nitrate. We also noted some indication of upward fluxes of processed organic aerosol within the urban area. Both observations indicate that chemical processing of urban aerosol is fast, even in winter time. Sulphate is found to be continuously deposited, so the measurement approach has enabled the first direct measurement of deposition rates of aerosol to urban areas.

Impact: The measurements improve our understanding of sources and processing of urban aerosol. The information will help to refine abatement strategies to reduce urban particle pollution.

Niall McNamara, Nick Ostle, CEH Lancaster. Contact: *nmcn@ceh.ac.uk*

Climate Change

"Key environmental issue of climate change and its impacts."

CEH harnesses its expertise in biogeochemistry, water and biodiversity to tackle climate change.

How might atmospheric circulation affect Siberian forest fires?

Our team carried out a study of the total area of forest burnt in central Siberia using data from satellites. We studied this area over a period of time and the variability in this area between individual years (interannuality). The variability was shown to be related to the Arctic Oscillation. The Oscillation is a pattern of atmospheric circulation where the atmospheric pressure over the polar regions varies in opposition with that over middle latitudes (about 45 degrees North), on time scales ranging from weeks to decades. Our study may indicate that there is a feedback mechanism between the extent of Siberian fires in any one year and the state of the climate system.

John H. Ghent, USDA Forest Service, www.forestryimages.org

Impact: Our work contributes to a better understanding of Earth system processes.

Heiko Balzter, France Gerard, Tim Jupp, Charles George & Clare Rowland, CEH Monks Wood. Contact: *ffg@ceh.ac.uk*

Can soil microbes cope with increasing carbon dioxide?

We conducted novel research into the effects of increased carbon dioxide (CO_2) on trees, in collaboration with the Lancaster Environment Centre. Key findings showed that carbon dioxide enrichment caused increased short-term growth in a range of European tree species. But we also found that increased CO_2 led to an increase in soil microbial respiration and a marked decline in the chemical binding or 'sequestration' of root-derived carbon in the soil.

This finding has important implications for the role of forests to act as carbon sinks — dealing with the continuing increase in atmospheric carbon dioxide concentration and associated climate change. Our results indicate that, if similar processes operate in forest ecosystems (which include soils), the size of the annual terrestrial carbon sink may be substantially reduced. This would result in a surge in the rate of increase in atmospheric carbon dioxide concentration.

Impact: We found unexpected impacts of increased CO_2 enrichment and their relationship to carbon sinks.

Helaina Black, Nisha Parekh, CEH Lancaster. Contact: *nisha@ceh.ac.uk*

Photograph: Peter Wakely, Natural England

How much organic carbon might there be in watercourses in future climates?

We have been able to model the amount of dissolved organic carbon (DOC) in rivers that drain peaty catchments in Sweden, Ireland and the UK, using a two-phase process of peat decomposition and washout. Decomposition is modelled as a function of soil moisture and temperature; and washout occurs via near-surface or sub-surface flow pathways.

We have investigated future DOC levels using a range of possible future climate scenarios. A sequence of wet and dry years has a fundamental influence on the level of DOC in stream flows. In some catchments significant increases were predicted throughout the year, whilst in others a distinct 'autumn flush' is enhanced. In northern Europe the loss of the snowmelt results in a significant change in the timing as well as the amounts of dissolved organic carbon entering rivers and lakes.

Impact: The work highlights potential issues for the costs of water treatment, requirement for new capital works and changes in lake ecology.

Pam Naden, CEH Wallingford. Contact: *psn@ceh.ac.uk*

Designing and implementing the AMMA network of measurements in W. Africa

The African Monsoon Multidisciplinary Analyses (AMMA) project is an international project to improve our knowledge and understanding of the West African monsoon and its variability. AMMA is motivated by an interest in fundamental scientific issues and by society's need for improved prediction of the monsoon and its impacts on West African nations.

A number of national and pan-national projects have been set up.

The scientific aims include:

- improving our understanding of the monsoon.
- providing the underpinning science relating climate vulnerability to issues of water resources, health and food security
- ensuring that the research is integrated with prediction and decision making activities.

CEH have implemented a network of flux and meteorological measurements across West Africa and now have 12 recording sites in five countries. This network will form a backbone of measurements to support the national and international AMMA activities

Impact: The network facilities will be used by AMMA partners, both nationally and internationally.

Chris Taylor, Colin Lloyd, CEH Wallingford. Contact: *cmt@ceh.ac.uk*

Sustainable Economies

"Strategic environmental science."

