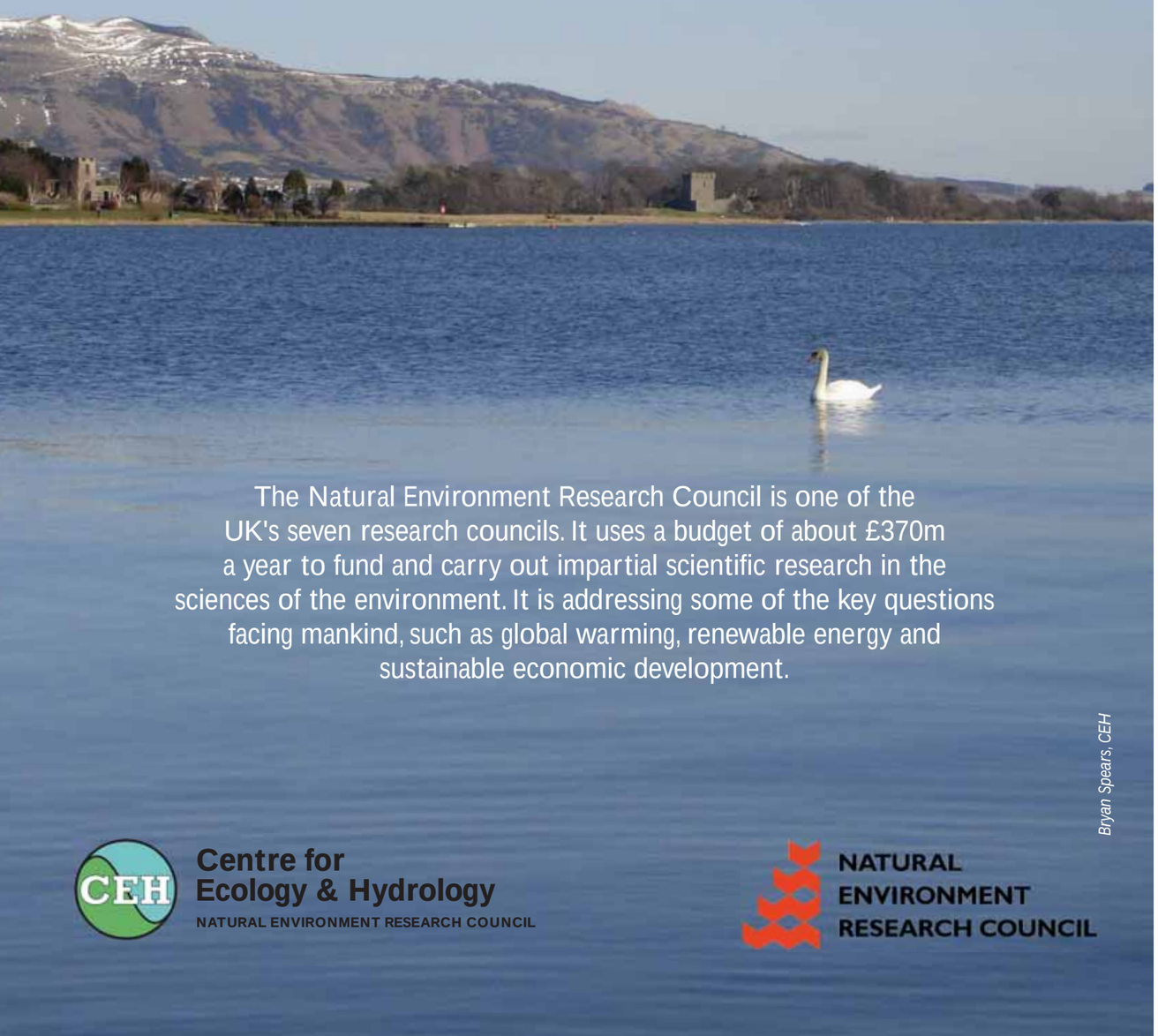
Centre for
Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

Science Review 2006-2007

The Centre for Ecology & 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 support life on our planet. We are particularly interested in the impacts of human activity on the world around us. CEH's research will help generate workable solutions to today's pressing environmental problems.



The Natural Environment Research Council is one of the UK's seven research councils. It uses a budget of about £370m a year to fund and carry out impartial scientific research in the sciences of the environment. It is addressing some of the key questions facing mankind, such as global warming, renewable energy and sustainable economic development.

Bryan Spears, CEH

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The Centre for Ecology & Hydrology
is a Research Centre of the UK's
Natural Environment Research Council

Contents

Nigel Brown, CEH

Letter from the Director, Prof. Patricia Nuttall OBE

Last year the Centre for Ecology & Hydrology (CEH) was faced with the most significant restructuring challenge since it was formed, and this year (2006/07) has therefore been a most difficult one as we have started putting the plans into action. The downside of the progress has been saying goodbye to many valued staff, which has affected all of us. Sadly there are still more goodbyes to come as we reduce our numbers from 600 to 440, but I do believe the most difficult period of accepting the change and seeing the first sites close is behind us and staff are increasingly looking forwards.

I would like to stress what fantastic people we have in CEH. The level of commitment to building a bright future for CEH from the staff that are staying, those that are re-locating and even those who are leaving has constantly impressed me. Staff have worked hard whilst handling the extra work and inconvenience of the restructuring. We have had a lot of help from our colleagues in NERC at Swindon Office, but most importantly no one has let the science delivery or interaction with stakeholders go off the boil.

Increasingly, we are starting to see and celebrate the first successes of the new CEH, both structurally and scientifically. New investments are being made at our sites in Edinburgh and Lancaster and we now have a wonderful new 'green' building at Bangor that we share with the University of Wales. The new building at Wallingford is next, and as you will read in this review, there have as usual been many science highlights, including the discovery of ant-hoverfly interactions, laser tweezers for bacteria and seabirds' seafloor secrets. A new UK inventory of greenhouse gas emissions has been developed, and the Extremes Dataset is already improving flood forecasting and emergency planning. These are the kind of science achievements CEH has always proudly delivered: that advance knowledge of complex natural environments, develop technologies, and help our stakeholders to develop policy and make evidence-based decisions.

I have every confidence that CEH will continue to deliver such underpinning science achievements. Ensuring the foundation for this has been the focus of the year 2006/07. Encouragingly, we won the most funding awards from Research Councils of any other organisation in our class, and our success rate increased from 19% in 2005 to 29% for 2007 (Research Fortnight, 12 September 2007). Not bad for an organisation going through major change!

To all, a heartfelt thank you.

Pat Nuttall

Pat Nuttall
director@ceh.ac.uk


Frank Farquharson, CEH

Our Vision

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

CEH's Aims

Our Mission

- 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 **provide advice** to UK and EU government departments on environmental issues based on high quality research and analysis;
- To **secure and manage** environmental data and provide access for 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 **work in partnerships** wherever appropriate, to exploit the full potential of the Centre's expertise, data and facilities;
- To **apply 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 **continue to implement** the standards of an 'Investors in People' organisation.

Science Programmes

In 2006-2007 CEH carried out its science within four Science Programmes: Biodiversity, Water, Biogeochemistry and Environmental Informatics. Research is integrated, allowing us to bring together multi-skilled teams to tackle complex problems.

The Biodiversity Programme, led by Prof. Mark Bailey, aims to understand many 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 aquatic environments, better management of risks from floods and droughts, and the sustainable management of catchments and water resources.

"multi-skilled teams to tackle complex problems"

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. Objectives include the identification of the cause of changes in atmospheric composition, the ecological effects of pollutants and cost-effective control measures.

The Environmental Informatics Programme is led by Dr Matthew Stiff. The Programme seeks to provide users with integrated access to environmental information using techniques from environmental and information sciences, statistics and information technology.

Two cross-cutting Themes are relevant to all the four Programmes listed above:

Sustainable Economies. This Theme 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 energy use, and ecological and hydrological risks.

Climate Change. This Theme harnesses expertise in biogeochemistry, water, biodiversity and environmental informatics in a holistic way. The Theme aims to investigate the underlying processes in the global climate system, assessing the impact of climate change and developing cost-effective mitigation and adaptation strategies.


Sue Wallis, CEH

Each year, CEH identifies its top science achievements. Here are the top achievements for 2006-2007, showing the breadth of our expertise.

Top Science Achievements

Parasitic hoverflies improve the reproductive success of their ant hosts

Karsten Schönrogge and colleagues

The hoverfly *Microdon mutabilis* spends its early life as a predator of larvae in the nests of the ant *Formica lemani.* New CEH research has demonstrated a type of ant-hoverfly interaction that results in a fitter and possibly more fertile ant colony, which is not predicted by standard ecological theory.

The *Microdon* hoverfly only preys on the ant species *Formica lemani* and only on ant colonies near to where the hoverflies were themselves born.

The study found that hoverfly larvae specifically target small prey including ant eggs and small larvae. Ant larvae destined to become queens grow before the predator becomes active, gaining more access to limited resources. The result is that more than twice as many new queens are reared in nests infested with hoverflies than in non-infested nests.

Karsten Schönrogge, CEH

John Breen

IMPACT

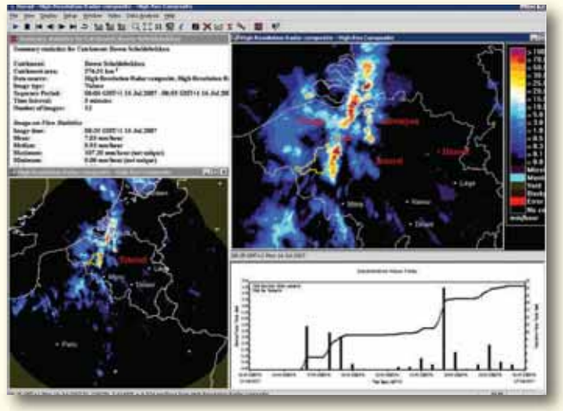
CEH's research has demonstrated that ant nests infested with hoverflies produce more reproductive females and may be ecologically more successful than non-infested ant nests.

The Extremes Dataset

Bob Moore and colleagues

This dataset contains rainfall estimates from weather radar and rain gauges for extreme storms of different types. It also contains artificially-enhanced forms of these storms through changes made to their position, movement, orientation, size and shape. Some of the historical storm case studies also include river flow data.

The Extremes Dataset is now available on DVD and is being used by forecasters in the Environment Agency to gain experience of managing extreme events before such events happen. Animated images of the storms can be displayed using 'Hyrad' (an advanced weather radar display system developed by CEH). Storm Transposition software allows a storm to be 'relocated' to another area to study the effects (rainfall, run-off and flooding) of an extreme storm.



IMPACT

The Extremes Dataset is giving flood forecasters important prior experience of coping with extreme storms and providing flood warnings.

Seabirds' seafloor secrets

Francis Daunt and colleagues

Dave Carss, CEH

In a recent project between CEH and partners in Japan, miniature bird-borne cameras were used to obtain the first underwater digital images of North Sea seabirds searching for and capturing prey.

