ANNUAL Report 2002 - 2003

Centre for Ecology & Hydrology

NATURAL ENVIRONMENT RESEARCH COUNCIL

The Centre for Ecology and Hydrology (CEH) is the UK's Centre of Excellence for research in the terrestrial and freshwater environmental sciences. Our parent organisation 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 practicable 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.

Cover photograph by Bill Meek, CEH Monks Wood

Director's Report

When I wrote my introduction to last year's Annual Report, CEH had just turned a corner. Support from the Natural Environment Research Council (NERC) for our plans to produce a leaner and more fit for purpose CEH provided an opportunity that we have firmly grasped. We are now on course for a balanced budget, the new CEH science strategy 'Health and Wealth of the Environment' has been published, and we are transforming CEH from a science-based to a science-driven organisation. We have made remarkable progress during the year.

Balanced Budget

One of the major challenges I have faced since taking over as Director in June 2001 was to establish a sustainable financial platform on which to build our future. We have had to release staff to achieve this goal and have managed to do so through a call for volunteers. This could not have been achieved without the support of staff and trade unions, and help from NERC.

Site Developments

Through the tremendous teamwork of staff from CEH Merlewood and Windermere, the original phase I plan for the new site on the campus of Lancaster University has been expanded. CEH Lancaster will now bring together freshwater and terrestrial ecology in one purpose built facility, providing an active gateway between CEH and the Lancaster Environment Centre. The new site will also provide facilities for fellows of the Freshwater Biological Association, so continuing CEH's strong links with the FBA. The model of locating CEH sites within University campuses is also being explored at other sites.

Changes in the Management Board

The year covered by this report saw changes to our senior management. Dr Barry Wyatt, Director CEH Monks Wood, took up the opportunity to manage a key project within the EU programme 'Global Monitoring for Environment and Security' (GMES). At CEH Merlewood, Professor Mike Hornung retired but is retaining his presidency of the British Society of Soil Science. We are extremely grateful to both Directors for their outstanding contributions both to their Sites and to building CEH as a whole.

Staff Successes

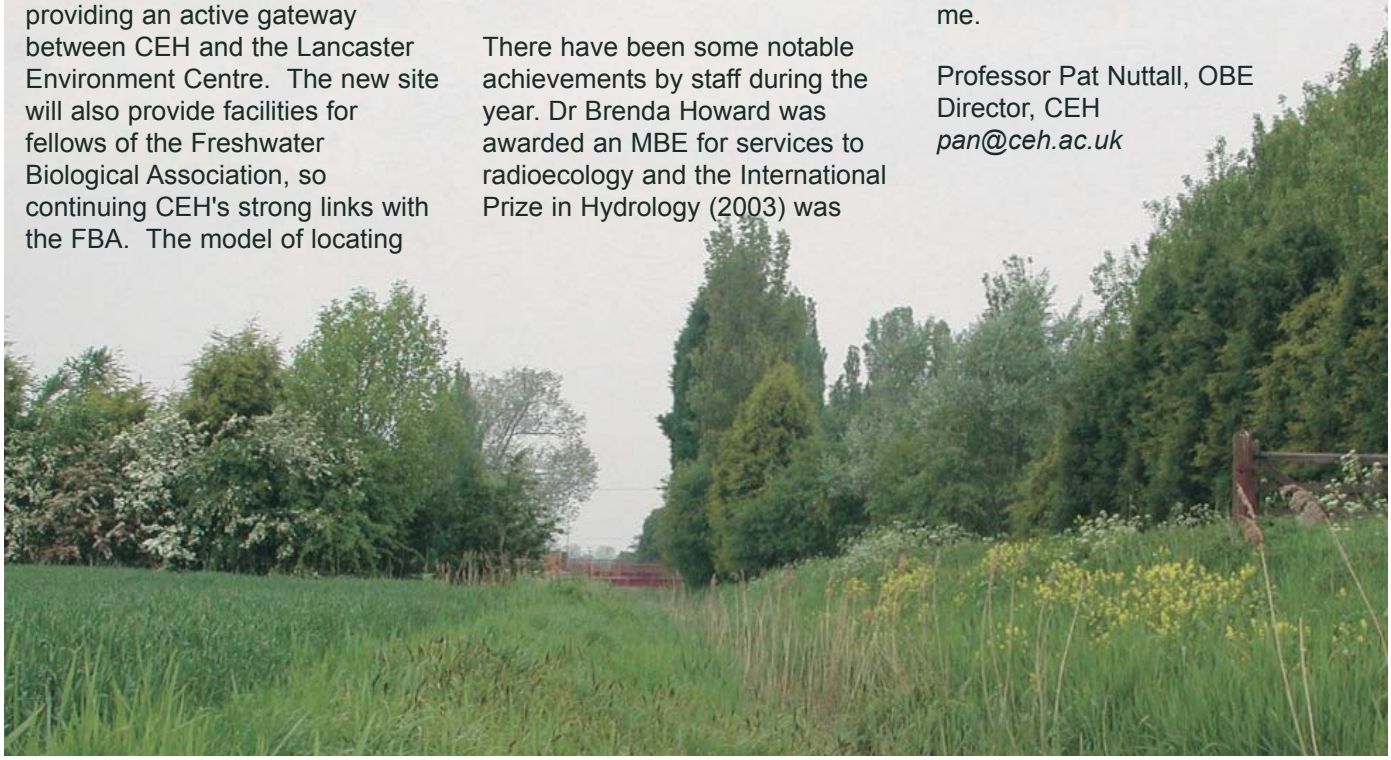
There have been some notable achievements by staff during the year. Dr Brenda Howard was awarded an MBE for services to radioecology and the International Prize in Hydrology (2003) was awarded to Dr Alan Gustard by the International Association for Hydrological Sciences. The 17 NERC studentships awarded to CEH this year again reflect our success in competing for NERC funding.

CEH Annual Report 2002/2003

I have already mentioned the publication of CEH's new science strategy. This milestone for CEH has provided the platform for a science management plan to create a science driven, corporate CEH. Details of the plan are outlined in the following section of this Annual Report. Next year I will tell you of our progress in implementing this radical new structure.

I hope you enjoy reading this report, and I shall welcome any comments you may like to send to me.

Professor Pat Nuttall, OBE
Director, CEH
pan@ceh.ac.uk



A new structure for CEH

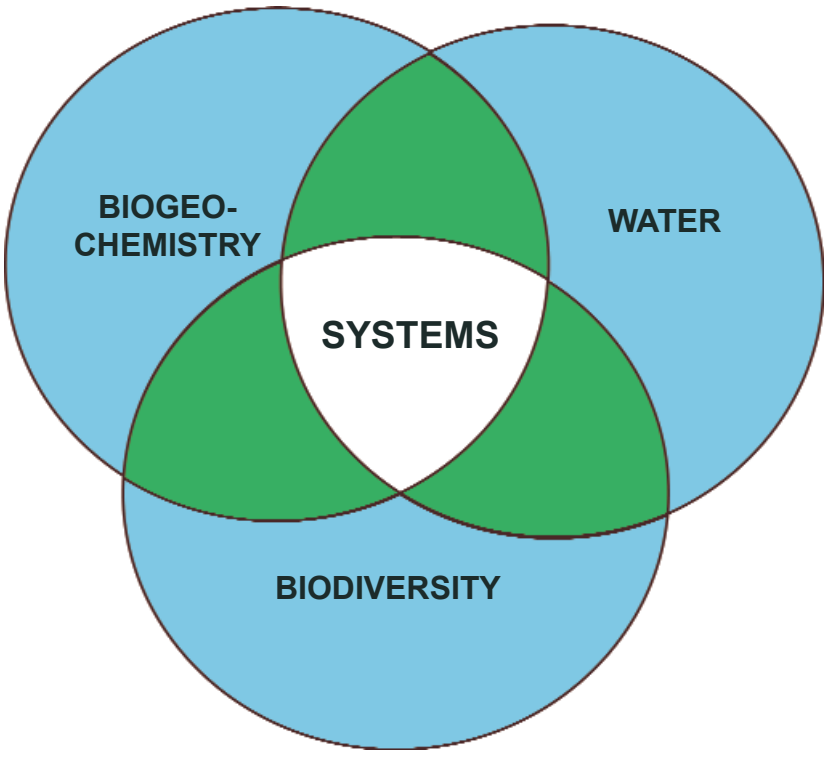
Following wide consultation in 2002, we published CEH's new science strategy 'Health and Wealth of the Environment'. The Strategy sets out the key challenges and scientific questions for CEH, for the next five years and beyond. It addresses the broad issues of 'Why is the natural environment as it is?' and 'What is it likely to be in the future?' To tackle these big questions, we will need to extend and expand our understanding of the processes governing Earth's life support systems - **Water**, **Biogeochemical Cycles** and **Biodiversity** - and build scientific underpinning for two key environmental issues - **Climate Change** and **Sustainable Economies**. Working in partnership with others will be essential.

CEH is ideally placed to build knowledge at the interfaces of Earth's life support systems. We are recognised internationally for our large area, long-term and multi-disciplinary research. Our next step is to look closely at the individual systems that underlie ecological and hydrological processes. We will use CEH's existing specialist and generalist expertise in new ways, to cross science's disciplinary boundaries. In order to capitalize on these interdisciplinary skills and knowledge, CEH is adopting a science-based management structure. The new structure will be based around five science programmes (listed in bold above) each led by a Science Director.

Why is the natural environment as it is? What is it likely to be in the future?

CEH's eight sites will each contribute to several (sometimes all five) programmes.

The Science Directors will be responsible for managing their programmes, interacting with key stakeholders and co-ordinating programme activities across CEH. They will be supported by a 'Programme College', involving staff from all relevant sections in CEH. Over the coming year, the Directors and Colleges will be tasked with developing detailed five-year proposals for their programme for approval by NERC. Our achievements during the last five years and our plans to implement this new strategy will be the subject of a five-yearly science management audit early in 2004.

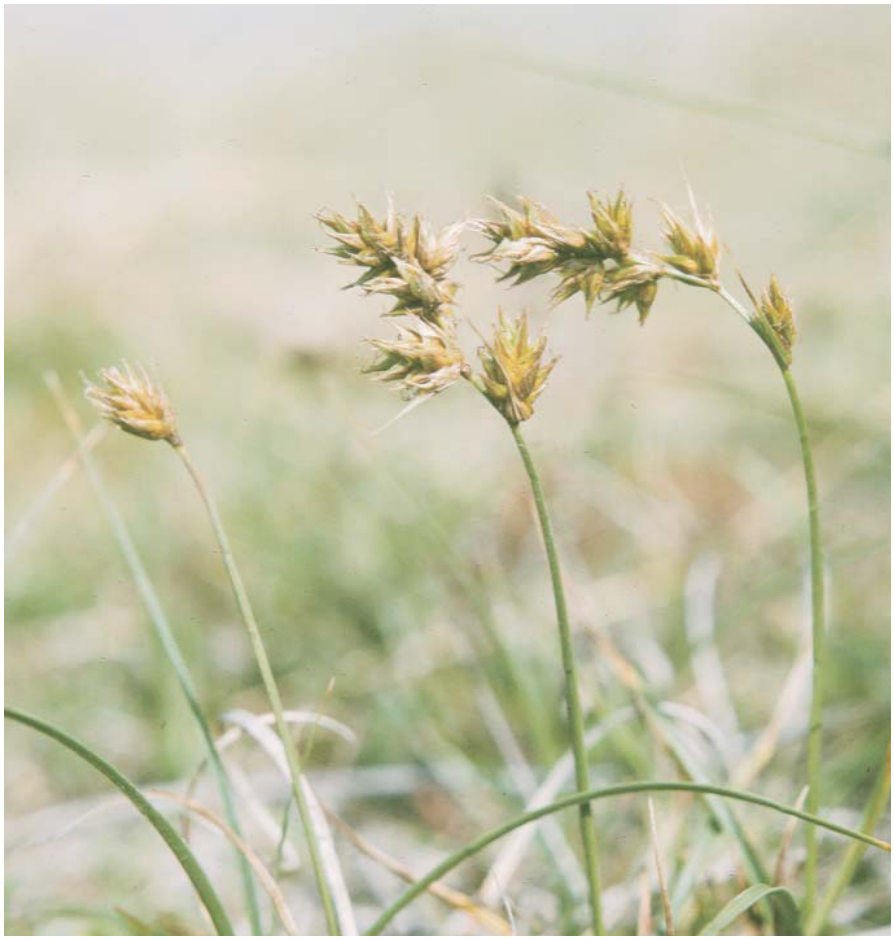


CEH will build knowledge in its core disciplines and at the the interfaces (green segments) within Earth's life support systems.