This programme supports national decision-making and the wise use of natural resources by people, industry, and governments.

Long-term ecological change in British woodland and woodland soils (1971-2001)

The countryside has changed dramatically over the last 50 years in response to changing woodland management, general land-use practices and impacts such as air pollution and climate change. The effects of these changes on the richness and structure of our woodland have not always been apparent because they may be gradual or slow to show. Wildlife Agencies and Defra (Department for Environment, Food and Rural Affairs) need to know how environmental pressures are affecting woodland biodiversity and what the future trends are likely to be.

Our work described the results of a re-survey of 103 woods across Britain that were first looked at in 1971. Vegetation data show that nutrient overload (or eutrophication) is now a significant pressure on British woodlands. The 30-year repeat survey of woodland soils clearly shows the recovery of soils from acid rain. We have produced unique survey results and data which will help in the future management of Britain's woods. The work was funded by a consortium of funding bodies.

Impact: A stakeholder said: "This is exactly the sort of robust evidence we need, but seldom have, to underpin policy & delivery. And it was ideally timed to inform the development of the England Ancient & Native Woodland Policy—a rare occurrence."

Simon Smart, Helaina Black, CEH Lancaster. Contact: *ssma@ceh.ac.uk*

Photograph: Paul Glendell, Natural England

A possible way of reducing stress in artificially reared fish

Fish reared by aquaculture are now selectively bred to improve economically important traits such as fertility and growth rate.

But because aquacultured fish are not domesticated, in an intensive rearing environment the exposure of fish to stressful events is unavoidable. Would it be possible to breed selectively for a reduced response to stress?

In order to do this, we need a better understanding of the genetic basis of the stress response. A purpose-designed microarray platform, developed by the Stressgenes consortium (in which CEH is a participant) was used to investigate the changes in gene expression within the liver of rainbow trout when exposed to a chronic stressor. Results indicate that while the primary role of the liver during stress may be linked with the provision of energy, this role is not reflected in the patterns of gene expression. Instead, the response seems to be associated with non-specific defence. This is the first evidence that the acute phase response plays an important role in fish exposed to a non-invasive stressor.

Impact: Our work may help towards selective breeding of fish better suited to commercial rearing.

Tom Pottinger, CEH Lancaster. Contact: *tgp@ceh.ac.uk*

Water quality: Discovery of natural female hormones derived from UK farms

We wished to investigate the amounts of female hormones or oestrogens entering headwater streams in livestock rearing areas of England and Wales.

Using a novel type of passive membrane sampler, water samples were taken on 10 farms in livestock rearing areas in the winter of 2004/05 and tested for steroid hormones and oestrogenic activity. We found that most streams contained measurable amounts of oestrogens, mainly consisting of natural hormones excreted by dairy cattle but in some cases possibly derived from plant oestrogens in silage.

Some oestrogen levels were high enough to affect the sexuality of freshwater fish. Intersex male fish are found very widely in UK rivers, often downstream of sewage works effluents. Intersex fish are also sometimes found upstream of sewage works – they may be affected by farm effluents. These effects on fish populations are now being investigated as part of the CEH-led EDCAT programme, mainly funded by Defra (Department for the Environment, Food & Rural Affairs), which began in January 2006.

Impact: Natural hormones produced during normal farming activities can be translocated to streams at concentrations that could pose a risk to fish.

Peter Matthiessen, Tom Pottinger, Kim Pulman, Andrew Johnson & Richard Williams, CEH Lancaster and CEH Wallingford. Contact: *pmatt@ceh.ac.uk*

A first assessment of glomalin in dry-land African soils

Glomalin is a substance made by certain soil fungi living in very close association (or symbiosis) with plants. The glomalin is an important 'glue' in soils and it is also an important part of long-term carbon and nitrogen stores. It is a sticky glycoprotein that holds soil particles together and so helps prevent soil erosion.

We have taken assessment methods first developed in the U.S., and for the first time adapted them to work in African soils. We have found five-fold differences in glomalin abundance in soils from three different rainfall zones and in different cultivation zones. Good soil structure was associated with high levels of glomalin and less disturbed vegetation.

Impact: Our results have highlighted the importance of these symbiotic fungi in promoting good soil structure. The work has also provided important pointers for sustainable cultivation systems in the Sahelian zone of Africa.

Nicola Hall, CEH Edinburgh. Contact: *hall@ceh.ac.uk*

Environmental Informatics

"The science of information."

Environmental Informatics applies the use of computer sciences, database and information technology skills to problems related to the natural world.