Cameras were deployed on European shags *Phalacrocorax aristotelis* on the Isle of May in 2005, when breeding success was very poor, and in 2006 when success was high. Shags typically feed in sandy areas on lesser sand-eels *Ammodytes marinus*. However, in 2005 the cameras revealed that birds were foraging in rocky areas covered in soft coral. Butterfish *Pholis gunellus* was the main prey and capture rates were very low because each fish had to be brought up to the surface to swallow. In contrast, in 2006 shags were frequently recorded foraging in prime habitat for sand-eels.

IMPACT

This new technology has revolutionised our ability to study the interactions between seabirds and their prey, as well as the impact on breeding success.

Greenhouse gas emissions: the UK's inventory

Amanda Thomson and colleagues

The UK is required to produce annual inventories of greenhouse gas emissions and removals from sources and sinks, resulting from human activities, for the UN Climate Change Convention. CEH has been producing the inventory for the land use change and forestry sector for over ten years. There are complex processes governing emissions and removals in this sector (the only sector that can be both a net sink or source). CEH leads the way both in research for the explicit improvement of the inventory and in the underpinning science on the wider biogeochemical processes involved. The UK's inventory is regarded as a world leader in terms of its completeness and scientific basis.

IMPACT

This work is essential for the UK to measure and monitor its progress in achieving the aims of the UK Framework Convention on Climate Change and the Kyoto Protocol.

Sue Wallis, CEH

Laser tweezers – for bacteria

Andrew Whiteley and colleagues

Most of the bacteria that live in the natural environment have not yet been grown in the laboratory. Bacteria live together in complex communities of many different species, so trying to separate and grow one species by itself is like trying to grow one seedling in a garden full of weeds. One way of overcoming this is to 'pick up' single cells of the bacterial species we are interested in and grow them on alone – not easy as bacteria are only 1,000th of a millimetre in length.

In order to overcome this we have developed laser-based tweezers which allow us to pick up objects the size of a bacterial cell and move them to individual culture vessels, where they can grow in the absence of other species.

IMPACT

The new method developed by CEH opens new frontiers for the cultivation of bacteria in laboratory environments.

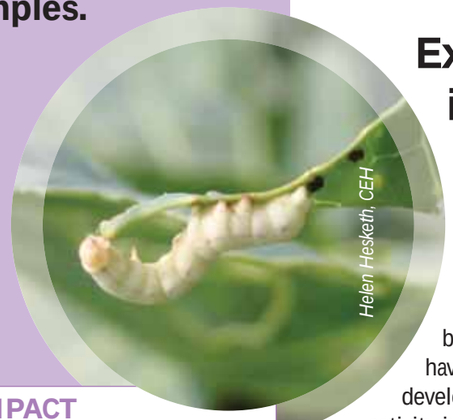
CEH Science

CEH's science is applied in a range of fields, benefiting the global environment. Here are some examples.

Science in Action

Exploiting the action of an insect virus

Helen Hesketh and colleagues


Helen Hesketh, CEH

Baculoviruses are viruses that are specific to insects and infect mainly butterflies and moths (Lepidoptera). Biological pesticides based on baculoviruses have been successfully developed, but need their activity improving to be more effective in horticultural and arable crops. Baculoviruses can be naturally transmitted between insects and to their offspring, so long-term pest control may be possible.

Working with colleagues at Rothamsted Research, CEH has shown that in the laboratory, larval death-rates can be increased if the baculovirus is combined with the bacterium *Bacillus thuringiensis* (Btk) and the pesticide Spinosad™. Field trials have shown that insects are more likely to become infected with baculovirus when they are exposed to a combination of baculovirus and Btk, but this exposure produces much smaller larvae. When these small larvae die they yield less virus per carcass, so there is less infectious material available to infect other larvae.

IMPACT

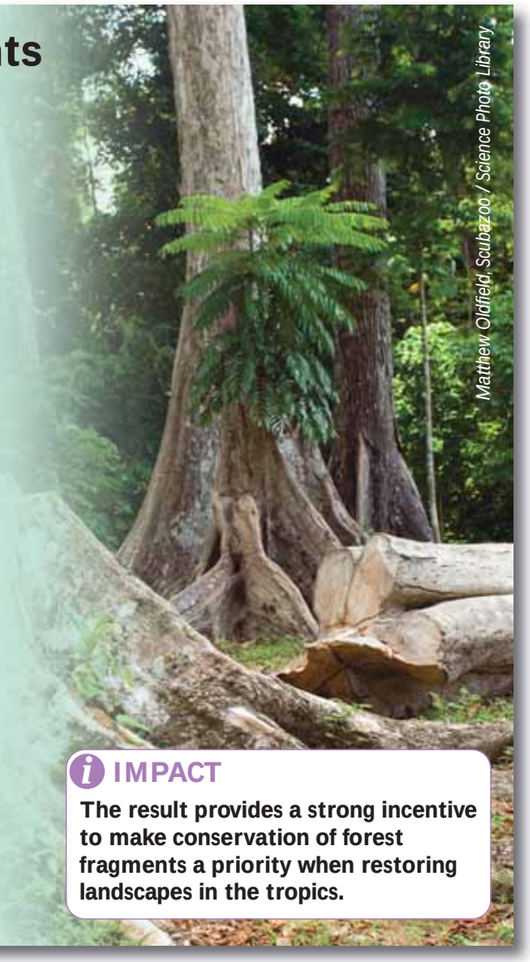
This ground-breaking work has provided new knowledge of the ecology of baculoviruses and will aid the development of new, sustainable methods of pest control.

Primary forest remnants provide the seeds of recovery in tropical forest restoration

Samantha Davies and colleagues

We have compared genetic diversity in populations of the tropical tree *Vochysia ferruginea* in primary (old) forest and secondary (re-established) forest. This has shown that, whilst the process of colonisation initially lowers diversity, pollen transport from the primary forest can restore diversity in mature secondary forest.

Remnant, primary forest tree populations were found to have higher diversity than 25 and 40-year-old secondary forest populations, and seedlings growing in nearby pasture showed reduced diversity compared to the forest populations. However, seed collections from both forest types had high genetic diversity levels, showing that genes from the more diverse forest populations have the potential to move into newer populations over time, helping genetic diversity to recover.


Matthew Oldfield, Scubazoo / Science Photo Library

IMPACT

The result provides a strong incentive to make conservation of forest fragments a priority when restoring landscapes in the tropics.

Can we increase the biodiversity and productivity of hay meadows?

James Bullock and colleagues


Sue Wallis, CEH

For many years it has been thought that farmers could maximise animal production by creating fields with only a few species of rapidly growing grasses, using high levels of fertiliser. However, environmentalists wish to restore traditional hay meadows and grasslands containing a variety of plant and associated animal species. Our study shows that both these aims could be achieved.

Using arable fields at two English farms, hay meadows were recreated with many wild flower species. Their agricultural output was contrasted with plots sown with a few species. Surprisingly, the wildflowers-plus-grass plots produced over 40% greater hay yield than the grass-only plots. The wildflowers-plus-grass hay had as good or better food quality for cattle than from the grass-only plots and the effects lasted and increased over eight years.

IMPACT

Increasing biodiversity can increase agricultural production, meaning we can develop 'win-win' solutions for both biodiversity conservation and economic gain.


Nick Beresford, CEH


Nick Beresford, CEH

How much natural radioactivity is wildlife exposed to?

Nick Beresford and colleagues

CEH, working in collaboration with others, has created databases of natural *radionuclide concentrations in soils, stream waters, sediments, selected wild animals and plants in England and Wales.

Available data for all these categories were collated and a measurement and sampling campaign was conducted to fill the gaps in information. CEH data holdings (e.g. the Environmental Change Network and the Predatory Birds Monitoring Scheme) provided sample material.

Potassium^{40} was identified as being the largest contributor to the exposure of wildlife. This work will allow us to put assessments of man-made radioactivity (e.g. power station discharges) into context with natural background exposures.

**A radionuclide is an unstable form of a chemical element that spontaneously decays, producing radiation.*

IMPACT

These results will help scientists, industry and regulators to better assess the impact of man-made radioactivity.

It is essential that we improve our understanding of how changes in climate patterns impact upon our natural environment. Here are some examples of CEH's work in this area.

Climate Change Impacts

Understanding the impacts of carbon dioxide on the oceans

Andrew Whiteley and colleagues

If, as predicted, global carbon dioxide (CO_2) levels rise, the acidity of the oceans will increase. An estimated drop in the pH from 8.2 to 7.8 (more acidic) over the next century would have major implications. A team from CEH participated in the 'Bergen mesocosm experiment' in May 2006, when CO_2 was bubbled through large volumes of seawater in bags suspended in coastal waters, to mimic future predicted levels of acidification.

Molecular detection tools were used to assess the effects upon oceanic microbes, which are a key component of the marine food web. Initial results showed a dramatic shift in microbial community structure; we are continuing to investigate the impacts of this further up the food chain and on higher animals.


Andrew Whiteley, CEH

IMPACT

Preliminary data has demonstrated that acidification of the oceans may cause significant changes within the food webs of marine ecosystems.

How is the British flora changing?

Chris Preston and colleagues

The book 'Change in the British Flora 1987-2004' by Braithwaite, Ellis & Preston is an analysis of recent changes in *vascular plant distributions. Detailed information on the current state was obtained from a survey of 811x2km squares throughout Britain. These squares were first surveyed by members of the Botanical Society of the British Isles in 1987-1988, and were re-surveyed in 2003-2004.

The analysis of the survey results demonstrates the increase in native species living mainly in southern Britain since 1987. This was especially noticeable in grassland and urban habitats. Species of infertile habitats have declined and, surprisingly, arable weeds show a modest recovery. Introduced species reaching Britain by 1950 have continued to spread, and have been joined by more recent arrivals.

** Vascular or 'higher' plants include ferns, conifers and flowering plants.*


Tony Dore, CEH

IMPACT

This is the first national survey of British vascular plants that demonstrates the apparent effects of climate change.

Launch of the JULES community land surface model

Eleanor Blyth and colleagues

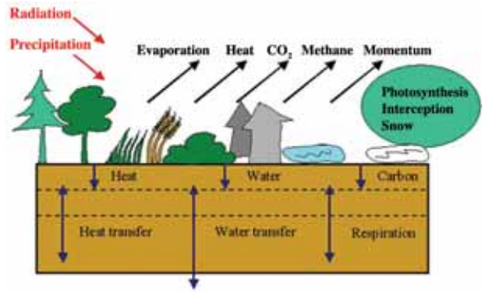

John Gash, CEH

JULES (Joint UK Land Environment Simulator) is a computer model that diagnoses the environmental state of the Earth's surface under changing weather conditions. Originally designed to operate within a climate model, JULES now has many other uses such as impacts of land-use and climate change on water resources.

JULES is a community model, where a large group of land surface scientists contributes to the development of progressively improved versions, which all can use. The current version is a joint development between the UK's Met Office and CEH.

Example outputs from JULES include calculation of snow melt rates and potential for soil freezing in cold weather. These results are combined with state-of-the-art mathematical description of processes such as vegetation photosynthesis and growth, to predict changes in other areas such as river flow rates and in carbon storage.


Colin Lloyd, CEH



IMPACT

JULES will provide scientists with a state-of-the-art tool for studying the impacts of climate change.