Besides building a more corporate Centre, we have looked increasingly for ways to collaborate and build partnerships with stakeholders and the university sector. In addition to the developments at CEH/University of Lancaster, CEH Bangor is developing exciting plans with Bangor University to strengthen environmental science in Wales. A similar initiative is being explored by CEH Banchory, with the University of Aberdeen and the Macaulay Institute. The advice and support of the five members of NERC Council who form the CEH Strategy Group has been a tremendous help.

This change from managing our science through sites and site directors, to cross-site programmes and Science Directors, represents a fundamental shift in emphasis. In the three years since our formation from our constituent Institutes, our staff have worked hard to bring together the science of the Institutes to add value to the diverse range of our disciplines. Integrating projects have played a key and productive role in this process. The new structure will progress this process of working across CEH, in a truly interdisciplinary way.

Success in delivering our ambitious plans will depend on strong support for our staff, including continued investment in their training and development. We are committed to achieving 'Investors in People'



status by September 2004. We are also taking advantage of opportunities provided by NERC and Government to support our activities in technology and knowledge transfer, both for commercial gain and to underpin environmental policy.

This year's Annual Report groups the achievements and outputs from the past year by the five new science programme areas and their key science questions. It also describes our activities in UK- and Europe-wide programmes and partnerships, and gives examples of our science put to work. We hope you enjoy reading them.

CEH's Strategy document 'Health and Wealth of the Environment' is available at *http://www.ceh.ac.uk/products_services/publications/online/science_strat02-07/science_strat02-07.htm*

The new Science Director appointments have recently been confirmed. They are:

Professor Alan Jenkins, Water Sciences;
Professor David Fowler, FRS, FRSE, Biogeochemical Cycles;
Professor Mark Bailey, Biodiversity;
Professor Melvin Cannell, Climate Change;
Dr Daniel Osborn, Sustainable Economies.

Advising CEH

The CEH Advisory Committee was set up in 1998, to advise Director CEH on scientific focus and priorities, with particular attention to external relationships with Government bodies and other research customers. The present Committee includes members from relevant Departments or Agencies of the Government and devolved administrations, non-governmental bodies and independent members, as well as a representative of NERC. Membership is under review, and additional strengths will be sought from appropriate public and private sector organisations.

The Committee is chaired by an independent member, the Earl of Cranbrook, and meets twice a year, visiting different CEH sites. In 2002-3, the Advisory Committee met at Monks Wood and Banchory. On both occasions, members greatly appreciated the opportunity to meet staff and to receive presentations on work being undertaken.

Lord Cranbrook comments: " The Committee members have been pleased, collectively, to bring their best advice to bear in support of CEH Director and Management Board throughout this eventful year. We have seen the evolution of a new strategy for managing CEH' s science, which will permit the Centre to move forward in a more focussed way to address critical and topical national and international problems, within the overriding objective of maintaining a healthy and wealthy environment. During this process of change and adaptation, the Committee has been able to offer advice from the perspective of the research customer and end-user. CEH's new strategy will encourage exciting and innovative science, through the application of a huge resource of skills and expertise. CEH is well positioned to tackle today's environmental problems, at home and abroad.

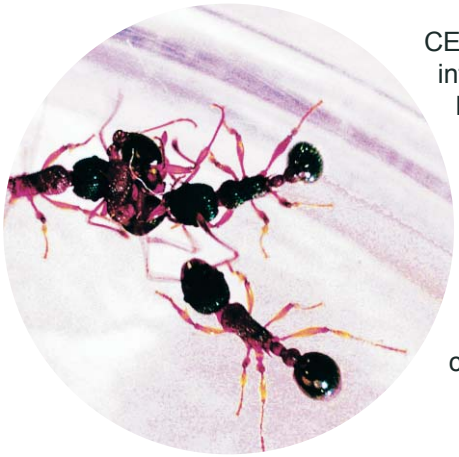
I am grateful to my colleagues on the Advisory Committee for the time, effort and support they have given. I should especially like to thank those who reached the end of their terms during the year. We look forward to supporting Director CEH and the staff of the organisation, as they begin to implement their new strategy in the coming year."

Advisory Committee Members

The Earl of Cranbrook, MA, PhD	Chairman
Dr Alan Apling	Head of Science & Technical Policy Division, Office of the Deputy Prime Minister (formerly at Department of Transport)
Professor David Cope	Director, Parliamentary Office of Science and Technology
Dr John Herrmann	Exploitation Consultant.
Dr John Holmes	Head of Research and Development, Environment Agency
Mr David Jones	Head of Horticulture and Potatoes, Department for the Environment, Food and Rural Affairs.
Dr Norman Lowe	Environmental consultant, (formerly Welsh Water) - to May 2003
Dr Harvard Prosser	Environmental Science Adviser, National Assembly for Wales - from May 2003
Dr Camilla Toulmin	Director, Drylands programme, International Institute for Environmental Development
Dr Mike Tricker	Director, Partnership and Exploitation Directorate, NERC
Professor Pat Nuttall	Director CEH
Professor Jim Wallace	Deputy Director CEH
Dr Jackie Hinton	Head of Science Policy, CEH. (Secretary)

Science highlights from 2002/03

Provoking ant warfare: Jeremy Thomas & Graham Elmes, CEH Dorset *jat@ceh.ac.uk*



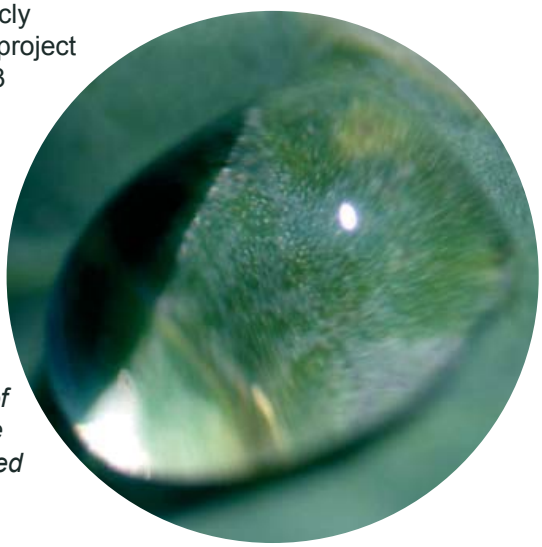
CEH researchers studying interactions within ant colonies have discovered a new group of chemicals, four of which are new to biology. The chemicals were discovered in use by a wasp that parasitizes rare butterfly larvae, who in turn live as social parasites of ants within the ant's nests. The chemicals released by the wasp provoke panic and in-fighting among the ants, distracting them from the wasp's activities. The wasp can then lay its eggs whilst the colony is unprotected.

***Impact**: These new chemicals may have applications for human control of pest ant species.*

Developing the Water Poverty Index: Caroline Sullivan & Jeremy Meigh, CEH Wallingford *csu@ceh.ac.uk*

An index to monitor progress in the water sector and to help prioritise water needs has been designed by CEH staff. The Water Poverty Index (WPI) takes into account factors including water availability, access, management, water use and environmental impact. The result provides an overall index value, and a detailed graph showing where the strengths and weaknesses are in current water provision. The results can then guide decisions regarding the most appropriate remedial actions. The WPI was first tested in 12 communities in three countries, and has been applied to 147 countries using existing publicly available datasets. The WPI project involved collaboration with 23 institutions, and was derived after extensive international consultation.

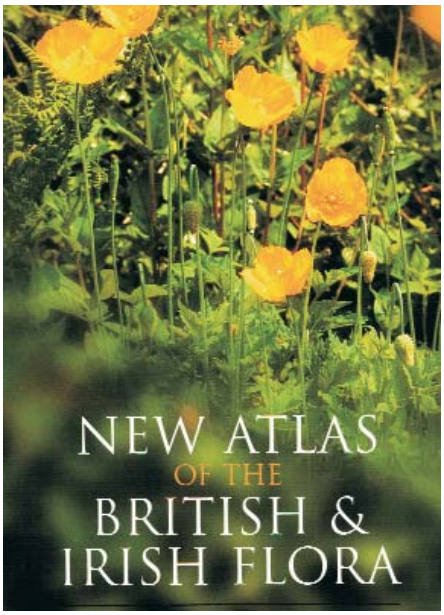
***Impact:** The Water Poverty Index is specially designed for application at the community level, and is relevant to all countries. The next phase of development of this important tool will involve larger scale piloting in selected countries.*



New Atlas of British & Irish Flora: Chris Preston, CEH Monks Wood *cdpr@ceh.ac.uk*

This publication is based on a massive five million plant records collected since 1987 by volunteers and evaluated and interrogated by the UK Biological Records Centre, managed and run by CEH. Analysis and comparison of the results with the only previous nationwide survey have demonstrated numerous changes, including the loss of species of arable land, calcareous grassland, heathland and bogs. The reasons for the relative success of plants within nutrient rich habitats, and the expansion of introduced plants have been analysed. Marked regional differences in the extent of change have been identified, with the greatest changes being in S. and E. England. CEH's partners in this major achievement were the Botanical Society of the British Isles (BSBI) and the Department for Environment, Food & Rural Affairs (Defra).

Impact: *This publication, based on a huge database, is a major national resource and reference on the status and range of wild plants in Britain and Ireland at the beginning of the 21st century. It will act as a source for many future studies, eg climate change impacts.*



West Nile Virus: Ernie Gould, CEH Oxford *eag@ceh.ac.uk*

We were prompted to look for evidence of West Nile Virus (WNV) in the UK by the first appearance of WNV in New York in 1999, and the fact that the virus has caused a number of wildlife deaths in N. America. CEH researchers carried out a systematic study of bird serum from samples collected in Cambridgeshire and Dorset. We suspected that WNV is being introduced into the UK annually. This was confirmed by finding WNV-specific antibodies in both resident and migratory birds; other evidence indicated that WNV was present in the brains of magpies. WNV's presence was also confirmed by using two additional techniques, immuno-fluorescence and western blot. Investigations are continuing, and attempts to isolate the infectious virus. Our results show that the virus is circulating actively amongst wild bird populations.

Impact: *This is the first evidence of the presence of WNV in the UK, and may have important implications for both human and environmental health.*

Photograph Gordon Langsbury, RSPB

CEH's science is grouped and managed by scientific programmes. In the following pages we showcase some examples of our science.

Biodiversity

Soil microbes control radionuclide availability in soils: Nisha Parekh, CEH Merlewood *nisha@ceh.ac.uk*

CEH staff have developed an innovative approach in order to study the role of soil micro-organisms in radionuclide sorption/desorption (how it 'sticks' to surfaces) in organic material. Using artificially produced mineral free organic material (leaf litter) we have been able to investigate the role of competing potassium and calcium ions, clay minerals, the impacts of broad spectrum antibiotics, and changes in temperature on the sorption of caesium and strontium isotopes. The results from studies so far show conclusively that factors related to living components of soil systems are of primary importance in the uptake of radionuclides in organic material. The soil microorganisms also influence the importance of chemical factors (eg adsorbtion to clay minerals) which were shown to play a secondary role in these highly organic systems.

What is the role of biodiversity in a healthy ecosystem?

Impact: *These results will be used in the development of geochemical and root uptake models. In further experiments we hope to define the precise role of specific soil micro-organisms in these systems.*

Measuring habitat quality; LiDAR* and woodland birds: Ross Hill & Shelley Hinsley, CEH Monks Wood *rhill@ceh.ac.uk*

Novel techniques have been developed using airborne remote sensing data, and used to measure and evaluate woodland canopy structure. This has enabled us to demonstrate the relationships between the canopy's structural variables and bird breeding success. In the latest developments, CEH scientists can now measure habitat structure across an entire wood. High-resolution data describing woodland structure on a landscape scale is now available.