Recording environmental change

The Environmental Change Network, which is managed by CEH, runs 57 recording sites across the UK and is sponsored by 14 partner organizations. The sites take regular, or continuous measurements of environmental variables eg. weather conditions, soils, invertebrates and surface water chemistry. Data from all the sites is stored in a central Environmental Change Network database. This is dynamically accessible via the Web and provides up-to-date information to UK researchers working on the detection of environmental change and is possible causes. The input of data for 2005 has been completed and validated and direct access to summary database tables provided for users. We have developed automatic systems to deliver data digest reports and indicator statistics. 774 users accessed the summary database on the web, while 60 licences were issued for users of raw data.

Impact: Access to long-term datasets is essential to show us how the world is changing and to investigate the reasons behind this change.

Mandy Lane, Susannah Rennie, Lorna Sherrin & Lynne Irvine, CEH Lancaster. Contact: *mlane@ceh.ac.uk*

The National Biodiversity Network (NBN) Gateway

A new version of The National Biodiversity Network (NBN) Gateway was released in 2005. The

website integrates about 20 million biodiversity records of over 10,000 taxa from 149 different data sources. We also receive around 80,000 requests for information each month.

National coverage is provided for twenty-four taxonomic groups including: amphibians, reptiles, birds, plants, mosses and liverworts, mammals, fish, molluscs, butterflies, dragonflies and a number of other insect groups. The 20 millionth record (of a mayfly) was contributed on 26th April 06. The NBN gateway provides access to a substantial volume of biodiversity data for the UK. It allows you to view and use this data alongside other relevant information on the web. You can navigate through the site by three different ways: you can type a word or phrase for a species or site, browse through lists of species or use map based navigation.

Impact: A huge proportion of Britain's biodiversity data can be interrogated via the internet and used for conservation, research and education.

David Roy, Jon Cooper, Richard Ostler, Cassie Hoyland & Francis Rowland, CEH Monks Wood. Contact: *dbr@ceh.ac.uk*

Helping the Water industry meet our demands

Managing water demand is becoming increasingly important. A team of international researchers, led by CEH, has developed a new toolkit that revolutionises the opportunities for water industry software developers. We have, for the first time, provided a common standard for linking essential computer programmes that help balance our water supplies against the demand from domestic, leisure and industrial users. The Open Modelling Interface (OpenMI) will make life easier for thousands of water and environmental managers across Europe, and open up the business market for development of computer models. Under the EU's Water Framework Directive water managers must consider all of the likely social, economic and environmental impacts of their policies before they implement them.

Impact: The OpenMI has the potential to transform the modelling market to the benefit of both developers and users. In particular, users no longer need to be locked in to proprietary systems but can pick and chose between suppliers.

Roger Moore, Isabella Tindall, Christel Prudhomme, Nick Reynard & Sue Crooks, CEH Wallingford. Contact: *rvm@ceh.ac.uk*

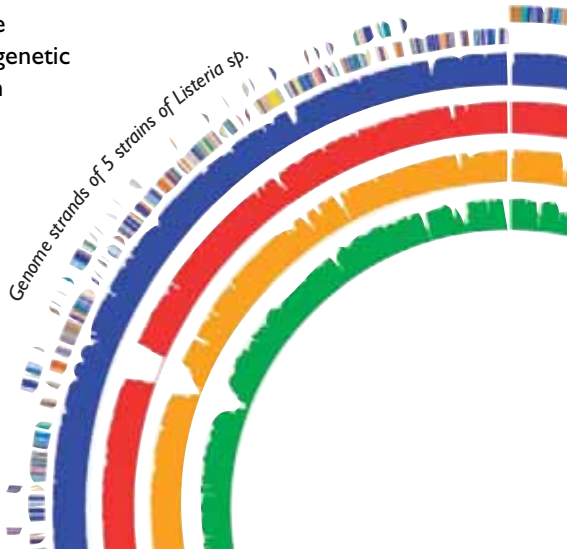
Establishing international standards: the Genomic Standards Consortium

CEH is leading the way on international genome* sequencing standards. We launched the Genomic Standards Consortium, an international working body, designed to work towards capturing a richer set of information about our complete genome collection. We have held two major meetings at the National Institute for Environmental e-Science and the European Bioinformatics Institute in 2005 and are planning several follow up events for 2006. We have a first draft of the "Minimal Information about a Genome Sequence" (MIGS) specification and have launched the Genome Catalogue database for holding MIGS records, in collaboration with the international community.