Increasing ozone concentrations damage upland vegetation

Gina Mills and colleagues

Ozone pollution, formed by a reaction of vehicle and industrial emissions at ground level in the presence of sunlight, is a growing threat to our vegetation. For example, concentrations measured in Snowdonia exceeded 40 parts per billion on 75 days during May, June and July in 2006, which is high enough to affect sensitive plant species.

Using eight dome-shaped greenhouses with computer-controlled ozone levels, we exposed plants commonly found in Snowdonia to four different ozone regimes representing past, present and predicted future ozone levels for Snowdonia. The results showed that some species may already be being damaged by ozone pollution in our UK uplands, and that the amount of damage to communities is likely to increase as ozone pollution worsens during the 21st century.

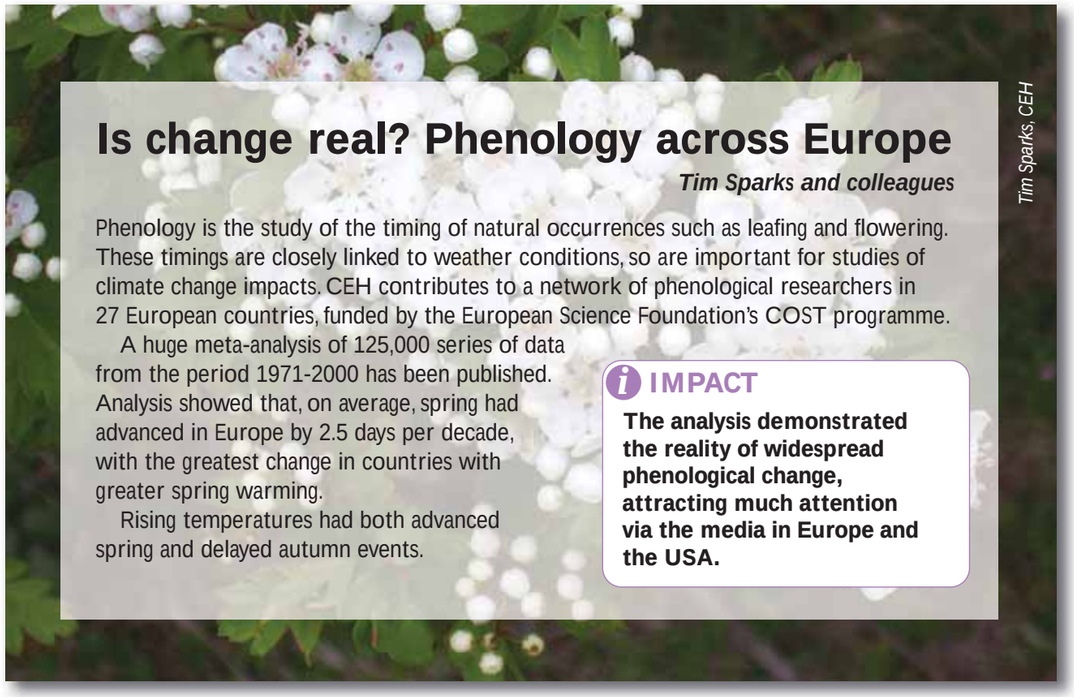

Gina Mills, CEH

IMPACT

Despite EU-wide controls, background levels of ozone continue to rise. CEH's results are being used to develop an international pollution control policy.

Gina Mills, CEH

CEH Science



Is change real? Phenology across Europe

Tim Sparks and colleagues

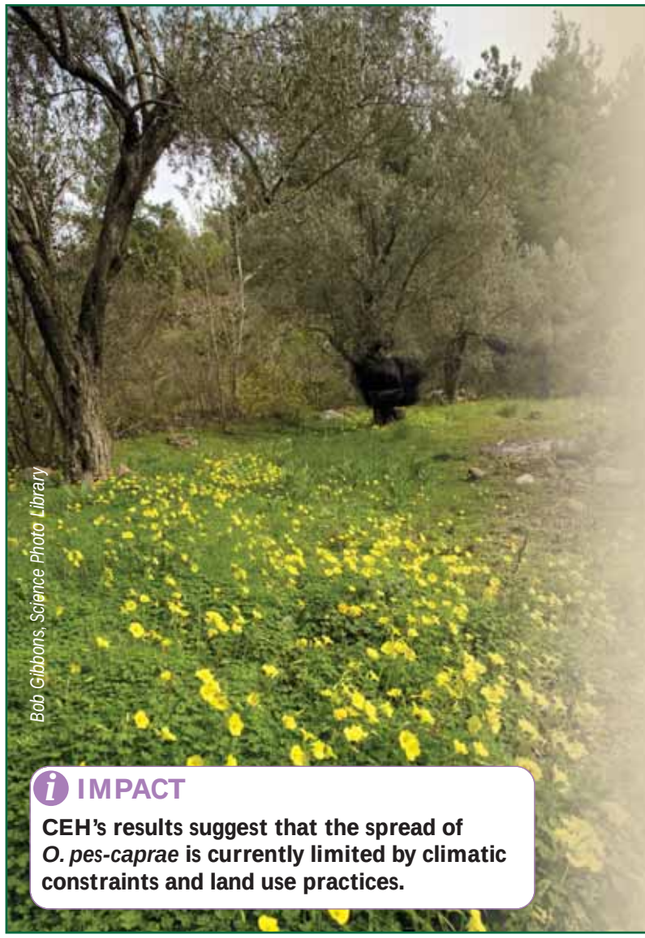
Phenology is the study of the timing of natural occurrences such as leafing and flowering. These timings are closely linked to weather conditions, so are important for studies of climate change impacts. CEH contributes to a network of phenological researchers in 27 European countries, funded by the European Science Foundation's COST programme.

A huge meta-analysis of 125,000 series of data from the period 1971-2000 has been published. Analysis showed that, on average, spring had advanced in Europe by 2.5 days per decade, with the greatest change in countries with greater spring warming.

Rising temperatures had both advanced spring and delayed autumn events.

IMPACT

The analysis demonstrated the reality of widespread phenological change, attracting much attention via the media in Europe and the USA.



Does climate affect the range expansion of an invasive plant species?

Louise Ross and colleagues

Warming of the climate and changes in land use may help invasive plant species expand their ranges, but in order to predict this we need a better understanding of biological limitations on populations. A case study is presented of the alien *Oxalis pes-caprae* or Bermuda buttercup. This plant's distribution in the Mediterranean basin closely follows olive cultivation, which on Crete is limited to below 600 metres. The potential for colonisation at higher altitudes was unknown. To investigate this, performance was monitored in a series of replicated plots planted with *O. pes-caprae* *bulbils along an altitude gradient in the Lefka Ori mountains.

The survival rate, plant and bulbil biomass of the resulting plants all declined significantly with height, irrespective of soil type, initial bulbil size or seasonal variation. Plant performance correlated strongly with the duration of spring snow cover.

** Bulbil: an immature small bulb.*

IMPACT

CEH's results suggest that the spread of *O. pes-caprae* is currently limited by climatic constraints and land use practices.

Long-Term Monitoring

Monitoring the natural environment over long periods enables us to identify past and current change and to predict future change more reliably.

Sulphur and nitrogen deposition in Europe: how is it changing?

David Fowler and colleagues

Since legal controls governing emissions have been in place in Europe, the emissions of sulphur and nitrogen oxides have been greatly reduced. However, in many regions of Europe the deposition of these acidifying pollutants has not decreased in proportion to the reduced emissions, as would be expected. Some regions have benefited much more than others, and in general the uplands have benefited least, while the industrial lowlands have benefited most. There are two reasons: firstly, the land surfaces are gradually becoming more effective in capturing sulphur dioxide; and secondly, the rates of atmospheric oxidation of sulphur and nitrogen have increased.

IMPACT

CEH's research has demonstrated that the changes predicted in acid deposition levels following emission reduction have not occurred uniformly across Europe, showing the need for better models of atmospheric transport, reaction and deposition.

What happens in the carbon cycle of an upland moorland?

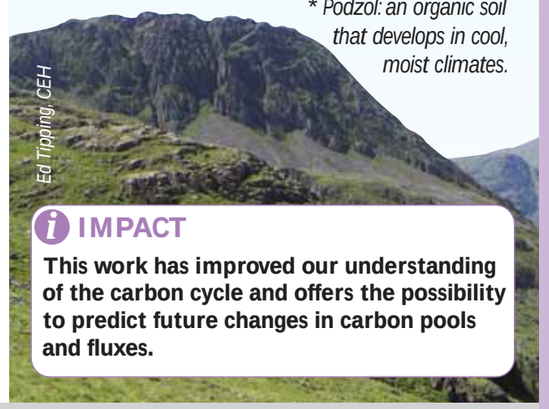
Ed Tipping and colleagues

The *podzolic soils of the Doe House Gill moorland catchment in northern England contain a soil carbon pool of 8300 grams per square metre. The carbon resides in the soil for an average of 800 years. Dissolved organic carbon (DOC) and particulate (litter) organic carbon fluxes were 2.5 and 0.4 grams per square metre per year respectively via the stream waters.

These figures were used to calibrate DyDOC, a model that simulates carbon cycling by tracking the isotope Carbon^{14}, which enters the system as litter and leaves as carbon dioxide and DOC. DyDOC shows that the moorland soil gains and loses carbon by similar amounts, and that warming over 200 years would cause a loss of soil carbon of about 5%.

The model also predicts higher DOC fluxes in response to increased litter inputs or warming.

** Podzol: an organic soil that develops in cool, moist climates.*



IMPACT

This work has improved our understanding of the carbon cycle and offers the possibility to predict future changes in carbon pools and fluxes.

Mosses of Europe

Mark Hill and colleagues

At the invitation of the European Committee for the Conservation of Bryophytes (mosses), CEH staff played a leading role in coordinating a new checklist of the species. The last comprehensive list was published in 1981. The checklist will enable researchers to ensure that references to species names are consistent and accurate.

The checklist was derived from those existing for the various component countries and regions of Europe. Such lists need updating periodically in order to reflect new knowledge about the group. The project was guided by a steering committee and also had access to specialist advice.

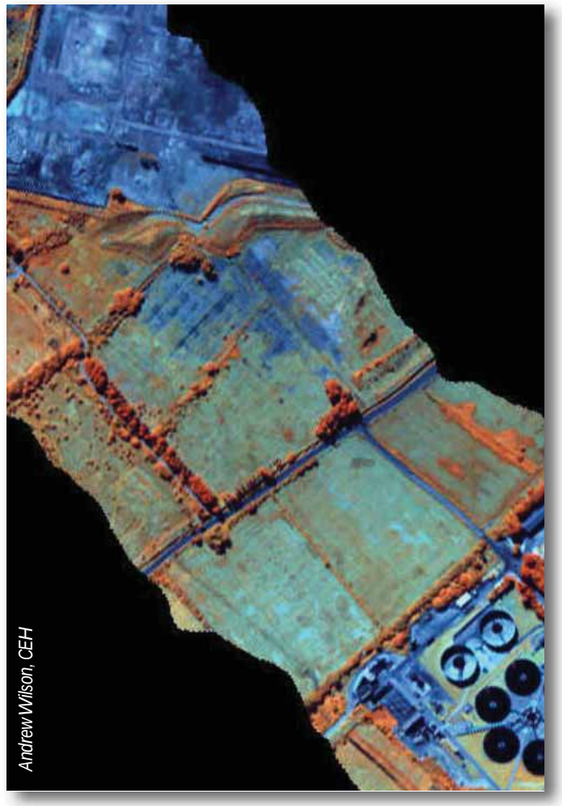
The final checklist shows that the moss flora of Europe and *Macaronesia comprises 278 genera, 1292 species, 46 subspecies and 118 varieties. Out of the total of 1292 species, 53 are confined to Macaronesia and 21 are thought to be non-native. Britain has about 770 species, substantially more than half the European total.