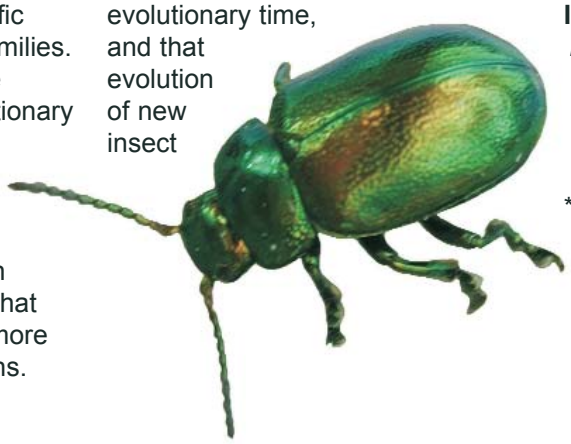
Impact: *This work has potential for assessing and predicting woodland habitat quality for birds and other wildlife populations in relation to management practices, impacts such as deer grazing, year-to-year weather patterns and even climate change. These new techniques offer a considerable advantage over traditional field-based methods.*

*LiDAR = Light Detection and Ranging, a remote sensing technique (in a way similar to Radar) measuring reflectance of light signals from the land surface.

Foodplants of modern invertebrates reflect their evolutionary history: Lena Ward, CEH Dorset *lkw@ceh.ac.uk*

The Phytophagous* Insect Data Bank (PIDB), holds detailed records of 182 families of plant-eating insects and their specific foodplants within 117 plant families. Advanced interrogation of the database has revealed evolutionary history that is reflected in modern ecological communities. Insects from primitive groups (those that evolved early) tend to feed on primitive plants, while plants that evolved more recently have more insect feeders with later origins.

This suggests that these plant/insect relationships have some stability in evolutionary time, and that evolution of new insect groups was driven by the evolution of new plant groups.



Impact: *Modern plant/insect relationships can give us a fascinating window onto evolutionary history and development.*

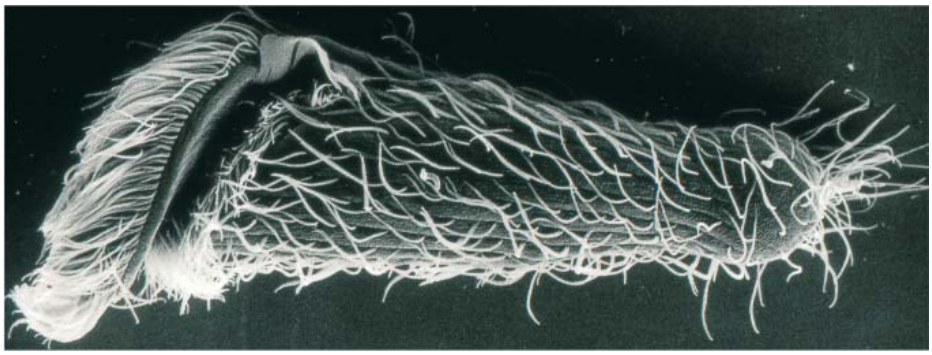
*The term 'Phytophagous' means plant feeding, and is used for insects that eat leaves and roots or suck sap.

Microbial diversity is different! Bland Finlay, CEH Windermere *bjf@ceh.ac.uk*

Most of the (larger) plants and animals we are familiar with have distributions that are geographically limited, but free-living microbes apparently do not. This implies that there must be some transitional size range where the geographical limitation ceases to apply. CEH scientists have analysed large scale geographical distributions of more than 2000 plant and animal species, spanning individual sizes from metres to microns, and have created a unique dataset. The key discovery is that all free-living organisms smaller than the size range 1-10mm are probably worldwide in their distribution.

In this respect biodiversity is fundamentally different at the microbial level. As microbes are the principal drivers of ecosystem functions (such as carbon fixation and nutrient cycling), if they are ubiquitous they are unlikely ever to become extinct - and ecosystem functions cannot be limited solely by lack of microbial diversity

Impact: *Basic ecosystem functions that rely on microbial activity are far more robust that was previously thought.*



A ciliated protozoon - about one tenth of a millimeter long - and therefore small enough and abundant enough to have a cosmopolitan distribution

Managed forest and biodiversity impacts: Allan Watt, CEH Banchory *adw@ceh.ac.uk*

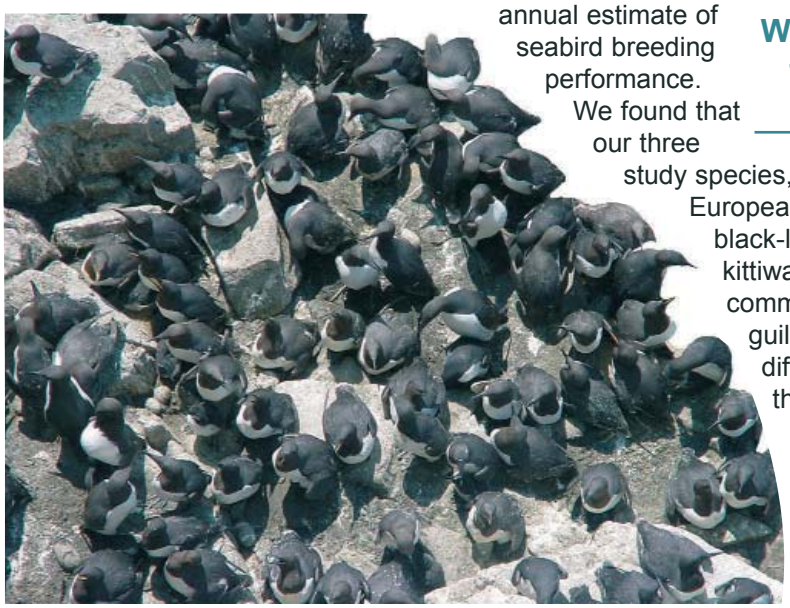
Tropical biodiversity is seriously threatened by deforestation, but few studies have been able to measure its impact, or looked for ways to resolve the conflict between timber production and conserving biodiversity. CEH scientists studied the impacts of forest clearance and re-establishment on ants, a major component of forest biodiversity in the tropics. Three different methods of establishing new timber plantations were studied, and we measured the ant populations living on and around these trees (eg in the tree canopy and in leaf litter).

Impact: *Our study was unique in showing that reforestation methods using a single tree species can have a marked effect on insect species richness and composition.*

Ocean physics and primary production affect seabird breeding: Francis Daunt, Linda Wilson & Sarah Wanless, CEH Banchory *frada@ceh.ac.uk*

In temperate regions, climate and the physical properties of the oceans drive the onset and magnitude of the spring algal bloom, which in turn fuels the productivity of higher animals, including seabirds. For the first time CEH staff have been able to investigate the effects of these processes on our annual estimate of seabird breeding performance. We found that our three study species, European shag, black-legged kittiwake and common guillemot differed in their response. The timing of breeding of the shag correlates with spring sea surface temperatures and algal bloom, whereas the timing of breeding of the other two species was more closely related to the winter North Atlantic Oscillation. These patterns correspond to over-wintering distribution: the shag is resident but the kittiwake and guillemot disperse outside the breeding season.

What are the environmental threats to biodiversity ?

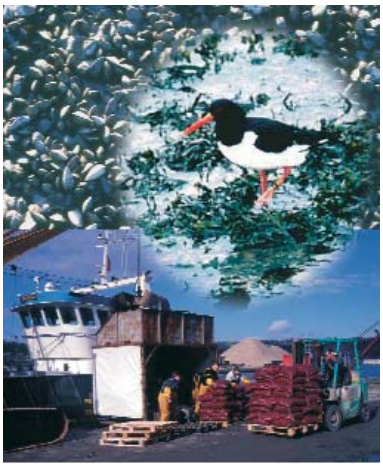


Photograph by Akinori Takahashi

Impact: *Our findings have implications in understanding the dynamics of marine ecosystems and highlight the need for a multi-species approach.*

Oystercatchers and mussel fisheries - can everybody win? Richard Caldow & Selwyn McGrorty, CEH Dorset *rwgc@ceh.ac.uk*

Commercial mussel cultivation is a valuable and fast growing fishing industry. However, when mussels are grown inter-tidally



oystercatchers (wading birds) can have a costly effect on the industry's profitability, as they can consume up to 25% of the largest ready-to-harvest mussels each winter. Collaborative work with a university partner and two commercial firms in the Menai Strait area investigated whether changing the shellfish management practices might be helpful to the industry, by reducing these losses. CEH researchers investigated the attractive of the musselbeds by using a behaviour based model of the birds' foraging activities. We were able to recommend how this attraction can be reduced, by changing the extent and layout of the mussel beds at different points in the cultivation cycle. The model was also used to predict the effect that such management changes would have on the birds themselves.

Impact: *Identifying the mussel bed layout least attractive to oystercatchers has resulted in new management strategies which should result in an increase of 144 tons yield at the Menai location alone (worth approx £187k). With better and more appropriate management the interests of both shellfish growers and competing birds can be met.*

Forest insects: do viruses regulate their populations? Jenny Cory, CEH Oxford *jsc@ceh.ac.uk*

Forest insect populations, such as the Western Tent caterpillar (*Malacosoma californicum pluviale*) of British Columbia, tend to increase and decrease in 7 to 10-year cycles. A 25-year population study in Canada indicates possible links between the levels of a virus common in tent caterpillar populations, and these population collapses. The tent caterpillars are gregarious and live in family groups derived from one egg mass. In a collaborative study, CEH has been investigating virus population variation between scattered caterpillar communities. We found that the virus population is spatially structured: there is more similiarity between viruses from caterpillars in family groups and separate sites, than in those from more distant populations. This means that there is the possibility for local adaptation of the virus. We are studying whether and how selection acts on the genetically diverse virus populations, over the next cycle of caterpillar population fluctuation.

Impact: *Better knowledge of factors affecting caterpillar population outbreaks could provide new methods of population control.*

Water

A Predictive model for assessing the effects of steroid oestrogens: Andrew Johnson, CEH Wallingford *ajo@ceh.ac.uk*

Steroid oestrogens are potent endocrine disruptors of fish, right across the UK. The oestrogens disrupt the fishes hormonal systems and may affect their gender. CEH has developed a predictive model to assess the impact of these substances. The model assesses human excretion of oestrogens (both naturally and from sources such as the contraceptive pill), and takes into account transformations in the sewer and sewage works to provide estimates of input and output concentrations. It is then possible to calculate concentrations throughout catchments, based on the distribution of human populations and sewage works, and the available dilution in receiving waters.

Impact: *This model is now used by both the Environment Agency and water companies to shape the UK's policy on regulating endocrine disruptors.*

What are the environmental factors affecting the transfer and quality of freshwaters?

Remediating acid mine drainage from a mine in Cornwall: Grahame Hall, CEH Windermere *ghh@ceh.ac.uk*

The abandoned Wheal Jane mine in Cornwall discharges an effluent that is high in acidity, and rich in iron, zinc, manganese and arsenic. CEH scientists were part of a consortium that investigated a pilot passive treatment plant (PPTP) used as an experimental facility. The facility was designed to remove these elements selectively in distinct unit process operations. The units were: A. constructed wetlands to co-precipitate iron and arsenic; B. anaerobic cells to encourage sulphate reduction to precipitate heavy metals and decrease acidity; and C. shallow rock filters to promote algal growth and precipitate manganese. CEH's researchers were particularly interested in the iron removal processes, and found that iron precipitation had a strong biological component involving a novel group of moderately acid-loving bacteria. This group is now found to have a wide distribution in mine waters in the UK.

Impact: *This is the first time that treatment of such an aggressive mine drainage has been demonstrated, using constructed wetlands. The consortium will now produce a critical appraisal of the PTTP and optimise design for remediation of acidic mine drainage.*

The impact of wet winters on the dynamics of Cumbrian lakes: Glen George, CEH Windermere *dgg@ceh.ac.uk*

Detailed analysis of weather patterns for the last fifty years reveal that winters have become much milder and wetter. These wetter winters result in a marked reduction in the flushing time of most lakes and the transport of nutrients from the surrounding catchment. There is an associated decrease in the winter concentration of phytoplankton* (as against a dry winter). These reduced concentrations can have an important effect on the dynamics of lake communities later in the year, when light is no longer a limiting factor.

Impact: *Our studies revealed that year-to-year variations in the size of overwintering populations can even influence the succession of species later in the year (such as the slow-growing blue-green algae)*

*Phytoplankton are plant plankton that derive their energy from sunlight.

Monitoring acid waters: John Davy-Bowker, CEH Dorset *jobo@ceh.ac.uk*

The acidity of streams and rivers remains a serious environmental problem in upland areas of Britain. Biological monitoring is a cost effective way of revealing the ecological impact of fluctuating chemical quality. CEH has developed a new scoring system - AWIC, the 'Acid Waters Indicator Community', which can be applied across the whole of England and Wales. AWIC works by allocating scores to the invertebrate families found in streams, based on their known pH (acidity) tolerance. The scores are then used to calculate the AWIC index that shows the biological impact of the stream's acidity.