Impact: We are set to develop new guidelines for the international community for describing complete genome sequences and metagenomic datasets.

*A genome is the complete set of genetic information of an organism.

Dawn Field, Tanya Gray, CEH Oxford. Contact: *dfield@ceh.ac.uk*



Outreach and Training

CEH communicates and discusses its science in many ways:

Here are some examples:

CEH: Government
Two CEH scientists have taken part in the Royal Society's "MP-Scientist Pairing Scheme". The scientists from Dorset and Edinburgh were each paired with their local MP, and kicked off with a week in Westminster starting on 14 November 2005, followed by reciprocal constituency and research site visits over the next two months. Both scientists and MPs gained a better understanding of each other's concerns.

CEH: public
CEH launched a completely new corporate website in June 2005. The site gives information on our research and activities, written in such a way that there is something for both public and specialists. The website has attracted many users, and acts as a 'shop-front' for CEH's capabilities and skills. There has been a three-fold increase in visits or 'hits' between June 05 and May 06.

CEH: local communities abroad
CEH staff ran a training course for biologists in the Polish Water Industry on the assessing the biological health of rivers and the impact of species invasions and extinctions in rivers. The course was provided at the Jagiellonian University, Krakow, Poland as part of the European Community's Centre of Excellence IBAES scheme (Integrating Basic and Applied Environmental Sciences for the benefit of local communities) in June 2005. Outputs were published in Polish.

CEH: Public events
Staff from CEH Bangor run a stand at the Royal Welsh Show each year. In 2005 the focus was on the interesting world of soil. Topic areas covered were climate change, diffuse pollution and diversification of agriculture. The many visitors all enjoyed the various activities on display and learnt that soil is teeming with life and how important the bugs are for keeping soil healthy. The new 'Environment Centre Wales', now being built in partnership between the University of Wales, Bangor and CEH was also promoted.

CEH: Press, Radio and TV
CEH appointed its first Press officer in 2005. This has resulted in many more articles about CEH being published in all forms of media. Expert commentators are provided for press queries. Two examples: Tim Sparks (CEH Monks Wood) is intimately involved with the BBC TV Springwatch initiative and programme series and had articles in all the major national newspapers on the increasingly early arrival of spring; Caroline Sullivan (CEH Wallingford) took part in Radio 4's 'Ask the expert' programme.

Tomorrow's Scientists

"We train the next generation of UK scientists through a PhD scheme and provide shorter term work placements for younger students."

The PhD training programme:

CEH is committed to providing high-quality supervision for students at PhD level, which is enshrined as an objective in our Mission statement. Students apply in open competition for a place with us and about 200 students are in training at any one time. The students receive one-to-one experience in research skills, often in science projects at the forefront of current knowledge. Their time is spent partly with CEH and partly with their host University (CEH is not a degree-awarding institution). CEH provides excellent laboratory facilities, field resources, historical datasets, libraries and computing facilities; all of which are available to the students.

Besides their scientific studies, students also learn other transferable skills, in accordance with recommendations from the Roberts Review (2002). CEH arranges courses and initiatives which are then shared with other providers of PhDs via a national ukGRADprogramme database. All students have access to a postgraduate handbook and personal progress file and will from this year onwards participate in an annual seminar day to be held at all CEH sites.

Fran Slater, PhD Student Representative writes "Through the PhD training scheme, I have attended courses organised centrally through CEH, such as a Technical Writing course at CEH Wallingford, and locally at the University of Oxford, such as courses on Statistics and Reference Databases. I have also been able to take part in a NERC training course on Communicating Science to the Public and a Quantitative PCR workshop at my host university, King's College London. The flexibility afforded by the CEH training programme is one of its greatest advantages. Students can pinpoint potentially useful courses themselves and then request permission and the funds to attend."

PhD student workshop

Work Experience placements:

We provide workplace experiences for many young people from Year 10 (14-year-olds) up to undergrads. At age 14, this is a young person's first experience of the world of work; their week or two with us may help them choose science subjects for A levels and a scientific career. Older students may come to us as part of a national activity such as the Crest or the Nuffield Bursary scheme for A-level students. The Nuffield Bursary scheme allows a student to run their own science project under supervision for 4-6 weeks, usually as part of a larger research project.

CEH's Dorset site has been particularly successful with these schemes, two of their students won places at the annual British Association's Crest Fair and one of these, Eric Topham, won the AstraZeneca Young Innovators Award for his project on 'Communication in Ants' as well as a place at the Gothenburg International Science Fair.