**Macaronesia consists of three archipelagos: Azores (Portugal), Madeira (Portugal) and Canaries (Spain).*

IMPACT

The checklist provides a common nomenclature for European mosses, to underpin both species conservation and science.


G.P. Rothero


Andrew Wilson, CEH

Detecting vegetation in poor health

Andrew Wilson and colleagues

CEH is using its new airborne *hyperspectral scanner to record very detailed information from the Earth's surface, suitable for study of a wide range of key environmental issues. This is the first time that a full system of these specifications has been flown in the UK.

The new sensor views the Earth in a 500-1000 metre wide swath of 1-2 metre sized 'pixels', each with nearly 500 spectral channels of information. Data from the sensor have shown that we can detect such things as poor vegetation health and correlate it with heavy metal pollution at a disused zinc smelter. Also, shortwave infrared wavelengths can be used to monitor leaks of methane and carbon dioxide from natural and man-made environments, the latter including leaking landfills and petroleum refineries.

** Hyperspectral: The use of many narrow sections of the electromagnetic spectrum.*

IMPACT

The use of this new airborne sensor will open up new scientific applications for those working in environmental research and monitoring. It will also provide better information for policy makers.


Sue Wallis, CEH

Butterflies as biodiversity indicators

David Roy and colleagues

Butterflies are excellent biodiversity indicators because they respond rapidly to environmental change. They are representative of many other insects, which together account for more than 50% of terrestrial UK species. For the first time, butterfly biodiversity indicators were developed by CEH for England, based on analysis of UK Butterfly Monitoring Scheme data. Three indicators were adopted by the England Biodiversity Strategy, published in 2006.

- The Headline indicator shows a long-term population reduction, in all species and in butterfly numbers.
- The Farmland indicator shows that the abundance of butterflies in semi-natural farmland has fallen by nearly a fifth since 1990.
- For Woodlands, the abundance of butterflies has declined by 43% since 1990.

In policy terms, the butterfly indicator is important for assessing whether there is sufficient habitat diversity across semi-natural sites and for measuring the effects of climate change.


Sue Wallis, CEH

IMPACT

The indicators that CEH developed will be used by UK conservation agencies to assess the success of their management of SSSIs (Sites of Special Scientific Interest) and the wider countryside.

The sensitivity of invertebrates to changes in river flow

Mike Dunbar and colleagues

The Environment Agency collects *biomonitoring data for many rivers, and CEH has continued to carry out innovative analysis of this data. Biomonitoring information helps to assess the overall health of the habitat. Using a modelling framework previously developed by CEH we have undertaken a project, funded by the Agency, to examine the relative benefits of collecting biological, flow and habitat data. Results have indicated that the degree of habitat modification (e.g. artificial channelling of a river) influences the sensitivity of larger invertebrates living in the river to changes in the water flow.

** Biomonitoring: the examination of the biological communities in a given habitat to determine the complexity, diversity, and species composition present.*


Mike Dunbar, CEH

IMPACT

This work should help develop future integrated management of rivers. It will also help decide the most effective means of achieving good ecological status as required under the European Water Framework Directive.

Change in the landscape can be driven by many different pressures, including human activities. CEH's research is providing a better understanding of these changes.

Landscape Change

Countryside Survey; preparing for the fieldwork

Ian Simpson and colleagues

Countryside Survey is a unique and internationally renowned survey which measures how the UK's countryside is changing and the effects of environmental pressures. Previous surveys were undertaken in 1978, 1984, 1990 and 1998. The latest in the series, in 2007, will add further value to this series. The current survey will combine detailed field recording and satellite mapping, providing information about habitats, landscape features, vegetation, soils and freshwaters. The Survey is being funded by a group of partners from UK Government Departments and Agencies led by *Defra, and NERC.

CEH is now carrying out the Survey, with the field work being conducted during the 2007 summer. Seventy surveyors have been working their way through over 600x1km squares, selected to represent all the major UK habitats. Separate reporting is planned for England, Scotland and Wales and a related Survey is being carried out in Northern Ireland.

**Defra: The UK Government's Department for Environment, Food and Rural Affairs.*

IMPACT

CEH is leading the latest Countryside Survey, which will provide the scientific evidence base needed for land management related policy and strategy development in the UK.
See *www.countrysidesurvey.org.uk*

Investigating the hydrology of wetlands

Mike Acreman and colleagues

Mike Acreman, CEH

The term 'wetlands' covers a wide range of ecosystems including floodplains, fens, mires and wet woodlands. Many of the hydrological characteristics (e.g. high water table) and processes (e.g. soil water dynamics) are common between all types of wetland. CEH has developed a wetland hydrology model based on physical processes, such as rainfall variability, and human-induced changes such as water level management.

The model is being used for two practical applications: assessment of the hydrological needs and impacts of major wetland restoration at the Great Fen, Cambridgeshire; and studies of climate change impacts on wetlands across the UK.

IMPACT

The new model has already been applied successfully in a major wetland restoration programme and could be used for similar work elsewhere.

Sue Wallis, CEH

IMPACT

CEH's work has increased our ability to improve the quality of secondary woodland habitats such as parks and gardens, through better-informed management.

How can we detect 'good habitat quality' for birds?

Shelley Hinsley and colleagues

The three-dimensional complexity of woodland and its large size makes estimating habitat quality very difficult. We used airborne remote sensing data to examine tree canopy structure and to identify tree species within woodlands. We also recorded breeding success in Great Tits and Blue Tits in both primary (continuous woodland) and secondary (urban parkland) habitats.

Tits breeding in parkland reared fewer and poorer quality chicks compared to those in woodland. In parkland, above a critical threshold, structural gaps in the tree canopy caused an increase in the energy expended by the adult birds to rear chicks. In continuous woodland, functional gaps created by the absence of oak trees (high quality foraging habitat) also increased adult costs. These measures of habitat quality revealed hidden costs to the birds.

Has plant biodiversity in the British countryside become more boring?

Simon Smart and colleagues

CEH tested the hypothesis that as species diversity declines, the species and traits (or distinguishing features) associated with winning or successful groups of plants or animals, become more common in the surviving organisms. This leads to a more 'boring' tapestry of rural habitats across Britain, with the successful species becoming ever more common.

Data on plant species occurrence and trait data was drawn from previous Countryside Survey sampling plots. It was found that where local diversity declined, plant communities became functionally more similar, converging on a similar range of winning trait syndromes. CEH's work has increased our understanding and our ability to predict how human activity helps to filter out these traits, and the resulting impact on ecosystem function.

Nigel Brown, CEH

IMPACT

CEH has highlighted that the continuing decline in habitat quality leads to the loss of key ecosystem functions.

Ecotone mapping

Geoff Smith and colleagues

An ecotone is the transition zone between one vegetation or habitat type and another (e.g. where heathland gradually becomes grassland). The ecotone usually contains species from each of the adjoining zones and so is particularly difficult to map. CEH has developed a method of identifying and characterising the spatial characteristics of these ecotones. The method is a very novel approach to the use of remotely sensed data and could provide an early indicator of ecological response to environmental change. CEH's research adds extra value to the satellite data being collected under the new Europe-wide Land Monitoring Core Service.

Jane Hall, CEH

IMPACT

CEH has developed a new mapping tool which could be used to provide an early indication of ecological response to environmental change across Europe.

Land use change in England and Wales, 1930–2000

Ruth Swetnam

Ruth Swetnam, CEH

IMPACT

The study highlighted the major impact of EU Common Agricultural policy on land use change at both local and national scales.

For the first time, historical data from the 1st and 2nd Land Utilisation Surveys of Great Britain from the 1930s (Dudley Stamp) and the 1960s (Alice Coleman) have been integrated with the later Countryside Surveys of CEH and its predecessors, for 1978, 1984, 1990 and 1998. A unique time-line of historical land use change has been constructed, and the integrated datasets have now been analysed alongside other socio-economic information. The key trends in recent land use change have been confirmed, including large increases in woodland area, intensification of agriculture and urban expansion.

A new method allows us to pinpoint where, when and how such change is expressed. Less than half of each of the 1km squares studied remained stable over the 70 year time-span. A detailed case study showed that large scale policy drivers clearly had an impact on landscapes at the 1km scale, although changes were also 'filtered' by social processes.

Pollution and Health

Pollution of the natural environment affects humans, wildlife, and resources such as water and the atmosphere.

What are the potential risks of drug usage during an influenza pandemic?

Andrew Singer and colleagues

Robert Brook, Science Photo Library

Tamiflu, an antiviral flu drug, is recommended by the World Health Organization for use during an influenza pandemic. CEH has published a model of the predicted concentration of Tamiflu in selected UK and USA rivers, resulting from large numbers of people taking Tamiflu at the same time. Our estimates suggest that the concentration of Tamiflu in some rivers would be high enough to generate viral resistance to the drug in birds, for a span of 40-60 consecutive days. There might also be toxicological risks to other river wildlife. Sewage treatment works would also be at risk, due to high concentrations of the drug in waste waters.

CEH was first in identifying the risk to wildlife and the environment from use of Tamiflu during a pandemic.

IMPACT

CEH's research encouraged the UK Government's Chief Scientist to facilitate an international workshop, bringing together industry, government and scientists to discuss further action.

Heavy metal concentrations in mosses decrease across Europe

Harry Harmens and colleagues

A European biomonitoring network has provided data on the concentrations of ten different heavy metals in naturally occurring mosses. The technique of moss analysis provides a measure of the amount of atmospheric deposition of metals to the Earth's surface and natural systems. Moss surveys across Europe have been repeated every five years, coordinated since 2001 by the *UNECE ICP's Vegetation Co-ordination Centre at CEH.

Across Europe a dramatic decline in the concentrations of lead (57%) and cadmium (42%) was observed between 1990 and 2000, with a smaller decline for vanadium (32%), zinc (19%) and copper (16%). Thirty countries took part in the 2005-2006 moss survey, sampling mosses at about 7,000 sites.

** UNECE ICP: United Nations Economic Commission for Europe, International Co-operative Programme.*

Sue Wallis, CEH

IMPACT

These data are used to assess the effectiveness of the Heavy Metals Protocol (1998) of the UNECE Convention on Long-Range Transport of Transboundary Air Pollution.

National scale mapping of persistent organic pollutants

David Spurgeon and colleagues

CEH has successfully carried out the first UK-wide survey of persistent organic pollutants (POPs). The POPs analysed were polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and organochlorines. The study enabled CEH to identify patterns in the distributions of persistent organic pollutants in different parts of the country and in different types of soil.

The results have allowed us to identify the regions of contamination where POPs are most likely to enter into the human and ecological food chain from environmental sources.