Impact: *The system was developed for the Environment Agency as a tool for evaluating the acidity of watercourses. AWIC will be included in the next version of RIVPACS (the River Invertebrate Prediction and Classification System), a software package to assess biological quality of rivers in the UK.*

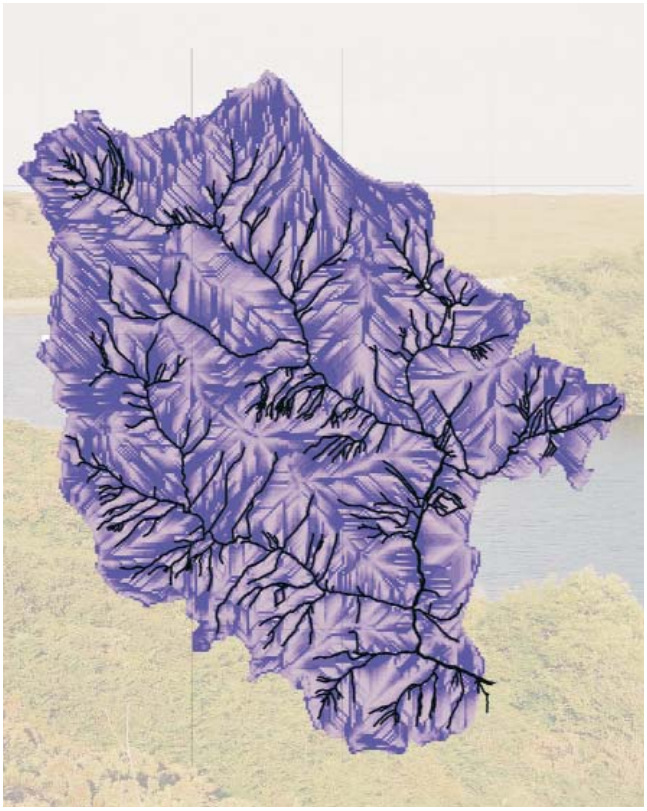
Water fluxes in residential areas: Ragab Ragab, CEH Wallingford *rag@ceh.ac.uk*

We know less about the complex hydrological processes in urban areas than in rural areas. Evaporation, surface runoff, groundwater recharge and contaminant transport are all important factors. CEH's researchers have developed and used new techniques and instrumentation to establish a unique dataset of water fluxes from different surfaces in a residential area in southern England. Results have shown that the amount of roof runoff collected is sufficient to supply a major part of the annual water requirements for an average household.

Impact: *Better domestic use of roof runoff (for appropriate 'grey-water' uses) could save on domestic water charges, help reduce demand on overstretched water resources, and reduce flood risk from roof runoffs*

How can we manage water resources sustainably?

Improving soil moisture prediction in the UK: Eleanor Blyth, CEH Wallingford *emb@ceh.ac.uk*



It is very important for farmers, water resource managers and flood prediction agencies to have good information on current levels of moisture in the soil. Currently the UK Meteorological Office predicts moisture at a 5km grid level. This is too coarse for many users, as soil moisture will depend not only on depth of the soil layer, but also its position in the landscape. For example, soil moisture levels at the bottom of a valley are different from those at the top of a hill. CEH has developed a method to predict the distributed soil moisture at a scale of 100 metres. This is a considerable improvement on the previous forecasting method, as it includes the effects of topography and 'bridges the gap' between the landscape and the point.

Impact: *The new model will allow users to make better forecasts and improved operational decisions.*

Biogeochemical Cycles

Carbon Cycle

How do forestry rotations affect the levels of carbon in soils?

Phil Rowland, CEH Merlewood *apr@ceh.ac.uk*

As part of a EU funded project, CEH researchers have been studying carbon levels in forest soils. We have shown that, during the forest cycle of clearing, replanting, thinning, and harvesting, that soil carbon stocks decline in the early years of the forest cycle and then build up as the stands mature. Following either progressive thinning & regeneration, or clear felling & planting, all the carbon assimilated towards the end of the previous crop is quickly lost. These estimates are in contrast with

What limits the binding of carbon in the Earth's natural cycle?

earlier assumptions that carbon is accumulating progressively in the soil as a result of increases in atmospheric carbon dioxide and climate warming.

Impact: *These findings will help improve models used to assess carbon sequestration (binding of carbon ions) in forest systems.*

Siberia: estimating carbon budgets for Eurasian forests: Heiko Balzter, CEH Monks Wood *hbal@ceh.ac.uk*

Internationally, great efforts are being made to measure the pools and fluxes of carbon, moving between the biosphere and the atmosphere. The Siberia-II project (funded by the European Commission) has developed earth observation techniques to help reduce uncertainties in greenhouse gas accounting. In order to determine whether the Eurasian forest belt is a net sink or source of carbon, CEH has developed algorithms to map and date historic fire scars in the Siberian forests. This technique uses optical data from the SPOT-VEGETATION satellite. The end product will help to resolve the impacts of ecosystem disturbance - particularly from forest fires.

Impact: *This work is enabling us to produce a unique account of carbon emissions from forest fires in Siberia.*

Photograph: Olga Toutoubalina

Nitrogen Cycle

Mosses struggle for light in a nitrogen polluted world: Rene van der Wal, Imogen Pearce & Rob Brooker, CEH Banchory *iskp@ceh.ac.uk*

Moss-dominated communities across Europe are under continuous threat due to their sensitivity to the deposition of atmospheric nitrogen. Many higher plants will grow more vigorously under additional nitrogen (N) deposition, but mosses generally suffer from the toxic effects of N deposition as they lack functional roots, and take up all their N from the atmosphere. Studies by CEH researchers in a Scottish montane ecosystem reveal that other vegetation (especially sedges and grasses) expand under these conditions, shading out the mosses. The shading effects were as damaging as the direct toxic effects of N deposition

Impact: *Moss dominated communities (and consequently those other organisms that rely on them) are at risk from increased N deposition; rare mosses may be critically endangered.*

What are the consequences of nitrogen enrichment and how can they be managed?

Nitrogen deposition and increased forest growth in Europe: Marcel van Oijen, CEH Edinburgh *mvano@ceh.ac.uk*

Researchers across Europe have reported that forests seem to have been growing faster since the late 1980's. 24 European research teams, including CEH staff, have collaborated to investigate the causes. In particular, we wished to determine whether increasing concentrations of atmospheric carbon dioxide and nitrogen, or a change in climate was causing the accelerated forest growth, and whether that growth was likely to continue. CEH co-ordinated the process-modelling work for the project, and carried out part of the work. The data showed most increase in height growth rates of Scots Pine and Norway Spruce (about 20%) and this was most noticeable in Central Europe. Analysis during the process-modelling phase indicated that at present, the increased nitrogen was more important for growth rates than effects from atmospheric carbon dioxide or changes in climate. However the model predicts that in the future, the situation will reverse.

Impact: *In contrast to current perceptions, in the coming decades nitrogen effects will diminish, and carbon dioxide and climate change will become the major causes of increases in forest growth rates, especially in northern Europe.*

Trees ARE good for you! David Fowler & Ute Skiba, CEH Edinburgh

dfo@ceh.ac.uk

Particles in urban air are known to be associated with human respiratory health and mortality. Urban air quality improvement schemes therefore focus on ways of reducing airborne particles. CEH has recorded detailed measurements of emission and deposition fluxes above Edinburgh, and also measured the deposition of particles onto different types of urban vegetation. Our results show that urban trees capture particles at three times the rate of deposition on grassland or other short vegetation.

Impact: *These results have been used in Regional atmospheric transport models for the West Midlands conurbation. The maximum feasible tree planting scheme in the West Midlands area would reduce atmospheric particles concentrations by 25% and annual human mortality by 140 people.*

Photograph: Andrew Phillips

Predicting uptake of harmful chemicals: Steve Lofts, CEH Windemere and David Spurgeon, CEH Monks Wood

stlo@ceh.ac.uk

Organisms living in soil and water are seriously affected by toxic heavy metals,

but impacts vary according to the sensitivity of the individual organism and the chemical composition of the system. Conventional calculation methods can account for the differences in organism sensitivity, yet find it difficult to account for the environmental properties of these heavy metals. A team of CEH researchers studying this problem have now developed a series of new models to calculate site-specific quality criteria. These criteria account for the way in which chemical variance (amongst different soils and waters) may affect the impacts of heavy metals on organisms.

Biogeochemical cycles - what is the Earth's tolerance of human disturbance?

Impact: *This approach is being adopted by the UN Economic Commision for Europe (UN/ECE) Convention on Long-range Transboundary Air Pollution. The approach will be incorporated into its methods as the best approach for deriving site-specific environmental quality criteria.*

Climate Change

Flood warning - making better decisions: Bob Moore, CEH Wallingford *rm@ceh.ac.uk*

In partnership with the Environment Agency, CEH has developed and implemented HyRAD (Hydrological RADar system) as the Environment Agency's standard for receipt, processing and display of weather radar products. An interface to flood forecasting systems provides average rainfall figures within a catchment for both past and future times, which are used to extend the lead time of flood forecasts. HyRAD operates as a client-server system supporting up to 200 users across England and Wales.

Impact: *HyRAD is a landmark in technology transfer, and is significantly helping to improve the decision-making for flood warning systems.*

How do rainforests respond to drought? Chris Huntingford & Phil Harris, CEH Wallingford *chg@ceh.ac.uk*

Early studies of rainforests suggested that they were not sensitive to soil moisture deficit. It was thought that rainforest only occurred where the soil moisture store was sufficient to allow the trees to continue transpiring through any drought. But in a new study of the Amazon region, CEH scientists have modelled recent flux measurements and revealed that the forest responds to even moderate soil moisture depletion. Climate modelling (carried out with our partners) suggests that throughout the 21st century,

How can we improve our predictions of climate change and its effects?

increasing atmospheric carbon dioxide will lead to changing rainfall patterns over South America and a drier Amazon basin.

Impact: *The response of the forest to soil moisture change will be important in determining whether Amazonia, currently a net carbon sink, will in the future become carbon neutral or even a net source.*

Can wet winters compensate for dry summers? Mike Morecroft, CEH Merlewood *mdm@ceh.ac.uk*

Climate change predictions indicate that, in addition to higher temperatures, summer droughts and increased winter rainfall are more likely, especially in southeast England. Could the wetter winters compensate for the hotter drier summers? CEH researchers have found that this may be true for some ecological systems. In our study of the effects of summer droughts on a 20-year old grassland being managed for conservation, we found significant impacts on plants and invertebrates. In years when autumns and winters were wetter, the proportional cover of grasses was maintained and fewer weeds colonised. Productivity of the grassland was consistently reduced by low summer rainfall.

Impact: *Changes in climate, including regional rainfall patterns, will have important implications for conservation management and agri-environment schemes.*

Do frogs benefit from warmer springs in the uplands? John Adamson, CEH Merlewood *jka@ceh.ac.uk*

Warmer springs are helping frogs to spawn earlier, but is this really a benefit to frog populations? Measurements from the Environmental Change Network (managed by CEH) have revealed large populations of Common Frogs at some upland sites, which spawn later in the year than lowland frogs. In the uplands spawning is typically in April, with the young frogs leaving the pools in August. Our studies also indicate that the migration of adult frogs to spawning pools before mating is heavily influenced by weather conditions, with the frogs preferring to arrive at the pools at noon when there has been rain in the previous 18 hours.

How can we estimate the potential impacts of climate change?

Impact: *If the climate continues to warm, upland frog reproduction will benefit by earlier breeding. But drier weather could be detrimental because of interruption of the migration to the spawning pools and an increased risk of pools drying out.*


Vestas

Sustainable Economies

Siting hydropower schemes, and disseminating research: Gwyn Rees, CEH Wallingford *hgrees@ceh.ac.uk*

The Himalayan region appears to be very suitable for hydropower schemes, but many small-scale schemes have failed, due to inaccurate assessment of available water resources. CEH has developed a range of generalised models that can be applied for estimating water resources in any prospective site in the region covering Nepal and the northern Indian State of Himachal Pradesh. The models are provided to users incorporated in a software package - HydrA, which provides users with a rapid and reliable assessment of both water availability and small-scale hydropower potential. The models and software were developed with funding from the UK's Department for International Development (DfID). In collaboration with local partners, CEH has been able to run training workshops for hydropower practitioners in the Himalayan regions. Local agents have been trained to act as dissemination partners and to deliver first-line support for users.