Science Week

"Engaging peoples' interest in science via public events."

We provide a gateway for anyone's (especially young people's) interest in science via public events. There are benefits for us too, interaction between our scientists and children or adults is stimulating and focuses us on practical applications of science.

The annual Science Week, held in March each year is promoted nationally by the British Association for the Advancement of Science (the BA). CEH organizes events for the public and schools to tie in with the Week; in March 2006 five of CEH's sites were able to lay on events.

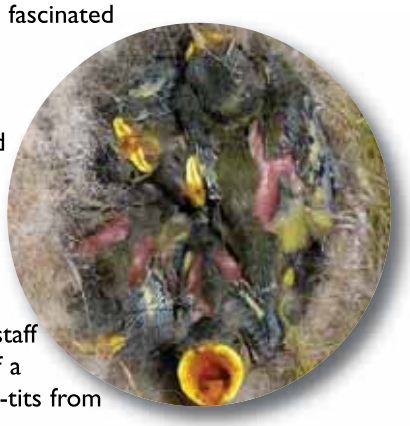
- CEH Lancaster held a Science Day for local primary schools. The children investigated soil animals, why different plants live in different places and what really goes on in a peat bog


Prof. James Lovelock FRS

- CEH Dorset were honoured by the veteran environmental scientist Prof James Lovelock FRS, who gave the Winfrith Public Lecture on his Gaia Theory to a packed and enthusiastic audience. Dorset staff also ran an interesting and lively sciBar event at a pub near Wareham where they debated 'Whose Water is it anyway?'

- CEH Edinburgh ran a 'Carbon Cycle Challenge' as part of a bigger event at Glasgow's Science Centre – players acted as carbon molecules moving around the carbon cycle.

- CEH Oxford joined in the 'Wow, How?' event at Oxford's Musem of Natural History. They showed the World of Worms to fascinated children and adults.