David Spurgeon, CEH

Sue Wallis, CEH

IMPACT

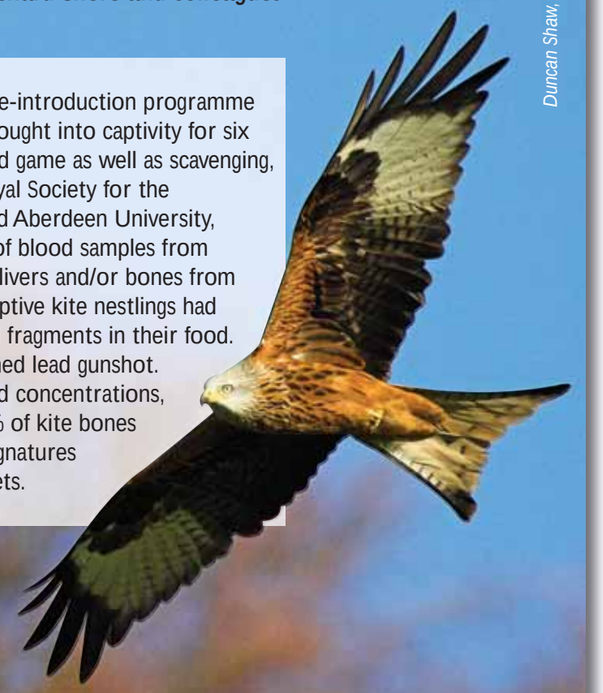
CEH's work has provided information on the likely regional exposure of humans and wildlife to persistent organic chemicals.

How are red kites becoming contaminated with lead?

Richard Shore and colleagues

Since 1989, Natural England (NE) has led a successful re-introduction programme for red kites *(Milvus milvus)* in England. Nestlings are brought into captivity for six to eight weeks before release. Red kites eat unretrieved game as well as scavenging, which may contain lead shot. Working with NE, the Royal Society for the Protection of Birds (RSPB), the Institute of Zoology and Aberdeen University, we assessed the exposure of kites to lead by analyses of blood samples from captive nestlings, pellets regurgitated by wild birds and livers and/or bones from dead kites found between 1995-2003. Some 37% of captive kite nestlings had elevated blood lead concentrations, probably from lead fragments in their food.

After release, 1.5-2.3% of regurgitated pellets contained lead gunshot. 16% of kites found dead or dying had elevated liver lead concentrations, and of these, 14% were fatally high. Approximately 20% of kite bones had elevated lead concentrations. Liver lead isotopic signatures were compatible with lead shot from regurgitated pellets.



Duncan Shaw, Science Photo Library

IMPACT

This study indicates that lead shot ingested by kites can give an exposure high enough to be fatal.

NitroEurope is established

Mark Sutton and colleagues

NitroEurope is a five-year EU-funded Integrated Project coordinated by CEH, involving over sixty scientific institutions across Europe. The project will investigate how the deposition of 'reactive nitrogen' (nitrogen that is biologically available) from the atmosphere affects the production and release of greenhouse gases. Most of this 'reactive nitrogen' results from human activities. The project involves a detailed programme of measurements at various scales across Europe, coupled to modelling that will be used to examine the influence of land use on the fluxes of trace gases.

The opening meeting was held in Spring 2006 and brought together all the research teams to finalise details of the research programme.
See *www.nitroeurope.eu*

NitroEurope IP

IMPACT

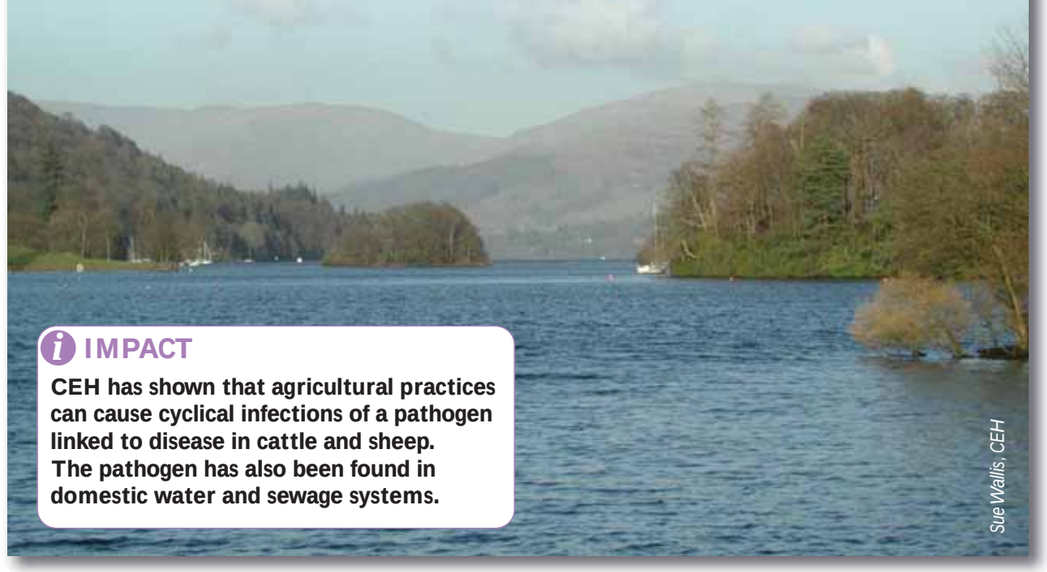
This is a major collaborative programme led by CEH, that will reduce uncertainties in the interactions between the nitrogen cycle and greenhouse gases.

A potential human pathogen in river and lake catchments

Roger Pickup and colleagues

CEH research has shown that the pathogen *Mycobacterium avium subspecies paratuberculosis* (*Map*) is present in rivers and lakes and is also found in the domestic water and sewage supply system. *Map* comes from infected sheep and cattle which excrete on pasture land. *Map* is known to cause Johne's disease in cattle and the pathogen is also suspected to be a causative agent in Crohn's disease in humans.

Sampling surveys were carried out in South Wales and the English Lake District. The results showed that the agricultural practice of reapplying *Map* contaminated slurry from sheep and cattle back on the land surface causes a cycle of infection and subsequent persistence of *Map* in the natural environment. Sediments up to 50 years old within river and lake beds also tested positive for *Map* as well as samples taken from lakes and rivers where water is abstracted for domestic use.



Sue Wallis, CEH

IMPACT

CEH has shown that agricultural practices can cause cyclical infections of a pathogen linked to disease in cattle and sheep. The pathogen has also been found in domestic water and sewage systems.

Alien and Invasive Species

Plant and animal species are continually trying to expand their range in order to survive, but climate and other factors both permit and limit this expansion. How does this affect other species and ecosystems?

How does an invasive plant affect riverbank ecosystems?

Anne-Marie Truscott and colleagues

Plant invasions have been widely recognised as having severe ecological impacts, yet very few studies have measured this. The impacts of the invasive riverside plant *Mimulus guttatus* (Monkey flower) are currently unknown, although it has been judged as having a 'moderate adverse significance' in Scotland.

Addition and removal experiments were used to measure the impact of *M. guttatus* on native plants and soil properties. CEH found that species richness and diversity were significantly lower in plots where *M. guttatus* was present. Where *Mimulus* was removed this was associated with an increase in species richness and diversity. The results suggest that *M. guttatus* is already a successful invader becoming more widespread, with the potential to exclude native species, decrease diversity and obstruct waterways.

IMPACT

This work is one of the few studies of the impacts of invasive plant species, using experimental manipulations, to be undertaken in Europe. The methods devised could be used elsewhere.

G. Antonio Milani, Science Photo Library

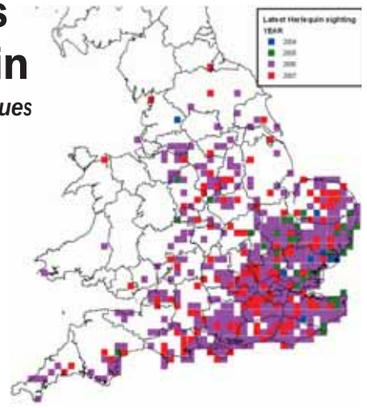
Jon White

IMPACT

There is growing evidence that the Harlequin will have a serious impact on native ladybird species and other insects. See *www.harlequin-survey.org*

Harlequin ladybirds march across Britain

Peter Brown and colleagues



Biological Records Centre, CEH

The Harlequin ladybird *Harmonia axyridis* is described as the most invasive ladybird on Earth. First recorded in the UK in Essex in the autumn of 2004, the Harlequin's invasion is being monitored by the UK Ladybird Survey, supported by the Biological Records Centre at CEH. The species has spread very rapidly from the south-east; between 2004 and 2006 the species spread westwards at over 140 km per year, reaching Cornwall and western Wales. The project relies on verifying sightings of the Harlequin made by members of the public. Over 10,000 online records have been submitted, many including a photograph to check identity.

The Harlequin ladybird is also a problem species in other parts of the world, particularly North America and increasingly in northwestern Europe, where it is established in thirteen European countries.

Seabirds highlight a population explosion of pipefish

Sarah Wanless and colleagues

Sarah Walness, CEH

UK seabirds traditionally rely on sand eels as their major food source, but recent collapses in sand eel stocks have had serious impacts on the seabird colonies. Routine surveillance of seabird diets on the Isle of May has revealed a dramatic change since 2004. A previously unrecorded species - the snake pipefish *Entelurus aequoreus* - is appearing in unprecedented numbers. Pipefish are nutritionally poor and difficult to swallow, so they are not a good food source for growing chicks. Evidence from trawl surveys and in plankton samples collected by The Sir Alistair Hardy Foundation for Ocean Science's Continuous Plankton Recorder indicates a massive increase in both the abundance of snake pipefish and their range, in the North Sea and Northeast Atlantic. The pipefish seems to lack major predators and its effects on marine ecosystems are as yet unknown.

IMPACT

The snake pipefish population explosion may already be affecting ecosystems and food web dynamics in seas around Scotland.

Alien invaders: GB countryside holds out against threat

Lindsey Maskell and colleagues

Our research used data from previous Countryside Surveys to study the distribution and possible impacts of non-native plant species in the UK. The investigation demonstrated that currently, non-native species are not as great a threat as commonly perceived. It was suggested that changes in land use were more significant.

The work has led to a European collaborative study. A comparative analysis was carried out on the level of invasion (and invasion potential) of different habitats between three contrasting regions of Europe. CEH wished to see whether national-level trends revealed are consistent across a wider geographical scale, and to what extent. Our work will feed into analysis and interpretation of the Countryside Survey 2007.

Sue Wallis, CEH

IMPACT

CEH's studies will contribute to UK and European risk assessment and policy on non-native species.

CEH Science

Understanding the factors that drive floods and droughts allows us to improve forecasting. Better information allows others to make better plans for protecting homes and businesses in emergencies, and to make wise use of water supplies.

Floods and Droughts

How can floods be forecast at ungauged locations?

Bob Moore and colleagues

A blueprint for an improved model for area-wide flood forecasting has been developed as a prototype. The prototype is linked to digital datasets on terrain properties (topography, slope angle, soil, geology and land cover) and contains physically-based linkages which make use of new representations of surface run-off, channel flow, lateral soil drainage, and stream-to-aquifer interactions.