Where are renewable energy schemes best located?

Impact: *HydrA has become the standard for estimating hydropower potential in the region. Over 70 copies have been sold locally.*

Changing land use influences soil methane exchange: Niall McNamara, CEH Merlewood *nmcn@ceh.ac.uk*

Recent investigations at a forested site adjacent to poorly drained grassland have concentrated on the exchange of methane between soil and atmosphere. Our field observations indicated a decline in the release of methane from soil following tree planting, possibly as a result of 'drawdown' in the water table. Measuring methane exchange from soils is difficult, because it is a net process - the sum of microbial production and oxidation. To clarify this, CEH scientists applied stable isotope techniques to a laboratory soil core experiment with different water tables. We were able to demonstrate the linkages between methane production processes and

How can we best identify and monitor landuse change and predict its impacts?

water table height via a new isotope capture field laboratory system. With a unique carbon isotope/methane tracer technique we showed that recently afforested soils have a low capacity for methane oxidation, and that the primary influence of afforestation at this site was to inhibit methane production.

Impact: *When estimating the net fluxes of methane (an important greenhouse gas) the effects and impacts of land use change need to be taken into account.*

Achieving sustainable use of soils in Wales: Brian Reynolds, CEH Bangor *br@ceh.ac.uk*

The health and performance of soils are a critical resource for sustainable development. CEH Bangor managed a study that drew on a range of sources in the UK research community, to define the current pressure, state and controls on the sustainable use of soils in Wales. Topics such as land management practices, climate change, development and pollution are all major pressures affecting soil resources. A key finding was the loss of organic carbon in farmland surface soils.

We urgently need more information on:

- the contribuiton of soil erosion to sediment loading in rivers;
- the influence of soil structure change on river flooding;
- the effect of climate change on soil function;
- the timescale and degree of recovery of soils as acidification decreases.

Past industrial activity has also left a legacy of over 40,000 ha. of grossly contaminated sites. New legislation and clean-up of contaminated land should provided more effective control in the future, and reduce current areas of contaminated land.

Impact: *The findings are now being used by the Welsh Assembly Government as the basis for a soils strategy for Wales.*

Climate Change and ecological recovery at Loch Leven: Laurence Carvalho & Alec Kirika, CEH Edinburgh *laca@ceh.ac.uk*

CEH has been conducting long-term monitoring at Loch Leven for 35 years, measuring nutrient levels, and plant and animal plankton (phytoplankton and zooplankton) numbers. These datasets have underpinned recovery schemes to restore the ecological balance in the Loch. Unexpectedly, it appears that warmer temperatures in recent years have had a positive impact on the water chemistry and quality. Lowered numbers of phytoplankton are being recorded and toxic blue-green algae are either absent or only present in very small numbers. One reason for this is the positive impact of warmer springs on *Daphnia* (waterflea) 'grazer' populations.

Impact: *Unusually, our findings show that the scale of climate change being predicted for the future may make remediation targets more easily achievable in shallow lakes, where 'grazers' are able to significantly limit algal populations.*

How do we estimate risks and hazards and develop mitigating measures?

Predicting changes in the frequency of flooding: Nick Reynard, CEH Wallingford *nsr@ceh.ac.uk*

Global warming is still predicted to cause significant changes to the world's climate, but we are unsure about the precise nature of these changes. We are particularly uncertain about local changes in extreme events, such as short duration, high intensity rainfall and its impact on the frequency and magnitude of flooding. There is a significant need to estimate the potential changes to the UK's flood regime over the next 100 years.

CEH is tackling this issue on a number of fronts. One of these methods uses high-resolution data from the Hadley Centre Regional Climate Model. These hourly rainfall series, provided on a 25km grid for the UK, are used to 'drive' a hydrological model for the simulated period between 1961-1990 and for the predicted 2071-2100 period. Studies were carried out for one example catchment in Scotland. Results suggested that for this catchment, under this scenario of climate change, the flood currently expected on average once every ten years, might be expected to occur once every four years by the end of the century.

Impact: *This type of investigation will be invaluable for local planners, who can then take action to protect lives, properties and businesses.*

Photograph: RAF Benson

Rodenticides in top predators: Richard Shore, CEH Monks Wood *rfs@ceh.ac.uk*

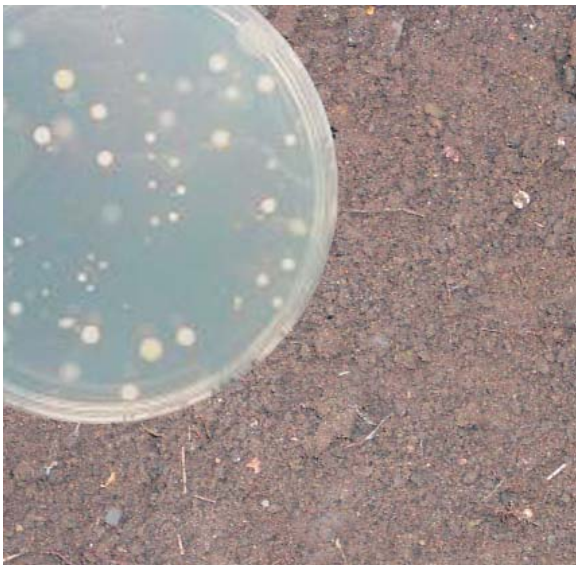
We have identified a previously unsuspected, large scale exposure of kestrels to modern second-generation anti-coagulant rodenticides. Some 60-70% of birds examined (obtained from road-kills and other accidents) contained these rodent poisons. Coupled with earlier work, this has led to new hypotheses about exposure routes, and has helped develop recommendations for government bodies.

Impact: *Our work suggests there are important conflicts to resolve between the need to control pests and the need to protect our native biodiversity*

Photograph by George McCarthy, RSPB

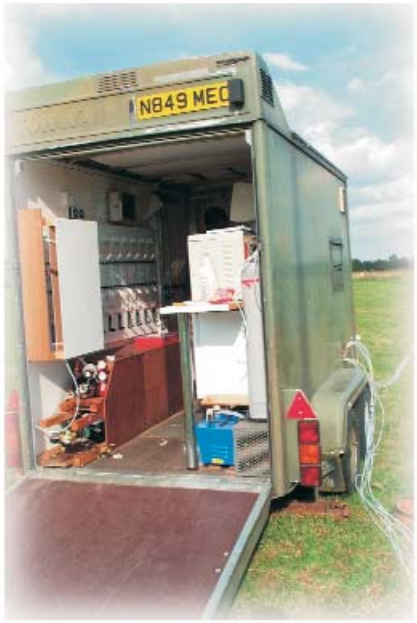
Radiation effects on microbial communities: Andrew Whitely & Mark Bailey, CEH Oxford *aswhi@ceh.ac.uk*

Microbes play a key role in overall 'soil health'. During 2002 CEH has investigated issues concerned with the ability of ecosystems to recover following environmental disturbances. One key aspect is the rate at which microbes recover, which underpins environmental recovery. Using the isotope ^{60}Cobalt as a model, we have established that microbial communities are incredibly resistant to radiation effects. Only seven days after radiation exposure, appreciable re-growth and reactivation of the community occurs, and microbial functionality returns to levels almost identical to those before the event.



Impact: *Interestingly, we found that the microbes which recover most quickly after radiation exposure are those most similar to organisms able to tolerate stress from dessication or low water availability. This may indicate a similar mechanism in action for both these stresses, and possible resistance mechanisms within microbial populations.*

CEH is internationally renowned for its long term environmental monitoring and surveying



Applying our science to today's problems

Much of CEH's science is commissioned by Government Departments, Agencies and international organisations in order to inform policy makers and solve environmental problems. Here are some examples of the wide diversity of applications:

Are soil microbes the key to reversing desertification? Douglas Deans, Bob Munro & Kevin Ingleby, CEH Edinburgh *jdd@ceh.ac.uk*

Studies in the dry sandy lands of Senegal show that two important groups of microbes often fail to form essential symbiotic relationships with plants. CEH researchers found that successful revegetation of the land may require the introduction of more suitable (and carefully selected) microbial inoculants. We found that leaf litter mulches improved soil properties and increased plant growth by 50%, and adding a mycorrhizal (fungal) inoculant to the leaf litter gave a doubling of plant growth.

Impact: *Our findings may point to practicable ways of assisting re-vegetation schemes in arid lands.*

How does nitrogen affect sand-dune communities? Laurence Jones, CEH Bangor *lj@ceh.ac.uk*

Previously, it was not known whether atmospheric nitrogen (N) deposition might increase the rate of soil formation in dunes, so decreasing areas of mobile sand available for some specialised dune-loving species. There was also concern that increased levels of N could lead to increased competition from other species and nutrient enrichment of groundwaters. CEH's work identified that sand dunes are indeed at risk from increased N. Plants increased their productivity, soil cycling of N changed, some species diversity was lost and ground water was affected.

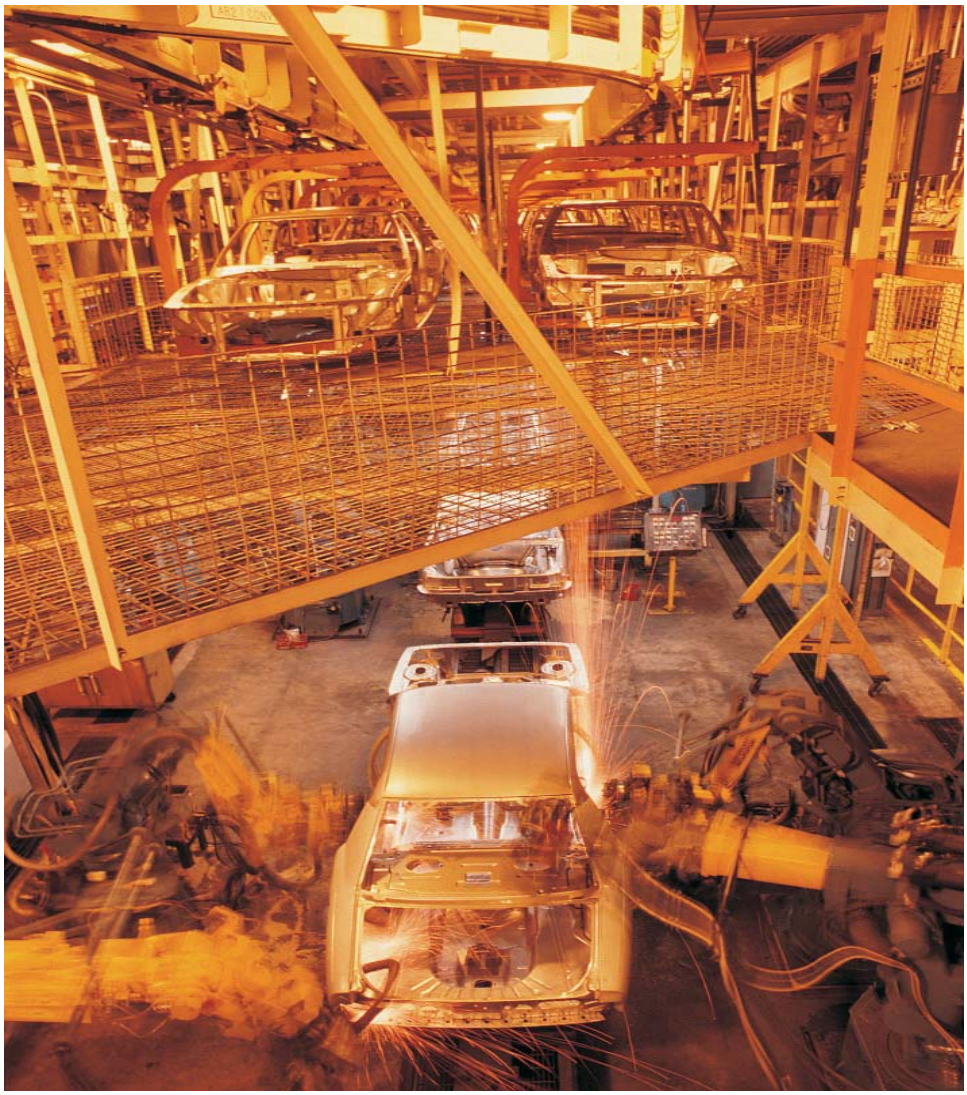
Impact: *We can now recommend the amount of N deposition, below which sand dune systems are protected from change due to N deposition. These values have been used in the latest revision of critical loads by UNECE*, which provides the scientific underpinning for EU negotiations regarding N emission reductions.*

*UNECE: the United Nations Economic Commission for Europe.