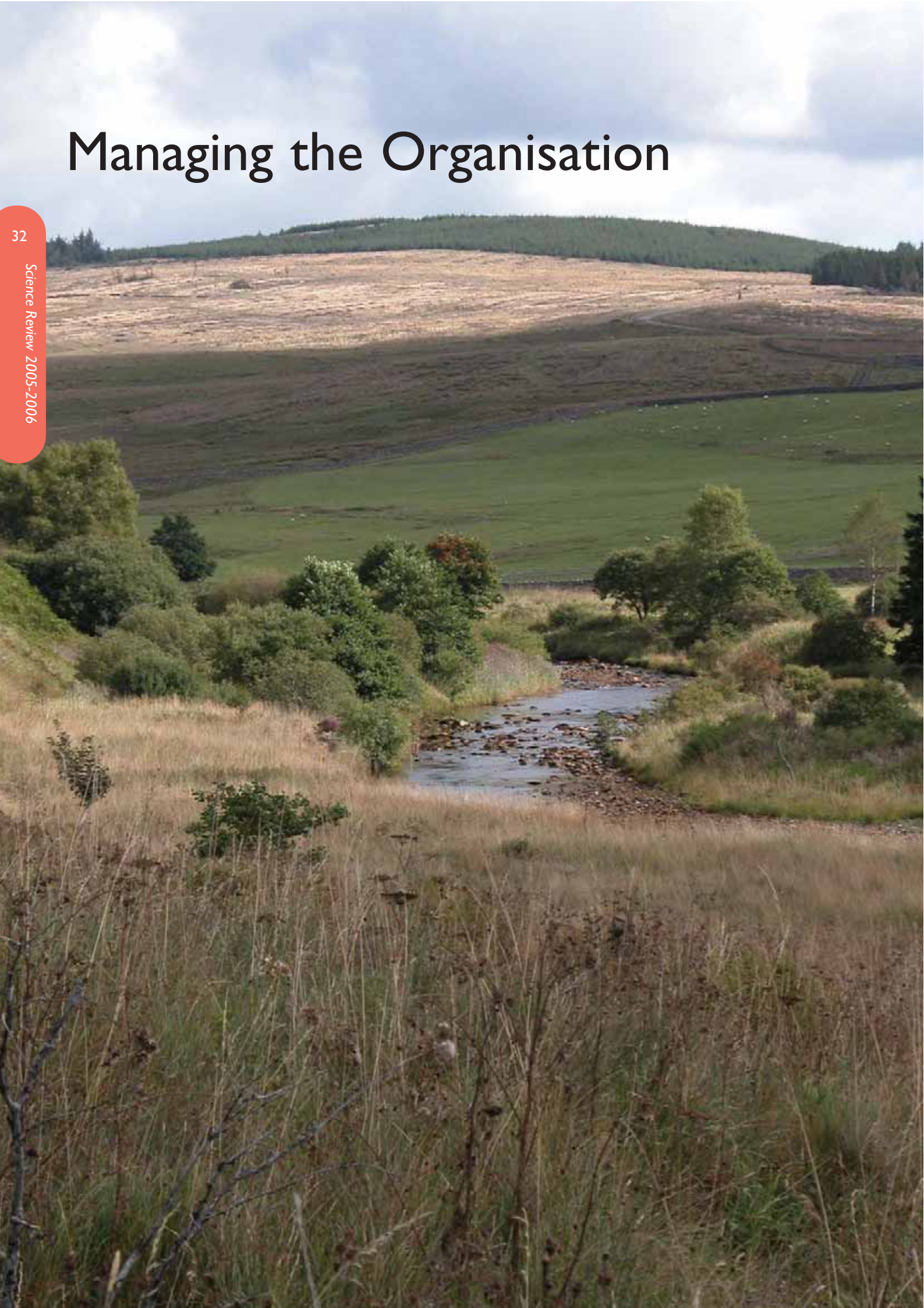


- CEH Monks Wood set up and published a web camera in a nestbox. The 'Nestcam' proved a popular attraction on CEH's website; schools, public and staff followed the lives of a family of young blue-tits from egg laying to fledging.

- CEH Wallingford, who had won a grant from the Research Councils for science communication, laid on events for schoolchildren about the links between water, agriculture and the environment. Called 'a carrot's life', it was enjoyed by over 300 school children and a public day was held as well.

In addition to all these events, three of our young scientists won places to attend the prestigious SET for Britain poster competition at the House of Commons in Science Week. They greatly enjoyed the event, meeting MP's and discussing their work.

Managing the Organisation



NERC and CEH: the Relationship

NERC Council and Chief Executive (Prof John Lawton outgoing, Prof Alan Thorpe, incoming)

Research Centres wholly owned by NERC

Collaborative Centres funded by contract

British Antarctic Survey

Proudman Oceanographic Laboratory

British Geological Survey

Centre for Ecology and Hydrology

Director, CEH
Prof Pat Nuttall

CEH Administration

Finance
Personnel
Estate management
Contracts and Tenders
Training and Development

Science Directors

CEH Research Sites

Banchory
Dorset
Monks Wood
Lancaster
Bangor
Edinburgh
Oxford
Wallingford

Biodiversity
Biogeochemistry
Climate Change
Environmental Informatics
Sustainable Economies
Water

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*
Head of Administration: Brian Butler, CEH Swindon. 01793 411517, *bwb@ceh.ac.uk*
Head of Finance: Nigel Bird, CEH Swindon. 01793 411581, *nibi@ceh.ac.uk*
Head of Personnel: Jaqui Dingle, CEH Swindon. 01793 442526, *jad@ceh.ac.uk*
Head of Site Management: Keith Rodgers, CEH Swindon. 01793 411666, *kmr@ceh.ac.uk*
Head of Knowledge Management: Dr Jackie Hinton, CEH Monks Wood. 01487 772519, *jchi@ceh.ac.uk*
CEH Health & Safety Adviser: Steven Marshall, CEH Wallingford. 01491 692510, *smar@ceh.ac.uk*
CEH Computer Support: Roger Parsell, CEH Monks Wood. 01487 772450, *rjp@ceh.ac.uk*
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Science Programme Management

CEH's six programmes are each managed by a senior scientist, the Science Director, aided by a Programme Coordinator. 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.

Biodiversity
Science Director: Professor Mark Bailey (CEH Oxford) 01865 281630, *mbailey@ceh.ac.uk*
Science Programme Coordinator: Dr Sarah Turner (CEH Oxford) 01865 281630, *sltu@ceh.ac.uk*

Biogeochemistry
Science Director: Professor David Fowler (CEH Edinburgh) 0131 445 4343, *dfo@ceh.ac.uk*
Science Programme Coordinator: Heath Malcolm (CEH Edinburgh) 0131 445 4343, *hmm@ceh.ac.uk*

Climate Change
Contact: Heath Malcolm (CEH Edinburgh) 0131 445 4343, *hmm@ceh.ac.uk*

Environmental Informatics
Science Director: Dr Matthew Stiff (CEH Lancaster) 01524 595800, *mastiff@ceh.ac.uk*
Science Programme Coordinator: pending appointment