The improved modelling strategy marks a move away from 'statistical regionalisation approaches' for forecasting, previously used at ungauged locations. The new prototype has a sounder physical basis and a more robust and accountable performance.

IMPACT

The new model can be used to forecast at any location, including sites that may be ungauged at present but still require flood warnings.

Neville Llewellyn, CEH

Ned Hewitt, CEH

Monitoring the drought, 2005-2006

Terry Marsh and colleagues

CEH is the leading source of authoritative and impartial guidance regarding drought conditions across the UK. We carried out careful monitoring of patterns of rainfall, river and groundwater levels throughout the 2005-2006 drought.

A range of reports from the National Hydrological Monitoring Programme (NHMP), run by CEH and the British Geological Survey, were exploited by stakeholders, including Government Departments, the Environment Agency and the water industry. The NHMP information helped to monitor the drought's development and severity; and was widely utilised in Public Enquiries to support or challenge applications for Drought Orders or proposals to augment water resources.

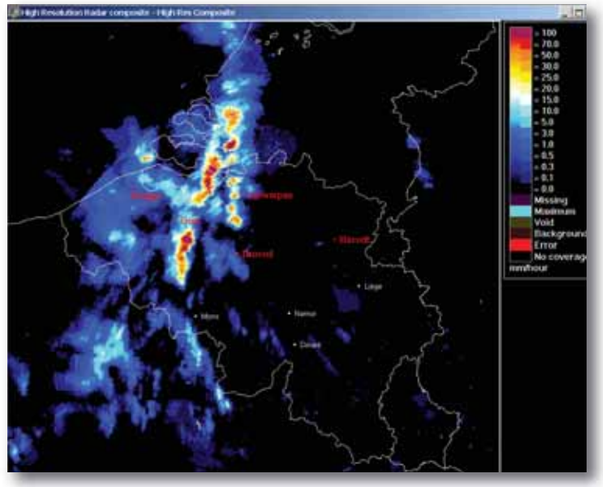
The drought resulted from successive very dry winters, unusual in the context of the last 30 years. Low winter rainfall was more common prior to 1914, as was shown by the long-term data held by CEH in the National River Flow Archive.

IMPACT

CEH research has led to a better understanding of the processes contributing to the variations in time series for river flow and groundwater level data. This provides a key to improved seasonal and long-term forecasting of droughts.

Supporting real-time flood management

Bob Moore and colleagues



Hyrad is a real-time processing and display system for hydro/meteorological products such as radar rainfall and numerical weather prediction (NWP) model outputs. Hyrad serves as a key operational component of flood management and is currently used by agencies in England, Wales and Scotland. It is now being extended and developed for use across northern Belgium. Here, the system is configured to provide time-series of rainfalls for over a thousand catchment areas via an interface to 'FloodWorks', a flood forecasting system encompassing CEH's flood forecasting models and information control software. The system combines rainfall estimates from raingauge networks, high-resolution weather radar composite and forecasts from Hyrad, European Nimrod and NWP products.

IMPACT

Hyrad, together with FloodWorks, has been proven to enhance real-time flood management capability.

A new Flood Estimation Handbook

Lisa Stewart and colleagues

Since the release of the first edition of the Flood Estimation Handbook (FEH) in 1999, its procedures have become standard practice for flood estimation in the UK. The FEH provided users with values derived from digital data for over four million sites, with the use of spatial data revolutionising the quantification of flood risk in the UK.

The new version of FEH has provided several important improvements. A new index describes the urbanisation of catchments, based on data provided by CEH's Land Cover Map 2000. The Digital Terrain Model (DTM), which defines catchment boundaries and drainage paths, has been improved. The development of a DTM for the Scottish Islands means that the data provided now extends to all parts of the UK. The new release provides powerful search facilities and enhanced map production.

IMPACT

Version 2.0 of the Flood Estimation Handbook provides improved data, allowing more reliable assessment of flood frequency throughout the UK.

Neville Llewellyn, CEH

CEH Science

CEH's long-term datasets are a national resource that underpins much of our science. Improved methods of managing and interrogating these datasets, using tools such as Environmental Informatics, are increasing their value.

Managing Environmental Data

What is Environmental Informatics?

Matthew Stiff

'Environmental informatics concerns the systems and processes required to capture and preserve environmental data, allowing it to become knowledge and understanding.'

Environmental informatics is a discipline practised across our Science Programmes; it covers data capture, digital curation, modelling, statistics, applications development and knowledge transfer, supported by a range of activities including *ontology, development of standards and management of intellectual property rights.

CEH is adopting an holistic view of its information assets, which include paper and digital datasets, physical samples, and publications. Over time CEH's intellectual assets will become increasingly visible, bringing a wide range of benefits to researchers and others.

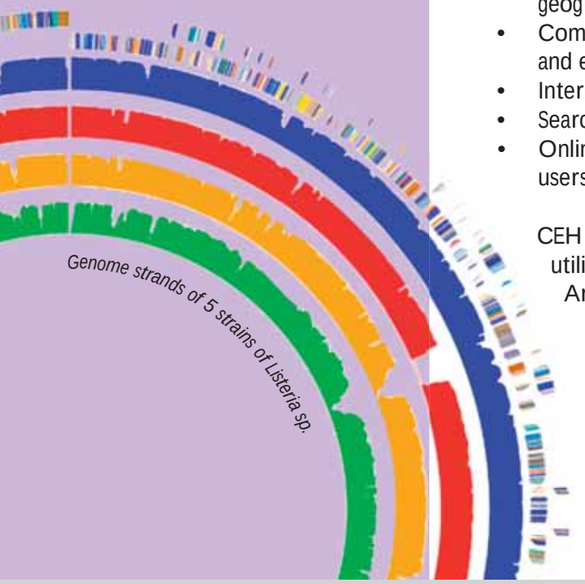
Benefits include:

- Visualisation of data in many different ways (including by time and geographical location);
- Combining information from both CEH's Science Programmes and external partners;
- Interrogating, analysing and transforming data;
- Searches across the organisation's entire intellectual assets;
- Online data-licensing, speeding up supply of information to our users and stakeholders.

CEH is committed to significant investment in IT and storage infrastructure utilising new Web technologies (Web 3.0, the Semantic Web and Artificial Intelligence).

Fast-growing research areas, including genomics and proteomics, are presenting new challenges for the capture, analysis and curation of large volumes of data. Already the visibility of CEH research publications is improving through their publication in the NERC Open Research Archive. See *http://nora.nerc.ac.uk*

** Ontology: a standardised set of terms, similar to a thesaurus. Ontologies are especially useful to enable consistent recording of information in databases.*



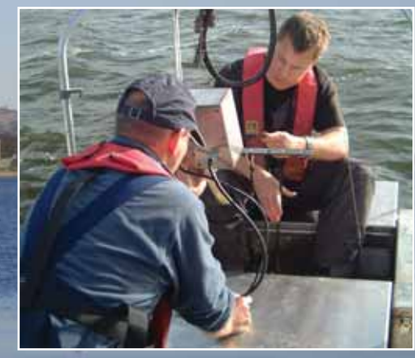
Genome strands of 5 strains of Listeria sp.

Making historic data available: 40 years of records from Loch Leven

Bernard Dudley and colleagues

Long-term monitoring work has been carried out at Loch Leven by CEH and its predecessors since 1968 and some earlier records also exist back to 1951. Most of these data have been in paper form, making analysis very difficult.

A huge amount of work has been completed in recording the data from paper and electronic sources. A single database now contains all the available data on Loch Leven, including weather records, water quality analysis results, physical and chemical parameters, phytoplankton, invertebrates, aquatic plants and fish. The finished database will allow easy data extraction and analysis across a range of environmental and biological parameters. It will also permit consistent future collection and storage of data.



Bernard Dudley, CEH

IMPACT

CEH has provided a tool especially needed by water quality managers required to comply with the EU Water Framework Directive.

Capturing field data for the Countryside Survey

John Watkins and colleagues

IMPACT

The new technology will underpin the quality of the science that can be carried out with this data, and the improved accessibility will be invaluable to policymakers.

CEH has managed the development of practical methods for digital mapping and data capture in the field, for carrying out the Countryside Survey in 2007 (a regular audit of the GB countryside). This system will allow surveyors to take digital maps and recorded *map attributes from previous Countryside Surveys into the field, to check earlier data and record change across the countryside. Data can be quickly transferred from the field computers to the main database, where automated analysis routines will run.

In previous Countryside Surveys, the process of recording, validating and reporting data has taken two to three years. With the new technology, CEH can reduce this to less than 18 months, and provide improved quality assurance.

** Map attributes: detailed characteristics of landscape features, such as hedges, cropped areas etc.*

CEH would like as many people and organisations as possible to know about our skills, expertise and knowledge and to utilise them fully.

CEH wishes to inspire young people to consider a career in science and to take up scientific training at a range of levels.

Outreach and Training

Press and media activities

Barnaby Smith and colleagues

CEH's science continues to be widely covered in the press. During 2006-2007 our Press Office handled over 300 media enquiries and around 70 staff spoke directly to journalists - leading to over 60 articles in UK national newspapers. 75 TV and Radio interviews were broadcast on UK and international outlets. During the year CEH staff were involved in several major TV and Radio series including 'Are we changing Planet Earth?' (BBC1) and 'Wild Thing I Love You' (Channel 4).

Several CEH science stories achieved significant press coverage in 2006-2007. They included the first convincing evidence that spring is arriving earlier across Europe and provision of authoritative commentary on the UK drought. Other key issues which captured the media's attention included the possible impacts of drug release on wildlife during a flu pandemic, the long-term impacts of the 1986 Chernobyl disaster, and the successful reintroduction of the large blue butterfly to South-West England.

Barnaby Smith, CEH

Talking to the public: National Science Week

Sue Wallis and colleagues

CEH takes part in the UK's National Science Engineering and Technology (SET) week in March each year. Our network of schools liaison officers at each CEH site organise and manage a local event, with help from their colleagues.

In March 2007, CEH provided a variety of events. For example, staff at Lancaster ran an activity day for local junior schools. The children investigated soil organisms, microbes living in lakes and the link between peat, the carbon cycle and climate change. Dorset staff ran their very popular 'Science in a Pub' event and Monks Wood staff provided a weblink to a nestbox camera that followed the fortunes of a Blue Tit family.

Two of CEH's younger scientists took part in national events: Claire Carvell attended a Reception for Young Scientists at 10 Downing Street and Helen Miller, a CEH PhD student, attended the Houses of Parliament Science Poster event.

Gareth McShane,CEH

Royal Welsh Show 2006

Bridget Emmett and colleagues

CEH staff from Bangor again ran an exhibition stand at the Royal Welsh Show, which takes place in July each year. Over 250,000 people attended in 2006. CEH's stand focused on our climate change research and the team were delighted to win the Gold Medal for 'Best Exhibit of Educational and Instructional Value'. Visitors were shown how climate change can affect the environment; they could take part in an experiment showing how the drying of peaty soils affects the amount of carbon dioxide released to the atmosphere.

The Show allows staff to reach public, scientists and policymakers in Wales; it is a great opportunity to interest them in CEH's work.

The next generation of scientists: student training schemes

Carol Mansfield

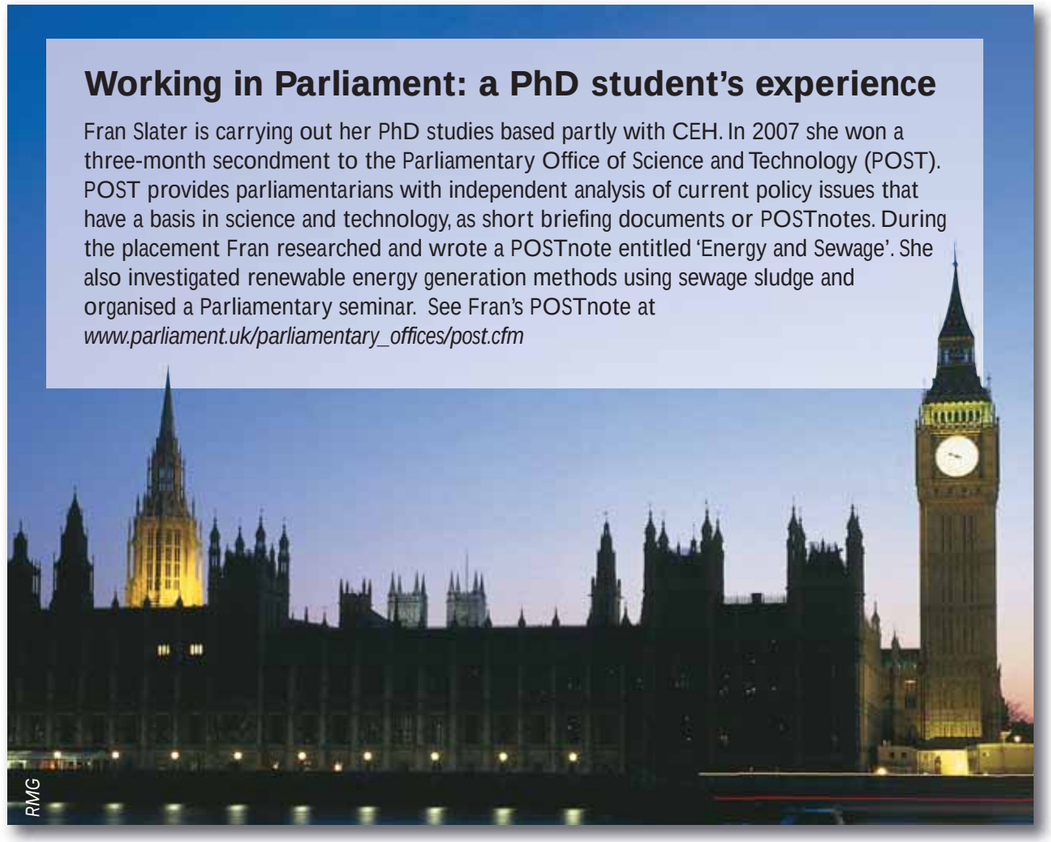
As part of CEH's commitment to PhD students, a full-time student coordinator has now been appointed; there is also a student liaison officer and a student representative at each research site.

Altogether about 200 PhD students were hosted in 2006-2007, for whom we provided access to expertise, field sites and laboratory space. CEH was awarded eight NERC-funded studentships for 2006 which were filled by open competition; we also support many CASE or industry-partnered students. Besides their research, students are expected to learn transferable skills; project management, scientific writing and statistics courses were all run during 2006. Postgraduate seminar days are held annually at each site, when students get a chance to present their work to CEH research staff.

CEH also hosts undergraduate students for work experience and contributes towards the support of Masters projects.

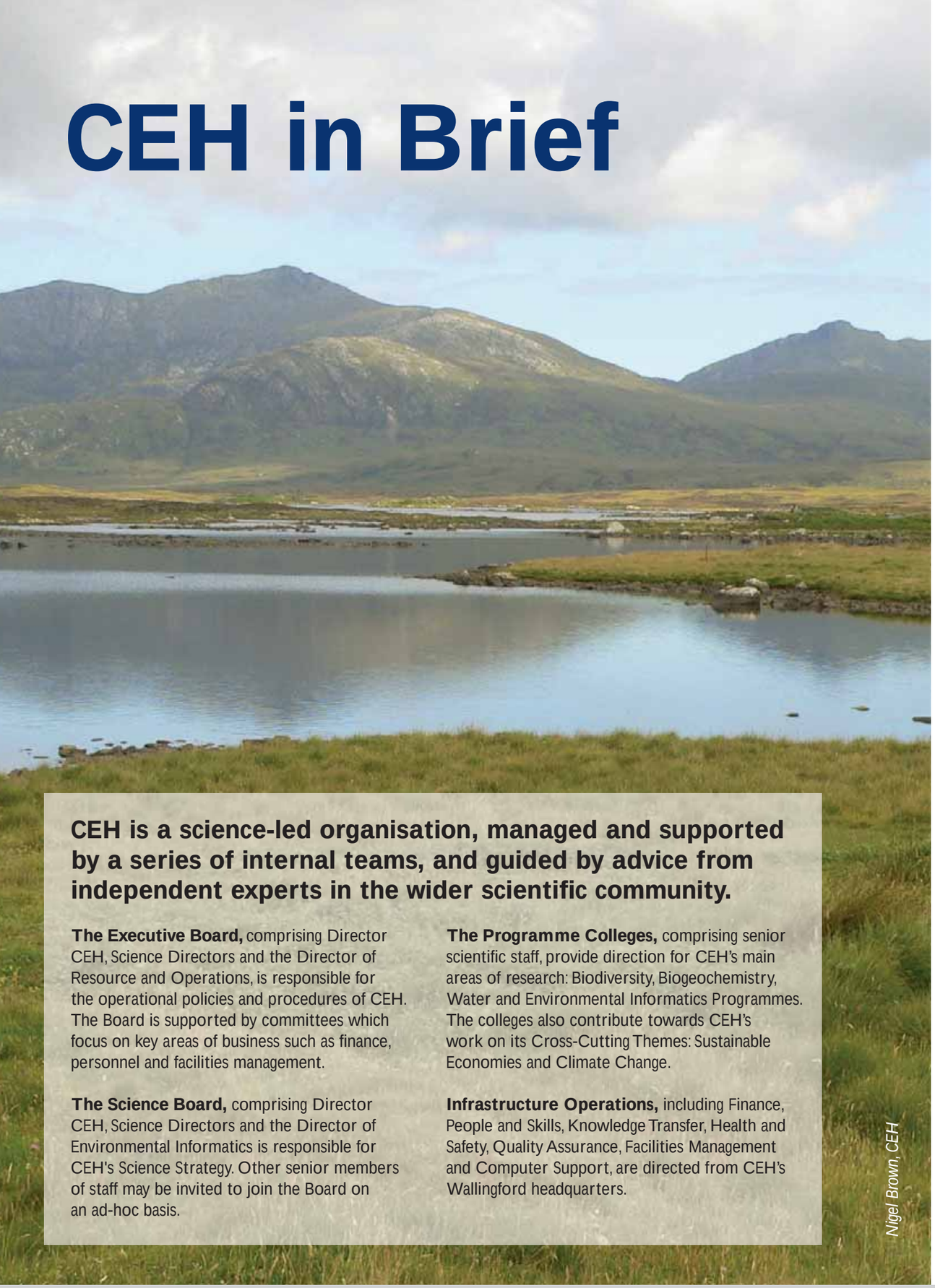
Working in Parliament: a PhD student's experience

Fran Slater is carrying out her PhD studies based partly with CEH. In 2007 she won a three-month secondment to the Parliamentary Office of Science and Technology (POST). POST provides parliamentarians with independent analysis of current policy issues that have a basis in science and technology, as short briefing documents or POSTnotes. During the placement Fran researched and wrote a POSTnote entitled 'Energy and Sewage'. She also investigated renewable energy generation methods using sewage sludge and organised a Parliamentary seminar. See Fran's POSTnote at *www.parliament.uk/parliamentary_offices/post.cfm*



RMG

CEH in Brief



Nigel Brown, CEH

CEH is a science-led organisation, managed and supported by a series of internal teams, and guided by advice from independent experts in the wider scientific community.

The Executive Board, comprising Director CEH, Science Directors and the Director of Resource and Operations, is responsible for the operational policies and procedures of CEH. The Board is supported by committees which focus on key areas of business such as finance, personnel and facilities management.

The Science Board, comprising Director CEH, Science Directors and the Director of Environmental Informatics is responsible for CEH's Science Strategy. Other senior members of staff may be invited to join the Board on an ad-hoc basis.

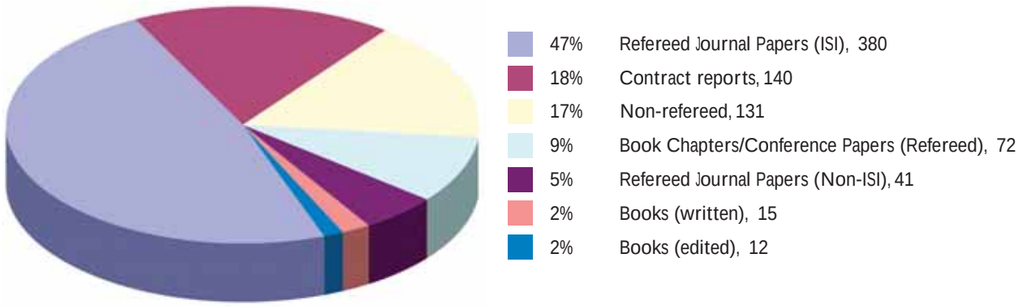
The Programme Colleges, comprising senior scientific staff, provide direction for CEH's main areas of research: Biodiversity, Biogeochemistry, Water and Environmental Informatics Programmes. The colleges also contribute towards CEH's work on its Cross-Cutting Themes: Sustainable Economies and Climate Change.

Infrastructure Operations, including Finance, People and Skills, Knowledge Transfer, Health and Safety, Quality Assurance, Facilities Management and Computer Support, are directed from CEH's Wallingford headquarters.

Facts and Figures

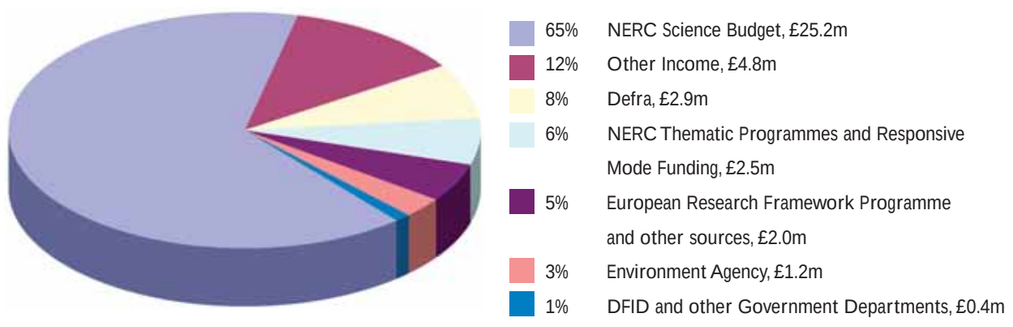
CEH's Publications, 2006

The publication figures are an important indicator of CEH's scientific activity and the quality of our research. 380 peer-reviewed ISI Journal papers were published in 2006, which is the most respected category.



CEH's Income, 2006-2007

In the financial year 2006-2007, CEH received approximately £39 million from the sources below.



Further financial details are provided in NERC's Annual Report, see *www.nerc.ac.uk*.

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

Advisory Committee and Programme Development Group

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

Advisory Committee

Member	*Affiliation*
Lord J Hunt	University College London *(Chair)*
Mr H Malcolm	CEH *(Secretary)*
Dr I Bainbridge	Scottish Executive
Dr P Costigan	Defra
Dr J Holmes	University of Oxford
Prof R Marrs	University of Liverpool
Prof P Nuttall	CEH
Dr H Prosser	National Assembly for Wales
Mr T Sangwine	Highways Agency
Dr J Seager	Environment Agency
Mr P Swann	DFID
Dr T Tew	Natural England
Dr S Wilson	NERC

The Programme Development Group is drawn from 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.

Programme Development Group

Member	*Affiliation*
Prof R H Marrs	University of Liverpool *(Chair)*
Mr H Malcolm	CEH *(Secretary)*
Prof C Anderson	University of Sheffield
Prof M Ashmore	University of York
Prof M Bailey	CEH
Dr G Fenech	Independent Adviser
Prof D Fowler	CEH
Dr J Gash	Research Fellow, CEH
Prof C Godfray	University of Oxford
Prof J Grace	University of Edinburgh
Prof P Grennfelt	IVL Swedish Environmental Research Institute
Prof A Hildrew	Queen Mary & Westfield College, London
Prof A Jenkins	CEH
Prof K Killham	University of Aberdeen
Prof N Kroer	National Environmental Research Institute, Denmark
Prof B Lawrence	Rutherford Appleton Laboratory
Prof J Nicholson	Imperial College, London
Prof P Nuttall	CEH
Prof A O'Donnell	University of Newcastle
Prof G E Petts	University of Birmingham
Dr F Raes	Joint Research Centre, European Commission
Prof J Slingo	University of Reading
Prof R H Smith	University of Huddersfield
Dr M Stiff	CEH
Prof K Turner	University of East Anglia
Prof A R Watkinson	University of East Anglia
Prof H S Wheater	Imperial College, London

Sue Wallis, CEH

The International Dimension: Collaborating with the Best

Sirpa Pellinen, SYKE

Directors of the PEER member institutes, Helsinki 2007

CEH's successful involvement in international research projects, often in a leading role, demonstrates its standing in the scientific community.

In order to fulfil its mission, CEH is collaborating with leading institutions worldwide through its engagement in institutional networks and international research projects.

CEH is a founder member of the Partnership for European Environmental Research (PEER), a strategic alliance of seven of Europe's largest environmental research centres. PEER aims to build a strong knowledge base for sustainable development. PEER fosters innovative interdisciplinary research and cross-cutting approaches, in support of national and European policy-makers, industry and society. CEH plays a significant role in this pan-European effort, which can call on a total staff of 4,500 and a combined budget of some £240 million per year. In 2007, the PEER Agreement was renewed by the partners for another five years. See *www.peer-environment.eu*

Jan Marco Müller, CEH

CEH Director Prof. Patricia Nuttall signing the new PEER Collaboration Agreement

Another example of CEH's strong engagement in Europe is its membership of EurAqua, the European network of freshwater research organisations. EurAqua aims to improve the integration of research resources in hydrological sciences, uniting a large number of freshwater research institutes across Europe. See *www.euraqua.org*

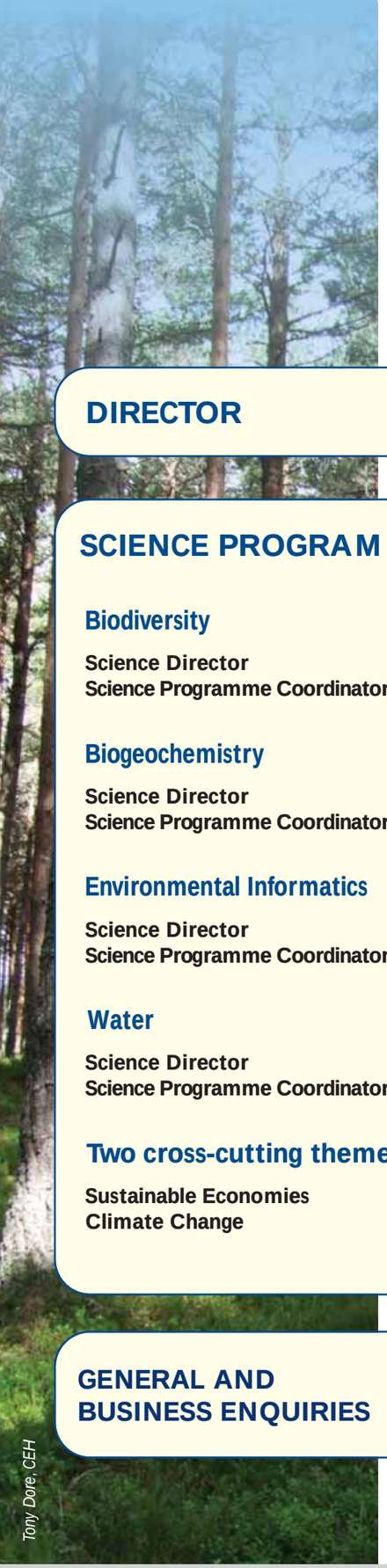
CEH co-ordinates several high-profile European projects involving numerous partners. Projects include:

- NitroEurope - The nitrogen cycle and its influence on the European greenhouse gas balance. See *www.nitroeurope.eu*;
- WATCH - Water and Global Change;
- ALTER-Net - A Long-Term Biodiversity, Ecosystem and Awareness Research Network. See *www.alter-net.info.*

CEH has also been playing a key role in the setting-up of LifeWatch, the European e-science and technology infrastructure for biodiversity data and observatories. LifeWatch has been short-listed on the European Roadmap for new research infrastructures of pan-European interest. See *www.lifewatch.eu*

Besides these activities, CEH collaborates with a multitude of international organisations, such as the European Space Agency and the Bureau of the Ramsar Convention on Wetlands. In addition, CEH actively fosters collaboration with partners in developing countries: for example, acting as co-ordinator of the Specific Support Action `African Water' which aims to help African partners to achieve the water-related millennium development goals set by the United Nations. See *www.africanwater.net*

Through its international partnerships, CEH supports knowledge transfer and actively enhances its world-class scientific expertise.



Tony Dore, CEH

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SCIENCE PROGRAMME MANAGEMENT

Biodiversity

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Science Programme Coordinator	Heath Malcolm	CEH Edinburgh	*hmm@ceh.ac.uk*

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Science Programme Coordinator	*To be appointed*		

Water

Science Director	Prof Alan Jenkins	CEH Wallingford	*jinx@ceh.ac.uk*
Science Programme Coordinator	Dr Nick Jackson	CEH Wallingford	*naj@ceh.ac.uk*

Two cross-cutting themes are also maintained:

Sustainable Economies	Prof Mark Bailey	CEH Oxford	*mbailey@ceh.ac.uk*
Climate Change	Prof David Fowler	CEH Edinburgh	*dfo@ceh.ac.uk*

GENERAL AND BUSINESS ENQUIRIES	CEH Wallingford, Maclean Building, Benson Lane, Crowmarsh Gifford, Wallingford, Oxfordshire, OX10 8BB	*enquiries@ceh.ac.uk* T: 01491 692562

CEH Sites

RESEARCH SITES	Address	Contact
Bangor	**CEH Bangor** Environment Centre Wales, Deiniol Road, Bangor, Gwynedd, LL57 2UW **CEH Bangor** Canolfan yr Amgylchedd Cymru Ffordd Deiniol, Bangor, Gwynedd, LL57 2UW	T: 01248 374500 F: 01248 362133
Edinburgh	**CEH Edinburgh** Bush Estate, Penicuik, Midlothian, EH26 0QB	T: 0131 445 4343 F: 0131 445 3943
Lancaster	**CEH Lancaster** Lancaster Environment Centre, Library Avenue, Bailrigg, Lancaster, LA1 4AP	T: 01524 595800 F : 01524 61536
Monks Wood	**CEH Monks Wood** Monks Wood, Abbots Ripton, Huntingdon, Cambridgeshire, PE28 2LS	T: 01487 772400 F: 01487 773467
Oxford	**CEH Oxford** Mansfield Road, Oxford, Oxfordshire, OX1 3SR	T: 01865 281630 F: 01865 281696
Wallingford	**CEH Wallingford** Maclean Building, Benson Lane Crowmarsh Gifford, Wallingford, Oxfordshire, OX10 8BB	T: 01491 838800 F: 01491 692424

CEH's research sites at Winfrith Technology Centre, Dorset and Banchory, Aberdeenshire closed during 2007.

Bangor

CEH is currently carrying out a long-term re-organisation, which is being managed by a dedicated Transition and Integration Unit.

Building for the Future

Background

The overall aim of the Transition and Integration Programme is to ensure that CEH is able to continue to deliver high quality science, within a long term sustainable framework, i.e. more than ten years. Benefits will include further integration of CEH's science, with new and refurbished laboratory and office facilities.

The research, services and infrastructure of CEH are becoming focused upon four of the existing sites at Bangor, Edinburgh, Lancaster and Wallingford, with the Wallingford site becoming the new headquarters of CEH.

Activities in 2007-2008

CEH sites at Dorset, Banchory and Swindon closed during 2007. The key science and infrastructure activities carried out at closing sites will be continued at the four retained sites.

During 2007-2008 several new building and refurbishment projects are being carried out:

- At Edinburgh, an extension involving new laboratories and office space will be completed;
- Refurbishments at Lancaster will include a new organic chemistry laboratory, as part of the overall centralisation of CEH analytical chemistry facilities;
- Also at Lancaster, central archiving facilities will provide secure long-term storage for materials from all CEH sites;
- At Wallingford an open plan office wing to accommodate CEH's Director and the corporate infrastructure staff is now complete;
- Other long-term developments at Wallingford will provide new laboratories to support our world-class Science Programmes;
- At Bangor, the new Environment Centre for Wales will accommodate staff from CEH and the University of Wales, Bangor.

Lancaster

Edinburgh

Wallingford

For more information on how CEH works, our science and our publications please

- **visit *www.ceh.ac.uk***
- **email *enquiries@ceh.ac.uk***
- **call 01491 692562**

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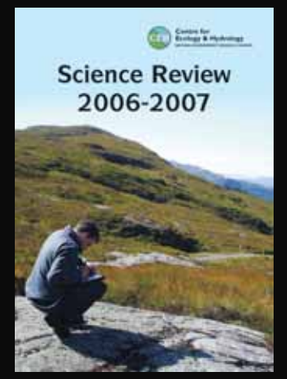

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Neville Llewellyn, CEH

The Centre for Ecology & Hydrology is a member of the Partnership for European Environmental Research.

Centre for Ecology & Hydrology

NATURAL ENVIRONMENT RESEARCH COUNCIL

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