Microbial degradation of metal working fluids: Ian Thompson, CEH Oxford
ipt@ceh.ac.uk

Disposing of spent metal working fluids is a real problem. CEH has developed a method where the fluids are inoculated with a specific microbial assembly. Their activity can reduce the pollution load by over 80% within 5 days, which is 50% more effective than either previous activated sludge methods or by using commercially supplied microbial inoculants. Additionally, degradation results are more reproducible, and therefore give a more reliable performance. The work has given us an increased understanding of microbial community composition and population dynamics. As a result of this, we have been able to select a specific microbial assembly, composed of particularly persistent and active strains.

Impact: *Successful trials have now progressed to pilot plant scale at a major motor manufacturer's engine plant.*



Atmospheric metal pollution - impacts on natural organic matter: Ed Tipping, CEH Windermere *et@ceh.ac.uk*

A computer model called WHAM (Windermere Humic Aqueous Model) has been developed, which describes the way in which natural organic matter interacts with metals and acidifying pollutants. Using knowledge from over 100 individual laboratory studies, the model helped us understand pollutant behaviour and impacts, notably the prediction of toxic effects for different biological species.

Impact: *This work is being used in the formulation of national and international policy on atmospheric metal pollution.*

Assessing the fate and environmental impact of radioactive releases: Simon Wright, CEH Merlewood *smw@ceh.ac.uk*

Landsat view of Yenisey River

CEH has just completed a project to assess the integration of remotely sensed information with radioecological studies at nuclear sites in Russia. Field studies focussed on the behaviour of radionuclides released from direct flow plutonium production reactors into the Yenisey River. The transport and deposition of river sediments was studied at field sites, using remotely sensed information. Complex contamination patterns were revealed, related to radionuclide discharges, river hydrology and sediment type.

Impact: *The information obtained during the project will be used by Scandinavian states to identify the risk to, and potential exposure of Arctic inhabitants, under a range of possible accidents.*

Radioactive pollution of aquatic systems: Jim Smith, CEH Dorset *jts@ceh.ac.uk*

In the last year simplified models have been developed for the prediction of radioactive contamination of rivers, lakes and reservoirs. These models have been provided within user-friendly software, for use by regulatory bodies responsible for regulation of radioactive waste disposals and management of nuclear emergencies. A model for direct discharges to the River Thames is now in use by the Environment Agency, and models for other rivers are being developed.

Impact: *The model for large-scale nuclear incidents is currently being evaluated by radiation protection authorities and environmental agencies in eight different European countries.*

Restoring biodiversity on arable land: Richard Pywell, CEH Monks Wood *rfp@ceh.ac.uk*

CEH research has shown that it is possible to successfully integrate biodiversity restoration schemes with intensively farmed arable land, as part of the farm's business plan. Initial survey of an experimental farm and study of its crop yield records indicated the least profitable areas. A number of these areas were taken out of production and a variety of wildlife habitats were created, funded by agri-environment scheme grants. Provision of winter food resources (for birds) was an essential part of the plan. The new habitats were managed for wildlife gain, and also to fit in with the farm's business plan. After four years, results show that farmland bird territories increased by 42% and insect abundance and diversity has greatly increased. Populations of declining arable plants have benefited from sympathetic management of set-aside land. Crucially, the farm's economic viability has remained the same.

Impact: *Our recommendations for change in management practices are being assessed in relation to the new national agri-environment schemes. The project is now being used as a demonstration site to transfer these skills to the farming community.*

Benefits of increased tree planting in agricultural landscapes: Bridget Emmett, CEH Bangor *bae@ceh.ac.uk*

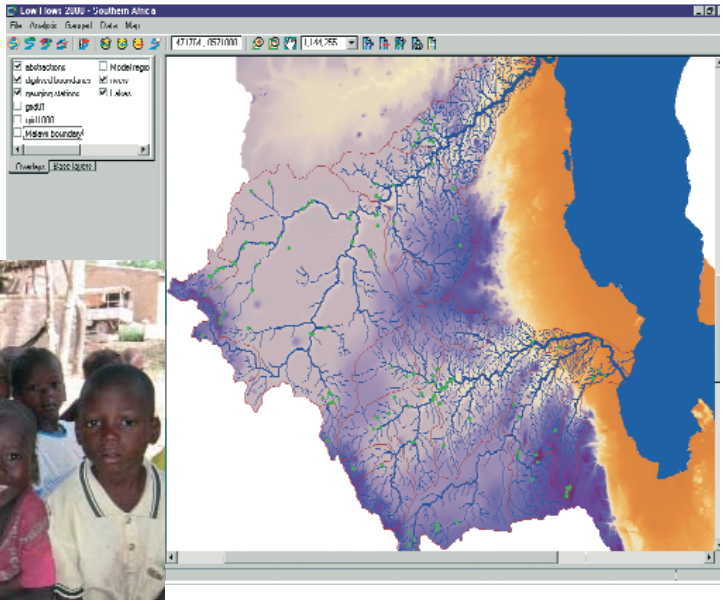
Agricultural practices in some parts of Wales may be contributing to risks of flooding, soil erosion, soil compaction and nutrient leaching. CEH has studied how management practices might be changed, to include greater use of trees for shelter and wood chip for bedding, reduction of stocking rates and restoration of wetland. Our work has identified several benefits: these include a 40-fold increase in water infiltration rates in newly planted areas of trees, and a significant reduction in soil compaction.

Impact: *Future benefits may include improvement of water runoff and quality, and increased carbon sequestration (the binding of an ion to a substrate).*

Low Flow design in Southern Africa: Matt Fry, CEH Wallingford

mfry@ceh.ac.uk

CEH has produced a low flow estimation and water resources tool, applicable for use in Southern Africa. This tool gives Malawi facilities (previously unavailable) to retrieve information about the availability of surface water. It also gives the ability to link this information to existing and predicted water use within catchments, and so to license and manage water resources sustainably.



Impact: *The tool has provided new methods that could be extended to enhance water resource management across the region.*

Chitinase* transgenic plants: Ian Cooper & Hui Wang, CEH Oxford

jic@ceh.ac.uk

This research is aimed at reducing chemical pesticide inputs to specific field crops, in particular for combating fungi attacking crop leaves - which are increasingly uncontrollable by traditional fungicides. The fungus species *Alternaria* is pathogenic in a range of crops - tomato, potato, brassicas and tobacco. An insect baculovirus provided a chitinase gene, coding from which was inserted into a tobacco genome. The resulting transgenic plants were able to resist pathogenic fungi in both glasshouse conditions at CEH Oxford and in the field in China. Further risk and efficacy testing is now being carried out in the laboratory and in the field.

Impact: *In 2002 knowledge and materials were transferred to horticultural researchers in Bangalore, India via a Material Transfer Agreement. The antifungal properties of the chitinase are now being assessed in tomato crops.*

*Chitinase is the enzyme that destroys chitin, the chief component of fungal cell walls.

Working with others: the PEER partnership

In August 2001 five of the largest environmental research centres in Europe decided to found the "Partnership for European Environmental Research" (PEER).

The specific aims of PEER are to:

- develop and promote joint strategies in environmental research, in support of both EU and national policies; and to enhance research on ecological sustainability;
- create synergies and a critical mass of research, and to improve the competitiveness of European environmental research;
- promote collaboration within the PEER institutes;
- build the capacity to integrate European environmental research databases with a focus on their interpretation and exploitation;
- create opportunities for the exchange of scientific personnel and the training of young scientists.

There are now seven members of PEER and a number of candidate members. A Launch event was held in Brussels in November 2002. Current members are:

- ALTERRA - Green World Research Centre, The Netherlands;
- CEH - Centre for Ecology and Hydrology, United Kingdom;
- CEMAGREF - Centre for Agricultural and Environmental Engineering Research, France;
- NERI - National Environmental Research Institute, Denmark;
- SYKE - Finnish Environment Institute, Finland;
- UFZ - Centre for Environmental Research, Germany;
- IES - Institute for Environment and Sustainability, EU Joint Research Centre, Ispra, Italy.

PEER's research programme is managed within six research 'pillars':

- Biodiversity & Nature Conservation;
- Aquatic water systems & Sustainable water management;
- Contaminated systems, Risk assessment & Remediation strategies;
- Global change impacts;
- Society, Natural resources & Environmental policy;
- Landscape planning & Management.

PEER also arranges training courses, drawn from the PEER members' areas of expertise, and organises scientific meetings. A graduate training course on ecological modelling has taken place (open to PhD students of any of the PEER institutes), and a conference on irrigation and water use conflicts is planned for September 2003.

CEH manages the Biodiversity pillar on behalf of PEER. The pillar's contact person is Allan Watt, CEH Banchory, email *adw@ceh.ac.uk*

PEER

For more information on the PEER partnership see *http://peer-initiative.org*

CEH's technology transfer initiative

Commercialising our science

CEH generates new knowledge and applications in the course of its research work.
In response to Government's drive to make the best use of this intellectual property, our parent organization (NERC) has established a Technology Transfer programme. CEH is enthusiastically responding to this and has appointed two Technology Transfer Scouts. Their job is to identify possible practical applications of CEH's science, and assist the researcher to establish whether there is commercial or other potential for exploitation. The Scouts then 'nurse' the idea through its first steps, from investigating alternative routes to exploitation, to proving a market need and establishing a business plan for development.

The incentive behind the Technology Transfer initiative is to make knowledge available by the most appropriate means, and if possible to generate an income stream for CEH which can be ploughed back into further research activity and to reward our innovative scientists. There may be scientific benefits too, which can include the generation of new research ideas and intellectual challenges, access to new technologies and industrial best practices, and collaboration with people from different backgrounds.

It is important to ensure that the (publicly-funded) knowledge developed by us is actively used to improve the environment and to contribute to the UK economy, and that it contributes to technology transfer activity across the UK, Europe and worldwide.

In the first year of this initiative over 100 ideas have been identified in CEH that are worthy of further investigation, and a significant number of these are being actively developed. Several have already attracted funding: for market research; to assess intellectual property; for further research and development; and for development of business plans.

CEH's Technology Transfer Scouts:
Ian Simpson, based at CEH Merlewood, *iss@ceh.ac.uk*
Carol Watts, based at CEH Wallingford, *cdw@ceh.ac.uk*

Some examples of Technology Transfer topics, currently in transition to the commercial marketplace

- **A method for removing oestrogen from outflow waters of sewage works (see Water Section page 12)**
- **Genetic fingerprinting in trees: to help settle legal disputes, also in insurance claims**
- **Water consultancy services and software: for use in the UK and abroad**
- **A method for reducing methane and odour emissions from landfill sites.**

Latest news: The Rainbow Seed fund (which provides capital investment to commercialise the outcomes of publicly funded science research) has now invested £20,000 for commercialisation of the technology for the process to remove oestrogen from sewage works. For more information on The Rainbow Seed Fund see: http://www.rainbowseedfund.com/

New resources for

As a part of CEH's responsibilities, we develop and maintain facilities and resources which are then available to the UK academic community. Here are two examples of new developments:

CEH's GRID project and the e-Science initiative: John Watkins, CEH Merlewood and Steve Hindmarsh, CEH Computing Service *jww@ceh.ac.uk*

A major development in new computing technology, the CEH GRID project, has taken off during the last year. The term 'e-Science' relates to the type of science questions that can only be answered by using Internet-based computing techniques. CEH's project will enable GRID super-computing power by permitting access to processing capability at clusters of remote computers. In effect, many computers will be connected together into a super-computer to work on a particular job. The results or outputs will then be transmitted back from the various processors to the initial computer. This super-computing power can be applied to numerically and data intensive problems such as large scale and long-term models or queries.

The UK's e-Science Programme is funding many projects in order to realise this vision. Major funding, won by CEH, has enabled the installation of the first phase of our GRID processing capacity at CEH Edinburgh, Wallingford, Oxford and Merlewood.