Water
Science Director: Professor Alan Jenkins (CEH Wallingford) 01491 838800, *jinx@ceh.ac.uk*
Science Programme Coordinator: Dr Nick Jackson (CEH Wallingford) 01491 838800, *naj@ceh.ac.uk*

Sustainable Economies
Contact: Dr Sarah Turner (CEH Oxford) 01865 281645, *sltu@ceh.ac.uk*

Advisory and Programme Development Group Committees

CEH's Executive and Science Boards are supported by two specialist committees: the Advisory Committee and the Programme Development Group

The Advisory Committee's members are drawn from our major stakeholders and provide a link at a senior level between CEH and many of our research customers. The Committee meets twice a year and provides CEH's Director and Science Board with advice on our future development and research needed to underpin Government policy.

The Advisory Committee met in March 2006 to discuss the outcome of the CEH strategic review and potential impacts on stakeholders. Valuable comments were provided on how restructuring has impacted on their representative organisations.

The Chairperson for this year was Prof Julian Hunt (University College) and the Secretary was Neville Hollingworth (CEH Dorset)

The Programme Development Group is comprised of academic scientists in the UK and Europe, who maintain an ongoing review of the quality of science carried out within each of CEH's Science Programmes. Many of these scientists (or their institutions) are our scientific collaborators. The Group advise on future scientific strategy and ensures that cross-programme links are exploited. Individual members of the Group are linked with CEH's Science Programme Colleges.

During 2005-06 the Group has had one meeting, held at CEH Wallingford in February. This was the first meeting of the expanded Group with several new members attending for the first time. The main focus of the meeting was to allow members the opportunity to discuss the proposed restructuring of CEH and the subsequent implications for the science.

The Chairperson for the year was Prof Rob Marrs (University of Liverpool) and the Secretary was Heath Malcolm (CEH Edinburgh).

Contacts

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CEH Bangor Dr Bridget Emmett	**Biogeochemistry & Ecosystem Function**	CEH Bangor, Orton Building, Deiniol Road, Bangor, Gwynedd, LL57 2UP T: 01248 370045 F: 01248 355365 E: *bangor@ceh.ac.uk*
CEH Dorset Prof Jeremy Thomas	**Population & Conservation Ecology** **River Ecology**	CEH Dorset, Winfrith Technology Centre, Winfrith Newburgh, Dorchester, Dorset, DT2 8ZD T: 01305 213500 F: 01305 213600 E: *dorset@ceh.ac.uk*
CEH Edinburgh Prof J Neil Cape	**Atmospheric Sciences** **Biosystems Dynamics** **Biosystems Management** **Scottish Freshwater Ecosystems**	CEH Edinburgh, Bush Estate, Penicuik, Midlothian, EH26 0QB T: 0131 445 4343 F: 0131 445 3943 E: *edinburgh@ceh.ac.uk*
CEH Lancaster Dr Brenda Howard	**Ecological Processes in Freshwater & Soils** **Ecosystem Assessment & Forecasting** **Environmental Chemistry & Pollution** **Environmental Informatics**	CEH Lancaster, Lancaster Environment Centre, Library Avenue, Bailrigg, Lancaster, LA1 4AP T: 01524 595800 F: 01524 61536 E: *lancaster@ceh.ac.uk*