Three examples of current e-Science applications within CEH:

- The GENIE (GRID Enabled Integrated Earth System Model) project at CEH Edinburgh is a modular, distributed and scaleable Earth System Model for long-term and palaeo-climate studies. It will flexibly couple together state-of-the art components to form a unified Model, execute the Model and share the distributed data produced via the GRID.
- The newly formed NERC Environmental Genomics Centre at CEH Oxford also seeks to promote the development and use of bioinformatics technology through GRID based dissemination of data and software.
- The Ecological Data Grid project is a collaboration between CEH and the CCLRC* e-science centre to develop integration of ecological data sets using GRID technologies.

Eventually the CEH Grid will link to national or international grids, so providing access to massive computing power. For more information on the UK's e-Science programme see *http://www.rcuk.ac.uk/escience/*

*CCLRC = Council for the Central Laboratory of the Research Councils.

UK Researchers

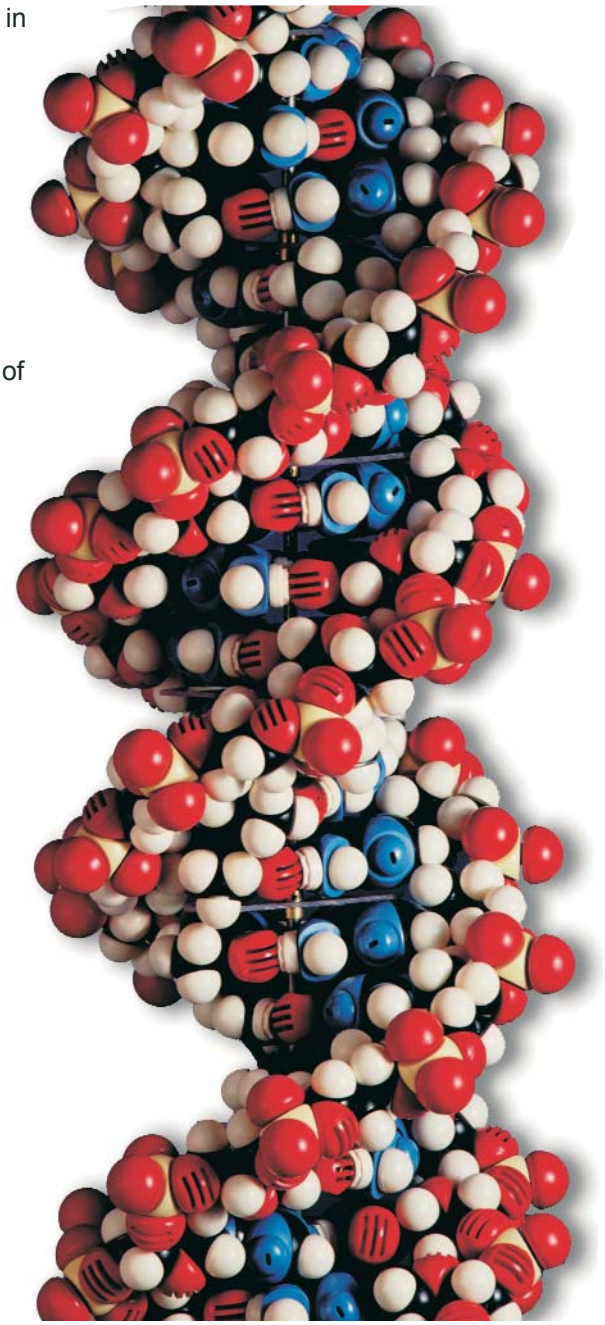
EGTDC - The NERC Environmental Genomics Thematic Programme Data Centre: Dawn Field, CEH Oxford *dfield@ceh.ac.uk*

EGTDC represents a new model for the development of bioinformatics* expertise in NERC and the wider UK research community. This new Data Centre at CEH Oxford is providing cutting-edge tools for a range of data management and data-mining activities. The members of EGTDC support the scientific work of researchers in NERC's Environmental Genomics Thematic Programme, promote beneficial links between UK research groups and provide a basis for collaboration with bioinformatics partners.
One of the Centre's achievements has been the active development of a turn-key solution for building sophisticated powerful bioinformatics workstations. This is based on the operating platform 'Linux' which is not only free, but is also the preferred choice for bioinformatics research along with Unix systems.

GRID-enabled features of “Bio-Linux” will also allow suites of workstations to function as small supercomputers or ‘clusters’. This flexible solution will provide the EGTDC and the environmental genomics community with a standardised and powerful computing environment, in which large-scale genomic and post-genomic studies can be tackled.

For more information on the NERC-EGTDC, see *http://envgen.nox.ac.uk*

*Bioinformatics: the use of computers in solving information problems in the life sciences, especially via the creation of extensive electronic databases in the study of genomes, protein sequences.



Communicating our science

CEH staff take part in a wide variety of activities and events which communicate our science to non-scientists. As part of CEH's mission, we engage the public in discussion of our science, its findings and its applications. Here are some examples of activities undertaken this year:

Science and International policy:
CEH staff from Wallingford played a major role in promoting the UK's expertise in water resource management at the World Summit on Sustainable Development, Johannesburg to policymakers and public via global media.

Science into government:
Betty Williams MP for Conwy visited CEH Bangor, and spent time discussing science projects with staff. She also visited the solardomes facility.

Science and policymakers:
The Rt. Hon. Margaret Beckett, Secretary of State for the Environment, Food and Rural Affairs launched "The New Atlas of British & Irish Flora" at Kew Gardens, to an audience of policymakers, conservationists, and botanists (CEH Monks Wood).

Mrs Beckett arriving at Kew

Science and local government:
CEH Merlewood staff contributed to a report by Cumbria County Council entitled "Measuring the quality of life in Cumbria", and provided a talk for the public.

Science and business:
A Business meeting was provided for the newly formed ENcluster - Peterborough Environmental Business Cluster. (CEH Monks Wood)

Tomorrow's citizens:
A post-graduate Researcher in Residence was trained and placed at Purbeck School (CEH Dorset)

Talks for schools: various topics are provided eg 'Biotechnology and GM's', and 'What are bacteria?' (CEH Oxford)

Professional development days for teachers: an intensive day of science and debate on controversial environmental topics (CEH Dorset) and the annual Water Course for 'A' level science teachers (CEH Wallingford)

Science and special interest groups:
Scottish Wildlife Trust - a talk was provided for members titled 'Rudolf's relatives', the ecology of reindeer and caribou (CEH Banchory)

Talks and demonstrations on fisheries science for local angling club (CEH Dorset)

A lecture and field course was provided for Cumbria WI on hedgerow survey methods (CEH Merlewood)

Science and the public, via the media:
CEH staff provide interviews for press and other media on a topics ranging across the whole spectrum of our activities. A few examples:

CEH Wallingford staff took part in a Channel 4 series, 'Bricks and Mortar' for homeowners, explaining the nature and causes of flooding.

BBC Countryfile's programme filmed the Shorebird Modelling group's survey work in Poole Harbour (CEH Dorset)

BBC Countryfile programme film CEH scientists and Poole Lifeboatmen

Web communication: CEH has provided six public access websites this year, on various areas of our science. (CEH Edinburgh)

Phenology is the recording of the timing of natural events. This revived area of scientific interest provokes many media articles and interviews every spring and autumn (CEH Monks Wood)

Some of the species recorded for the UK Phenology scheme are shown on this page.

Photographs provided by the Woodland Trust

CEH Publications

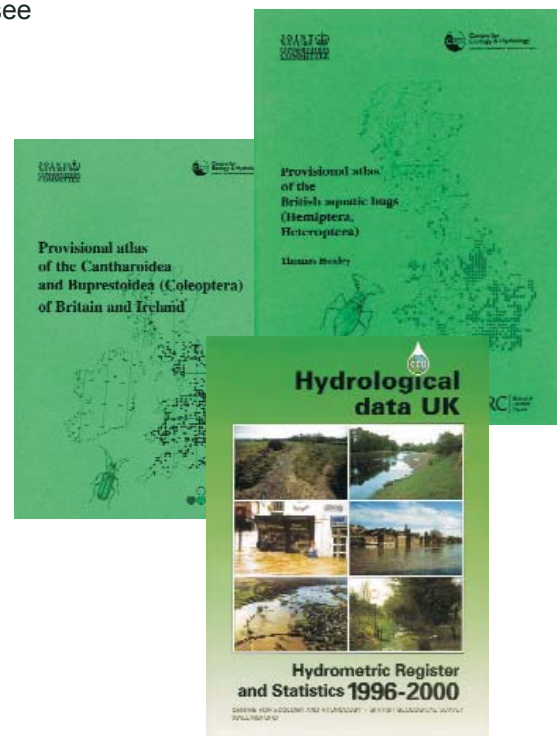
CEH's Publications Units manage the design and production of a range of publications, derived from research projects and long-term databases.

Printed publications for sale:
For information on all publications available, and how to order, see *http://www.ceh.ac.uk/products_services/publications/index.htm*

Examples of items published this year:

From Monks Wood:
Provisional atlas of the British aquatic bugs (Hemiptera, Heteroptera)
Thomas Huxley, 118pp ISBN 1870393678, 2003, £8.00
Provisional atlas of the Cantharoidea and Buprestoidea (Coleoptera) of Britain and Ireland
Keith N. A. Alexander, ISBN 1870393694, 2003, £6.00

From Wallingford:
Hydrometric Register & Statistics 1996-2000, Centre for Ecology & Hydrology and British Geological Survey, Wallingford. £30



Free publications:
Many publications are now available as downloads from *http://www.ceh.ac.uk/products_services/publications/online/*

Examples are:

CEH general information leaflets,
CEH Strategy,
Environmental Conflict brochure,
Ecofact volumes
past CEH Annual Reports.

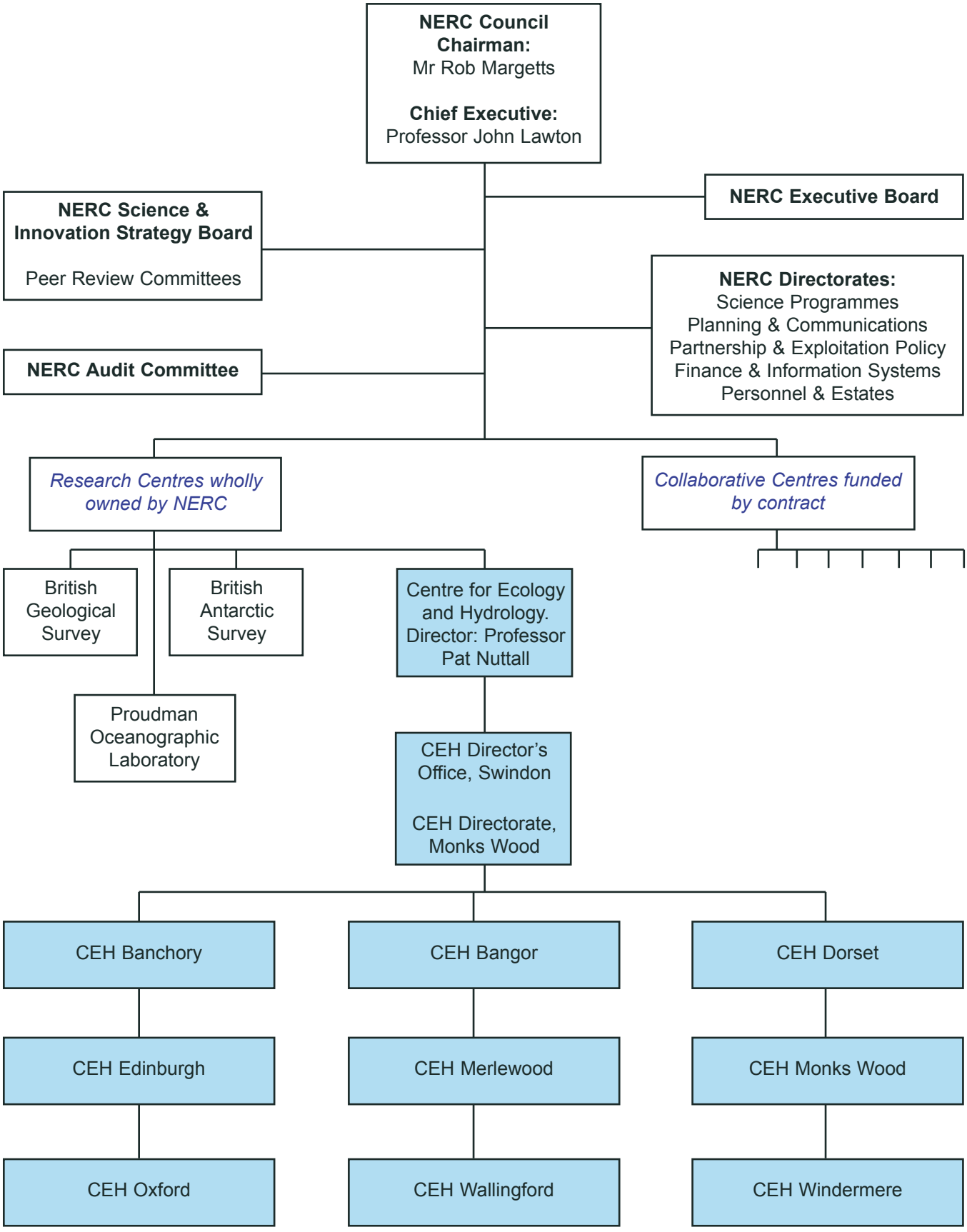
Software - available for sale or download via CEH's Web site see *http://www.ceh.ac.uk/products_services/software/index.htm*

Topics covered are: Terrestrial Ecology, Hydrology & Freshwater Ecology and Population Genetics

Data - a list of data available is at *http://www.ceh.ac.uk/data*

For postal addresses and telephone numbers see Appendix 4.

NERC - its structure and relationship with the Research Centres & Surveys



CEH Merlewood and CEH Windermere will combine and move to University of Lancaster Environment Centre during 2003/4

CEH - Directorate functions

Director
Pat Nuttall

CEH Administration
Brian Butler

Financial policy & procedures
Financial Management & Accountancy
Contract negotiation
Tenders
Personnel Policy & procedures
Recruitment
Training & Development
Investors in People
Estate Management

Science Policy Co-ordination
Jackie Hinton

Science policy & science programme management
Technology transfer
Stakeholder liaison
European liaison
Research funding opportunities
Communications
Web & Intranet
Scientific publishing
Media contacts
Specialist networks

Health and Safety
Jillian Binnie

Welfare
Jessica Winder (NERC)

Computer Support Services
Roger Parsell

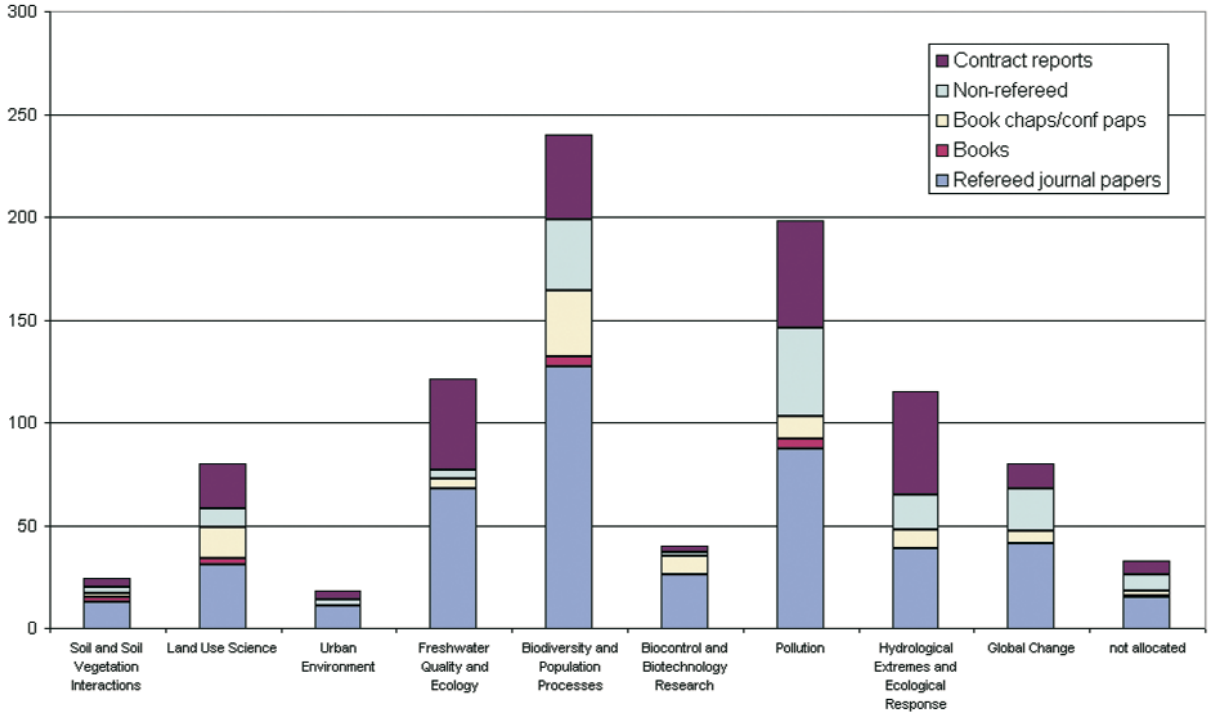
On-line internal services
Local & wide area networks
Computer operating systems
Web development

Library Services
Sue Wharton

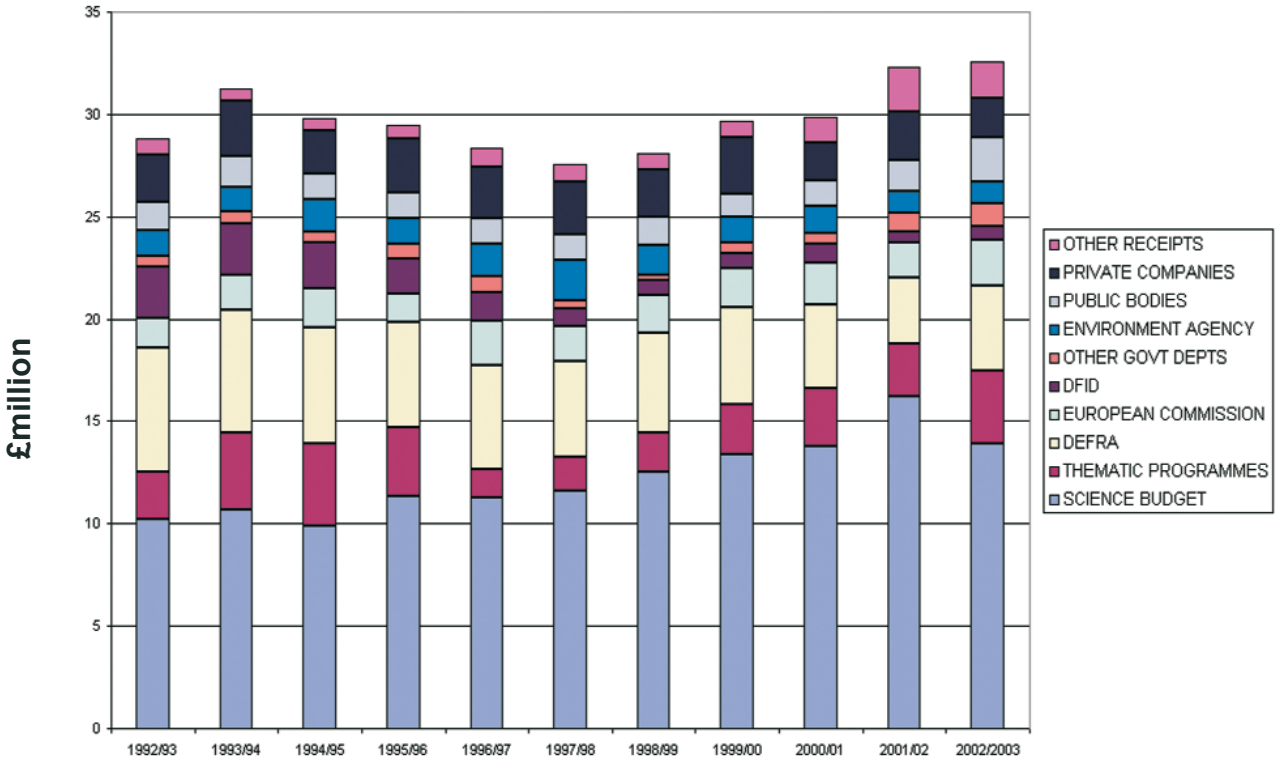
Library & information services
Staff publication records
Book & journal purchasing
Access to on-line databases & scientific journals

CEH Statistics

CEH Publications



CEH Income



CEH Sites, April 2002 - March 2003

CEH Director's Office
Prof. Pat Nuttall

NERC, Polaris House
North Star Avenue
Swindon Wilts, SN2 1EU
T: 01793 442516
F: 01793 442528
E: *pan@ceh.ac.uk*

CEH Directorate

Monks Wood
Abbots Ripton
Huntingdon, Cambs
PE28 2LS
T: 01487 772534
F: 01487 772590

CEH Banchory
Prof. Steve Albon

Biodiversity & Population Processes
Ecosystem Dynamics.

Hill of Brathens, Banchory,
Aberdeenshire AB31 4BW
T: 01330 826300
F: 0130 823303
E: *banchory@ceh.ac.uk*

CEH Bangor
Dr. Bridget Emmett

Biogeochemistry & Ecosystem Function.

University of Wales Bangor,
Deiniol Road, Bangor LL57 2UP
T: 01248 370045
F: 01248 355365
E: *bangor@ceh.ac.uk*

CEH Dorset
Prof. Alan Gray

Conservation & Population Ecology,
River Ecology,
Biometrics.

Winfrith Technology Centre
Winfrith Newburgh,Dorchester,
Dorset DT2 8ZD
T: 01305 213500
F:01305 213600
E: *dost@ceh.ac.uk*

CEH Edinburgh
Prof. Melvin Cannell

Atmospheric Sciences:
Land Atmosphere Exchange, Ammonia, Air Chemistry.
Biosystems Sciences:
Biosystems Management, Biosystems Dynamics, Scottish Freshwater Ecosystems.

Bush Estate,
Penicuik,
Midlothian EH26 0QB
T: 0131 445 4343
F: 0131 445 3943
E: *mgrc@ceh.ac.uk*

CEH Merlewood
Prof. Mike Hornung

Land Use,
Soil Ecology,
Radioecology,
Environmental Chemistry,
Environmental Change Network.

Windermere Road,
Grange-over-Sands,
Cumbria LA11 6JU
T: 015395 32264
F: 015395 34705
E: *merlewood@ceh.ac.uk*

CEH Monks Wood
Dr. Dan Osborn

Ecological Risk,
Ecological Processes & Modelling,
Earth Observation,
Environmental Information Centre.

Abbots Ripton,
Huntingdon,
Cambs PE28 2LS
T:01487 772400
F: 01487 773467
E: *monkswood@ceh.ac.uk*

CEH Oxford
Prof. Mark Bailey

Molecular Microbial Ecology,
Molecular Virus Ecology,
Biotechnology Development.

Mansfield Road,
Oxford. OX1 3SR
T: 01865 281630
F: 01865 281696
E: *oxford-enquiries@ceh.ac.uk*

CEH Wallingford
Prof. Jim Wallace

Process Hydrology,
Water Resources & Environment,
Hydrological Risks,
Water Quality.

Crowmarsh Gifford, Wallingford,
Oxon OX10 8BB
T: 01491 838800
F: 01491 692424
E: *rwf@ceh.ac.uk*

CEH Windermere
Prof. Peter Matthiessen

Fish biology,
Microbial Ecology,
Aquatic Processes,
Phytolimnology.

Ferry House, Far Sawrey,
Ambleside, Cumbria, LA22 0LP
T: 015394 42468
F: 015394 46914
E: *pmatt@ceh.ac.uk*

During 2003/4,CEH Merlewood and CEH Windermere will combine and move to University of Lancaster Environment Centre.

More information
Visit CEH's web site at: *www.ceh.ac.uk*
for more information on how CEH works
and what we do.

For copies of CEH publications,
Tel: 01487 772400
CEH Publications Office, Directorate,
Monks Wood, Abbots Ripton, Huntingdon,
Cambridgeshire, PE28 2LS

Photographcs courtesy of CEH staff
(unless credited)

ISBN: 1 870393 73 2

Printed on Recycled Paper

Designed and produced by CEH Graphics Design Office, CEH Directorate, Printed by Raven Marketing Group, St Ives

Centre for
Ecology & Hydrology

NATURAL ENVIRONMENT RESEARCH COUNCIL

CEH Directorate, Monks Wood, Abbots Ripton,
Huntingdon, Cambridgeshire, PE28 2LS
Tel: 01487 772400
Fax: 01487 772467
Website: *www.ceh.ac.uk*