SITE & HEAD	SECTIONS	ADDRESS

RESEARCH SITES

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CEH Oxford Prof Bob Possee	**Molecular Microbial Ecology** **Molecular Virology & Parasitology** **Molecular Evolution & Bioinformatics** **Environmental Biotechnology** **Pathogen Population Ecology**	CEH Oxford, Mansfield Road, Oxford, Oxfordshire, OX1 3SR T: 01865 281630 F: 01865 281696 E: *oxford@ceh.ac.uk*
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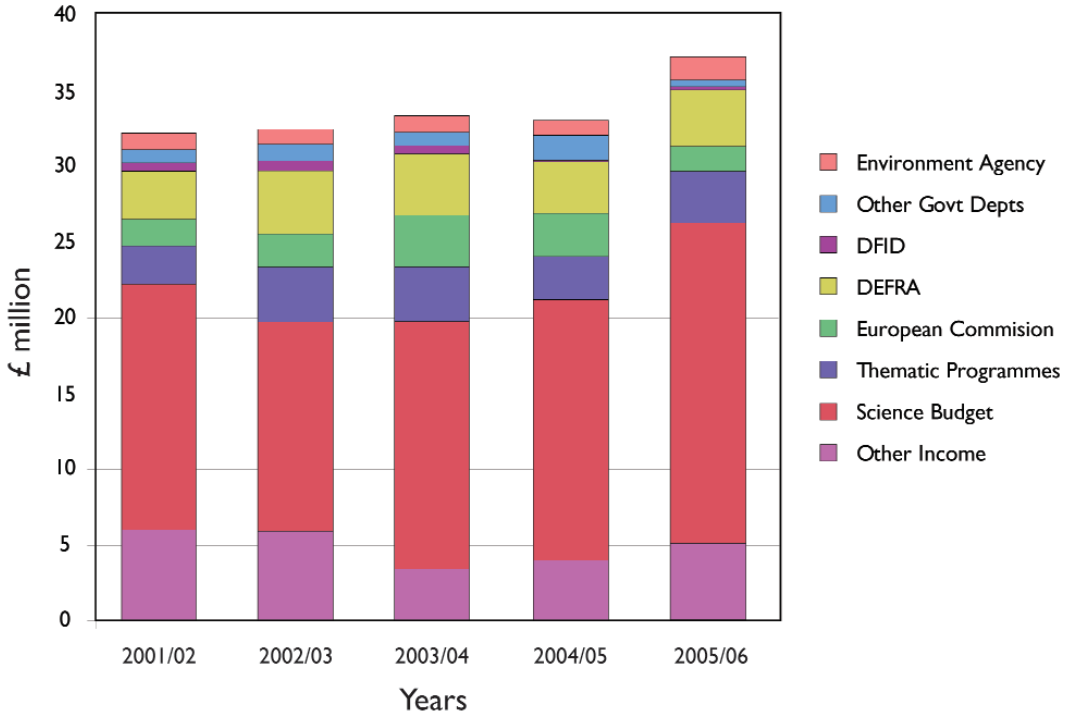
Biodiversity *Biogeochemistry* *Climate Change* *Environmental Informatics* *Sustainable Economies* *Water*

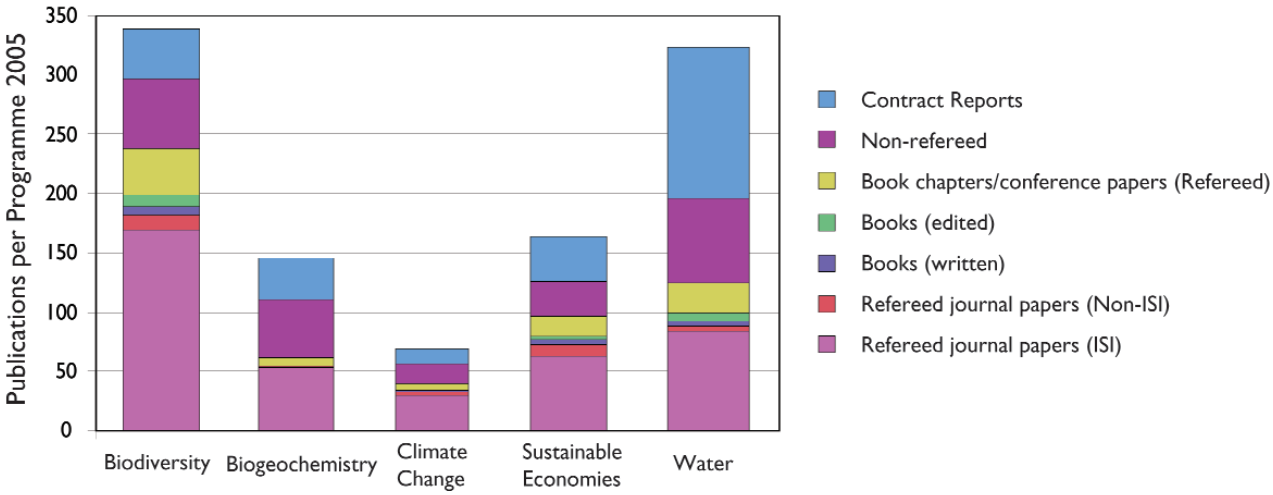
CEH Statistics

CEH's Income and Publications Record

INCOME



PUBLICATIONS



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Copies of CEH publications are available from CEH Monks Wood until April 2007.

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The front cover painting, the 'Jigsaw of Life' was created by Natalie Ball (natalieball@yahoo.co.uk) whilst on a work experience placement at CEH Monks Wood. Natalie is now completing a degree in Scientific and Natural History Illustration at Blackpool and the Fylde College.

Centre for
Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL