



**Institute of  
Terrestrial  
Ecology**

## **Annual Report 1994-95**

**Centre for Ecology and Hydrology  
Natural Environment Research Council**





## **The ITE mission**

The Institute of Terrestrial Ecology will develop long-term, multidisciplinary research and exploit new technology to advance the science of terrestrial ecology, leading to a better understanding and quantification of the physical, chemical and biological processes of the land.

Priority is placed on developing and applying knowledge in the following areas:

- the factors which determine the *composition, structure, and processes* of terrestrial ecosystems, and the *characteristics* of individual plant and animal species
- the dynamics of *interactions* between atmospheric processes, terrestrial ecosystems, soil properties and surface water quality
- the development of a sound scientific basis for *monitoring, modelling and predicting* environmental trends to assess past, present and future effects of natural and man-made change
- the securing, expansion and dissemination of ecological data to further scientific research and provide the basis for impartial advice on environmental protection, conservation, and the sustainable use of natural resources to governments and industry.

The Institute will provide training of the highest quality, attract commissioned projects, and contribute to international programmes.

ITE will promote the use of research facilities and data to enhance national prosperity and quality of life.

**Report of the  
Institute of Terrestrial Ecology  
1994–1995**

**Centre for Ecology and Hydrology**

**Natural Environment Research Council**

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# Preface

The terrestrial and freshwater sciences are a diverse and complex area covering a wide range of scales in space and time. There is also a strong interaction between them and the economic and social sciences, industry and commerce. It is increasingly recognised that many of the long-standing and the newly emerging environmental issues require a multidisciplinary integrated research for their resolution. The 1993 White Paper *Realising our potential - a strategy for science, engineering and technology* reaffirmed the Natural Environment Research Council as the lead body for research, survey and training in the environmental sciences and provided the NERC with a new Charter. To meet its aims, Professor John Krebs, the Chief Executive, working with the Council, restructured the NERC. A major element of this was the regrouping within the Centre for Ecology and Hydrology of the:

- Institute of Freshwater Ecology (IFE)
- Institute of Hydrology (IH)
- Institute of Terrestrial Ecology (ITE), and the
- Institute of Virology and Environmental Microbiology (IVEM).

The combined activities of the Institutes cover the full range of terrestrial and freshwater sciences and this combination must give CEH internationally one of the strongest capabilities for holistic research, environmental monitoring, and as a data resource. The CEH outreach is extensive. The two Figures in Appendix 2 of this Report (p112) show the location of the principal CEH Institute sites in the UK and in those overseas countries in which CEH scientists are, or have been recently, active.

In establishing CEH, the Institute of Terrestrial Ecology (North) and the Institute of Terrestrial Ecology (South) were drawn together into a single Institute, with Professor Mike Roberts as the ITE Director and Deputy Director of CEH. The two Institutes had been working together for many years and their integration came with the retirement of Professor Bill Heal (Director ITE (North)). Bill Heal joined NERC in 1964. Through his own research and scientific leadership he has made a significant contribution to advancing knowledge in terrestrial ecology. I am certain that all Bill's friends and

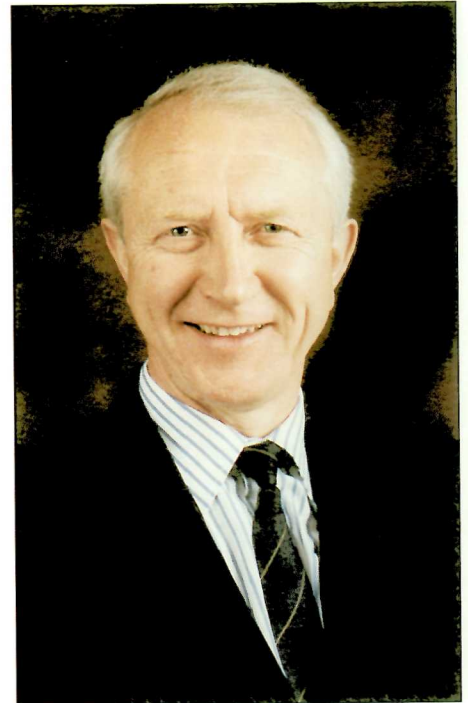


Plate 1. Professor Brian Wilkinson, Director CEH

colleagues within NERC would wish me to take this opportunity to offer him our thanks and good wishes in his retirement.

Under Professor Roberts' directorship, the reunification of the northern and southern Institutes has been accomplished smoothly and efficiently. It is clear from this Annual Report that the Institute of Terrestrial Ecology has had an excellent year. Its commissioned research has continued to grow and its science is buoyant. From a CEH perspective, it is most encouraging to see the way in which joint research programmes are being established between ITE and the other CEH Institutes.

This Annual Report describes a selection of the exciting scientific research and monitoring which has been undertaken at the Institute of Terrestrial Ecology during the past year, and I commend it to you. I would also take this opportunity to draw your attention to the complementary Annual Reports for 1994-95 from the other CEH Institutes and to the CEH overview report.

W B Wilkinson  
Director  
Centre for Ecology and Hydrology



# Introduction by ITE Director

This has been a most productive year for ITE across the whole range of performance indicators (from publication output, contract income, data resources, technology transfer, training and public awareness). The Institute's contribution to European programmes has been significantly enhanced and the personal standing of individual scientists is increasingly recognised. Many of these advances are attributable to the Director of ITE North (Professor O W Heal), who retired in October 1994.

## Reorganisation and restructuring

In 1994, NERC reorganised the five Institutes managed by the Terrestrial and Freshwater Sciences Directorate into a Centre for Ecology and Hydrology (CEH) in order to develop a more integrated and holistic research programme. ITE contributes a substantial part of CEH's strategic research and commissioned income from the user community. Incorporation of ITE into CEH, has presented new opportunities for ITE scientists to develop integrated, interdisciplinary projects across the full spectrum of terrestrial and freshwater

ecology, hydrology, virology and environmental microbiology.

The subsequent re-unification of ITE as a single Institute has created opportunities for greater strategic planning, improved communication and more direction in response to the user community. The re-unification of ITE with a single Directorate at Monks Wood has been completed with a minimum of disruption to the administration. The opportunity was taken to optimise procedures for resource management in order to secure efficiency gains and thereby reduce the administrative overhead.

The ITE management strategy has been revised to meet the changes in NERC and CEH (Box 1). The focus for the scientific groups at the six ITE sites has been reviewed and reorganised to minimise overlap whilst maintaining the potential for interdisciplinary collaboration (Figure 1). Specific changes have included consolidation of:

- tropical and arid zone ecology at ITE Edinburgh;
- soil ecology at ITE Merlewood, through investment in molecular microbiology;

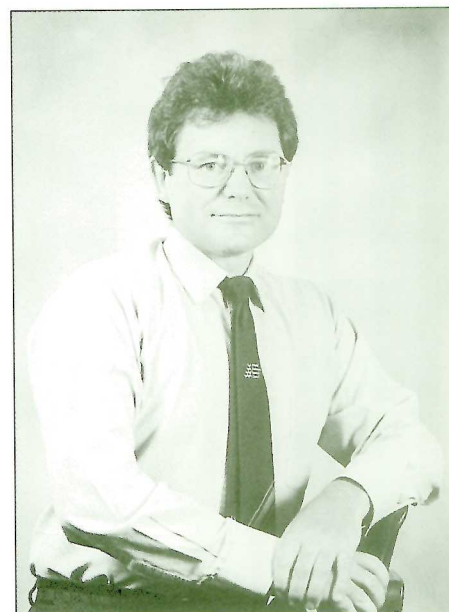


Plate 2. Professor Mike Roberts, Director ITE

- vertebrate molecular ecology at ITE Banchory, through a collaborative project with the University of Aberdeen;
- ecotoxicology at ITE Monks Wood, through amalgamation with the Analytical Chemistry Group.

In addition, the Environmental Information Centre at ITE Monks Wood now has the responsibility for an environmental information network which links all six sites. Similar networks have been established for key infrastructure activities, including computing, biometrics, mathematical modelling, spatial data analysis (geographical information systems), molecular technology, analytical chemistry, quality assurance, security, health and safety, and marketing. The resulting restructuring of staff resources



Plate 3. ITE Management Group at ITE's Banchory Research Station (L-R) Dr Alan Gray (Furzebrook), Dr Barry Wyatt (Environmental Information Centre), Dr Melvyn Cannell (Edinburgh), Professor Mike Hornung (Merlewood), Professor Mike Roberts, Dr Stuart Dobson (Monks Wood), Mrs Jane Parsell (Administration Officer), Dr John Good (Bangor) and Professor Brian Staines (Banchory)

### Box 1. ITE management strategy

- Maintain breadth of disciplines and flexibility to form interdisciplinary teams directed towards specific objectives within the Centre for Ecology and Hydrology
- Maintain geographical distribution to provide integrated national projects whilst exploiting regional opportunities
- Accelerate utilisation of new technologies
- Improve service to research community through access to national databases and large-scale facilities
- Maintain strong links between strategic projects and research needs of government policy
- Develop collaboration and technology transfer with the industrial sector



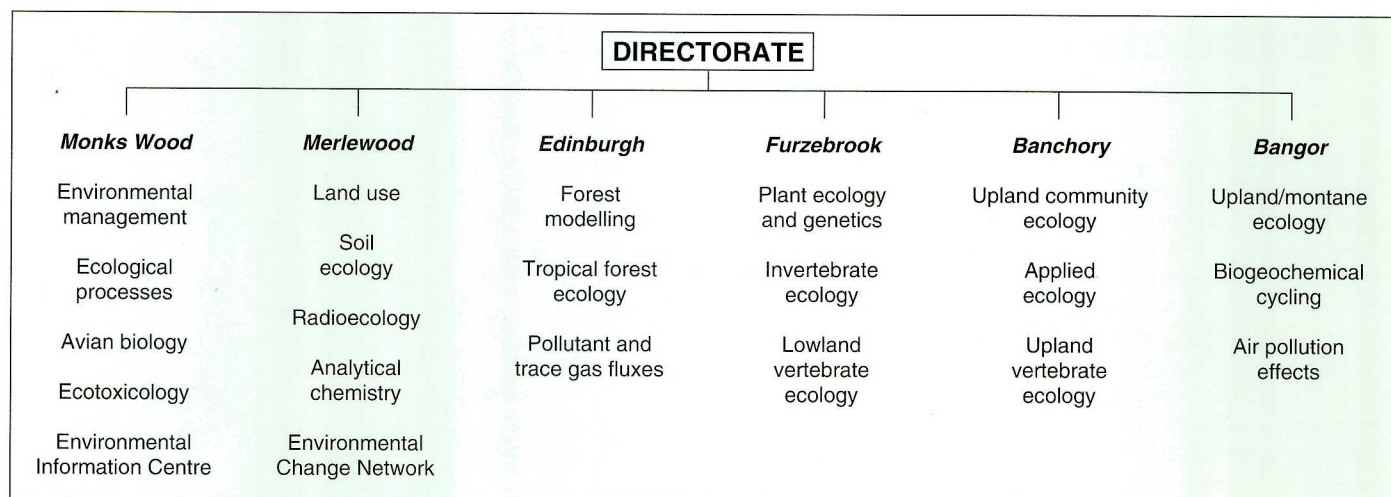


Figure 1. Structure of ITE science sections

has been facilitated by a modest redundancy programme. Efficient communication between sites has been enhanced by investment in high-speed links to the UK Joint Academic NETwork (JANET), local area networks, and standardised office automation hardware and software. As a result, the Institute's strength in maintaining a distributed research network capable of responding to national priorities whilst exploiting regional opportunities has been enhanced.

The drive towards improved efficiency, competitiveness and technology transfer has placed increased demands on administration, technical support and scientific staff alike. The commitment to produce scientific output and a high-quality service to the user community has been sustained, in spite of the uncertainty resulting from a prolonged period of change. Whilst living with change has become a way of life for Research Council scientists, the pace of change continued to accelerate as the Institute responded to a series of audits, reviews and re-organisations. Although individual scientists in ITE are now better resourced than they have been for over a decade, the pressures on individuals to deliver are unprecedented. That the performance indicators continue to improve is testament to the dedication, flexibility and resilience of all staff.

### Meeting NERC's strategic aims and environmental issues

ITE's mission is to deliver high-quality strategic and applied research, survey and long-term monitoring in terrestrial ecology. ITE plays an important role in meeting the seven strategic aims in support of this mission defined by NERC.

### Maintaining core strategic research in understanding and predicting environmental processes

In 1994–95, ITE's interdisciplinary, 'directed-mode' core research programme has been refocused to meet the new environmental priorities in NERC and the requirements of an expanding user community. The challenge to management and staff has been to sustain the synergy between science budget and commissioned research which has made ITE one of the most productive of NERC Institutes. An integrated core-strategic programme is currently in preparation across the Centre for Ecology and Hydrology. Until this is in place, ITE has arranged the research programme according to the six new environmental issues identified in the 1995 NERC Corporate Plan update:

- Management of land and the coastal zone; the identification and exploitation of land resources and their sustainability

- Understanding and protection of biodiversity
- Waste management, bioremediation and land restoration
- Pollution of air and land in relation to environmental and human health
- Environmental risks and hazards, including release of genetically modified organisms and improved prediction of extreme events
- Global change, including prediction on a range of time and space scales.

The current commitment of resources to those aspects of the NERC themes relevant to ITE is shown in Figure 2. The contributions to each of these environmental issues is illustrated by the selection of papers in this *Annual Report*.

### Developing and using technologies and maintaining scientific facilities

A key feature of a research institute is to maintain a 'well-found laboratory' and to

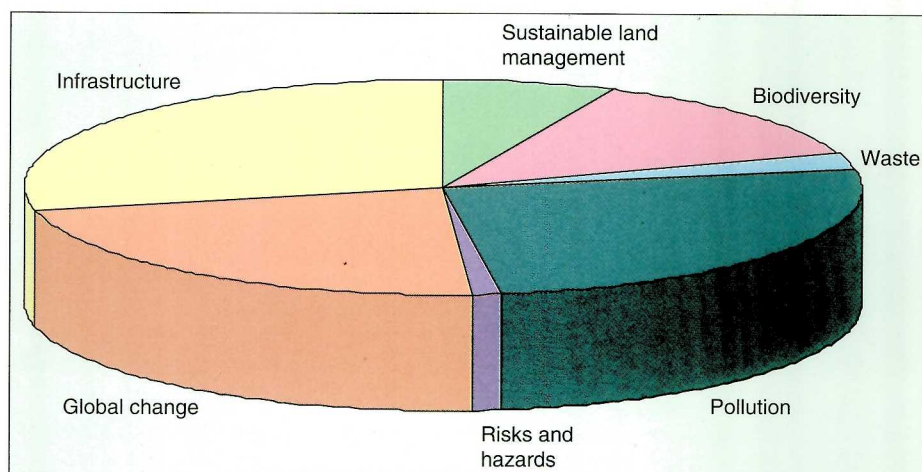


Figure 2. ITE expenditure by the six NERC environmental themes plus infrastructure projects



maximise the utilisation of its facilities through extensive collaboration. The infrastructure to maintain this status in terrestrial ecology includes

- well-instrumented field sites (eg Environmental Change Network, Trace Gas Flux sites)
- large-scale experimental facilities (eg Solardome Climate Change Facility at ITE Bangor, Open-Top Pollution Chambers at ITE Edinburgh)
- specialised analytical chemistry laboratories (eg for major cations/anions, radionuclides, stable isotopes and trace metals at ITE Merlewood, for toxic metals and complex organics at ITE Monks Wood, for air pollutants at ITE Edinburgh)
- laboratories for plant and animal ecotoxicology
- molecular ecology laboratories for applications in GMO releases (ITE Furzebrook), forest genetics (ITE Edinburgh), vertebrate ecology (ITE Banchory) and soil microbiology (ITE Merlewood)
- computing facilities for remote sensing applications (at EIC, Monks Wood)
- computing networks for GIS, database applications, biometrics and modelling activities

The ITE philosophy is to maintain the service units as close to the relevant scientific groups as possible and to sustain a 'critical mass' by effective networking. These networks are currently being integrated within CEH.

### **Collecting, curating, interpreting and supplying environmental data**

As the lead body in the UK for terrestrial research, survey and monitoring, the Institute is custodian to a wealth of environmental information and databases. Data are vital elements of scientific research and the foundation upon which decision-makers plan for and promote the effective protection and management of the environment. ITE plays a key role in environmental data management and seeks to realise the value of its data holdings by using them to further scientific understanding, and improve the quality of the environment. The Environmental Information Centre co-ordinates access to ITE databases, exchanging and licensing/selling data to charitable organisations and educational institutions, government departments, local authorities, agencies

and non-departmental public bodies, and commercial organisations and consultants.

ITE data are exploited widely within this extensive user community. For example, the Land Cover Map of Great Britain, launched in 1993, now has over 150 users from the academic, government, industrial and commercial sectors in a variety of applications, including environmental impact assessments and management, pollution effects, ecology, biogeography, policy and planning. The Countryside Information System (CIS), commissioned by the Department of the Environment and launched in December 1994 at the NERC Annual Lecture, was developed to give policy advisors, planners and researchers access to information about the British countryside. Increasingly, ITE's data are being combined with scientific expertise and knowledge to develop computer-based decision support systems.

The re-unification of ITE provided an opportunity to place EIC at the centre of a data-network linking each of the ITE Stations. EIC is linked to 'satellite' data centres for Wales and Scotland at Bangor and Banchory, respectively. The network includes the extensive data of the Land Use Section and the Environmental Change Network, both located at ITE Merlewood. In addition to extensive spatial databases, ITE scientists have substantial long-term databases on individual species, communities, pollutant residues and fluxes. A meta-database has been constructed and a programme outlined for central documentation and archiving. There is an increasing demand from ITE's user community for converting environmental data into information. This has been the basis for research projects concerning land use change, critical loads, biodiversity hot-spots, biogeographic zones and climate change impacts.

### **Providing objective independent expert advice and information**

The 'independent expert' role is the basis of much of the demand for ITE's services from a broad user community which stretches from pressure groups and non-governmental organisations, through government departments and statutory agencies to the industrial and commercial sector. ITE staff serve as 'expert members' on numerous prestigious UK Government committees (Box 2).

The greatest demand for ITE's consultancy and advisory services is in the areas of

### **Box 2. ITE representation on Government Advisory Committees**

- Advisory Committee for Hazardous Substances
- Advisory Committee for Releases (of genetically modified organisms (GMO)) to the Environment
- Advisory Committee for Genetic Modification
- Advisory Committee on Pesticides
- Advisory Committee on Toxic Substances
- Radioactivity and Environment Committee
- Biodiversity Steering Group
- Critical Loads Advisory Group
- Photochemical Oxidants Review Group
- Climate Change Impacts Review Group
- UK Man and the Biosphere Committee
- Red Deer Commission

environmental hazard and risk assessment and mitigation, environmental impact assessment, habitat engineering, and decision support systems.

### **Ensuing linkage with the user community and effective technology transfer**

ITE has developed extensive links with a broad user community in order to secure nearly £6 million per annum necessary to remain financially viable. Over 60% of this income is derived from UK Government departments, with the European Union (EU) (12%) and the public/private companies (20%) also key users (Figure 3). Within the industrial and commercial sectors, 50 companies utilise the Institute's research and development expertise. The key activities are described below.

#### **Information technology**

- database services
- software development
- $\beta$ -testing of new systems
- remote sensing applications

#### **Hazard and risk assessment of chemicals/air pollutants**

- Power sector
- Chemical industry
- Oil sector
- Insurance and loss prevention

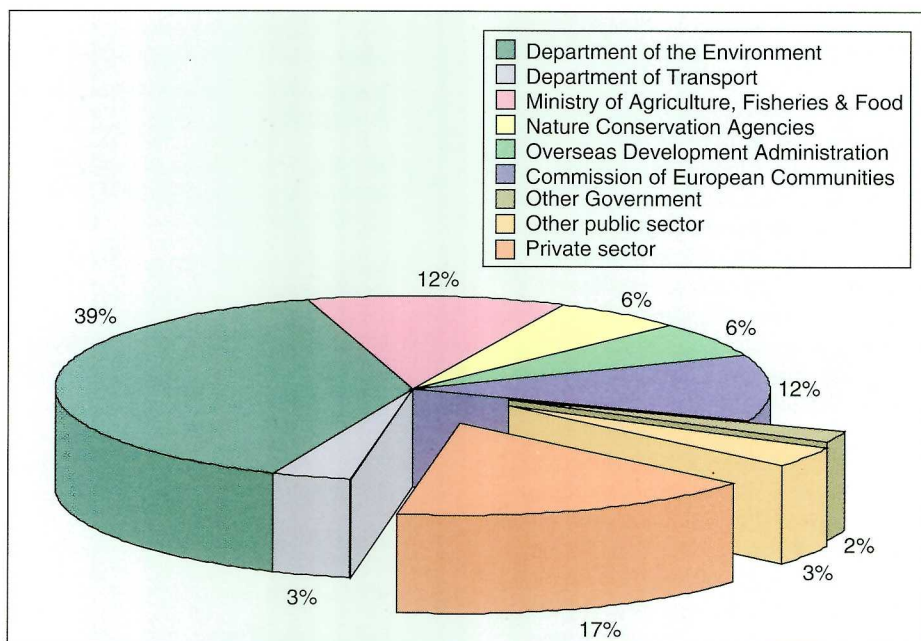


Figure 3. Division of ITE contract income for 1994-95 from major customers

#### Environmental impact assessment and habitat engineering

- Civil engineering and construction
- Transport
- Oil sector
- Environmental consultancies
- Forestry sector

ITE is well placed to enhance technology transfer through the new NERC mechanisms to promote wealth creation in the industry sector, eg Realising Our Potential Awards – (ROPA), environment/industry programmes (CONNECT) and Teaching Company schemes. In addition, there will be increased industrial collaboration through the Office of Science and Technology LINK scheme. There will, however, be constraints in that the environment industry is a developing market characterised by small and medium enterprises (SMEs) with little resource for research investment. Much of ITE's user community lies in the UK Government department or statutory agency sector.

Further initiatives will follow the Research Council's response to the recommendations of the Technology Foresight Initiative. The Steering Group identified three priorities relevant to NERC science: environmentally sustainable technologies; sensors and health, and lifestyle. NERC has tentatively identified 15 themes around which to focus a response to the Foresight Initiative. Of these topics, the following are relevant to ITE:

- Industry/environment interaction
- Environmental evaluation

- Land and soil
- Urban environment
- Mechanisms of climate change
- Coastal zone modelling and management
- Use of natural processes and materials
- Remote data acquisition
- Social and human impacts of environmental change

ITE already provides the Secretariat for NERC's Environmental Diagnostics Programme, which is a response to the first of these priorities. ITE is also strengthening

disciplines related to soil science, socio-economics and modelling. Links are being established for collaborative projects on environmental aspects of human health.

#### Training and education

The significance of the contribution of NERC Institutes to both undergraduate education and postgraduate training is often overlooked. Many of ITE senior staff hold university fellowships or professorships which involve substantial lecturing commitments. All ITE Stations now have a Memorandum-of-Understanding with at least one university, which covers arrangements for running courses, supervising student projects, and collaborative research initiatives. In particular, links have been established with several universities which operate the new NERC 'M Research' courses. At the undergraduate level, ITE provides funds for the placement of six Mathematics/Physics students and 25 sandwich course students each year. At postgraduate level, ITE supports between 40 and 50 CASE studentships for three different Research Councils. Occasionally, ITE also funds post-doctoral fellowships for specific collaborative projects. With the visiting scientists and overseas trainees, the ITE sites in 1994-95 hosted over 200 scientists and trainees, in addition to the 216 scientific staff.

#### Encouraging public understanding of the environment

ITE has responded to this important objective by initiating a range of activities

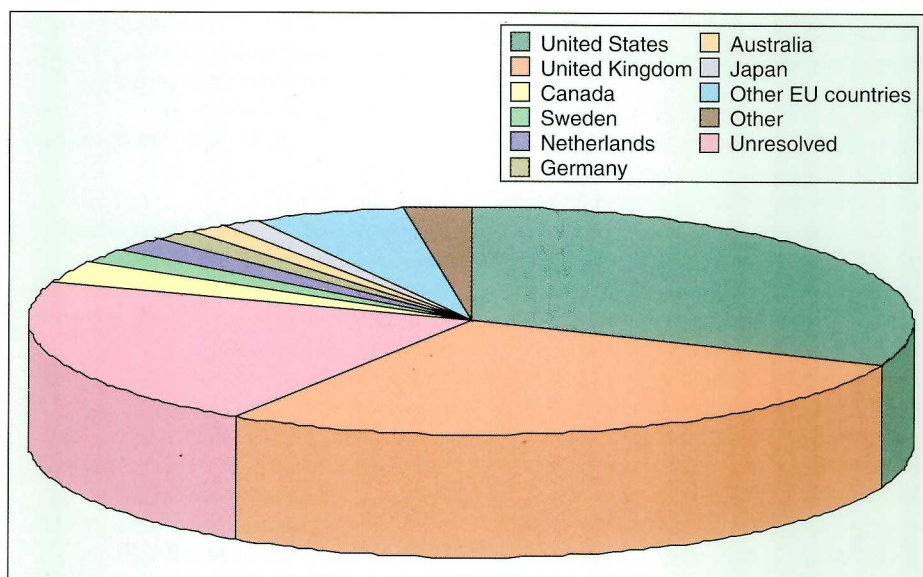


Figure 4. Major division by country of the 3000 different machines accessing the WWW for information about ITE since January 1995



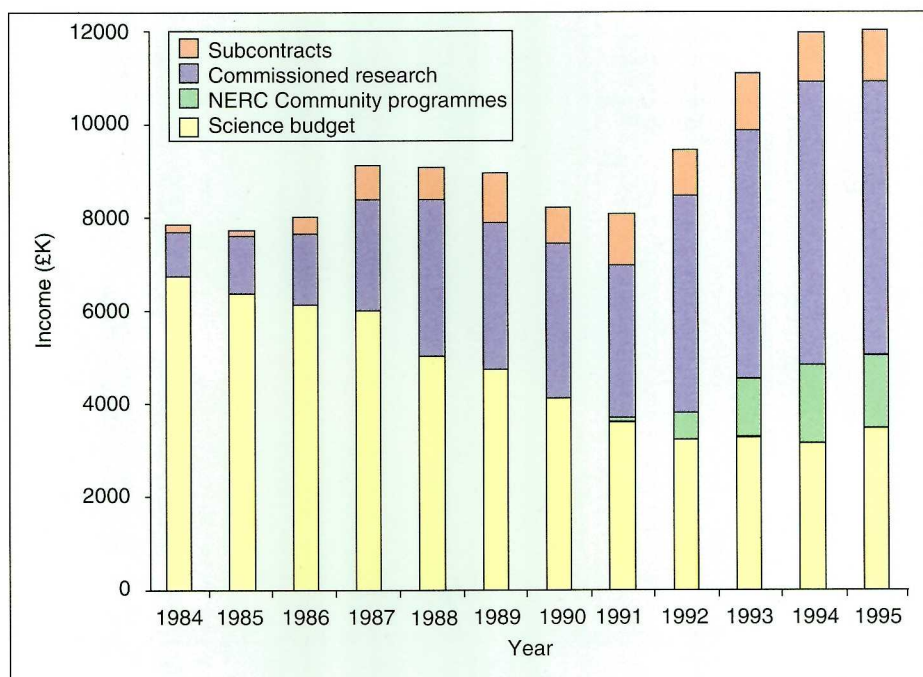


Figure 5. Trends in ITE income (at constant prices – 1984–95 using Gross Domestic Product indices)

involving schools liaison, work experience, open days, press reports, dissemination of information on the Internet, and contributions to national events. The Schools Liaison Officers have co-ordinated a number of interactive sessions with primary and secondary schools, related to the National Curriculum. Work experience for 16–18 year olds has been promoted through a number of Nuffield Science Bursaries. A successful 'Daughters-at-Work' day was held to promote equal opportunities. Institute research projects were reported in over 100 newspaper articles. The most successful was a press release on the development of biomarkers for pollutants using earthworms.

During the year of this *Report*, important strides have been made in disseminating information about the Institute. Details about the Research Stations and of current research have been mounted on World Wide Web (WWW), the newest and most powerful means of both disseminating and discovering information using the Internet. The ITE pages have been accessed by over 3000 users from 40 countries (Figure 4).

ITE's contribution to the Science, Engineering and Technology (SET) Week was to support a Science Museum Forum on 'Britain's place in space'. The objectives for the Forum were to raise the profile of space, and to enable those within the sector to exchange and listen to a range of different perspectives. The Forum brought together industry, academia, the public sector and education in a presentation of current UK

activities and in open debate. The Forum was accompanied by a space sector exhibition in Gallery 5 and the Space Gallery of the Science Museum. ITE exhibited the Land Cover Map of Great Britain, its applications and user community.

The Institute also supported the British Association for the Advancement of

Science (BAAS) Annual Conference at the University of Loughborough, with presentations on global monitoring and climate change processes.

### ITE performance in 1994–95

This was an excellent year in terms of financial resources, output of publications and development of integrated projects with other Institutes. The financial position was maintained by stabilisation of the science budget baseline at 35% of the £12M income (which included delegated responsibility from NERC for computing expenditure) (Figure 5). In addition, 15% of ITE's income was derived from NERC's thematic programmes, such as the Terrestrial Initiative in Global Environmental Research (TIGER) and the Land/Ocean Interaction Study (LOIS). The remaining £5.5M income was derived from an ever-expanding range of customers; ITE staff worked on nearly 200 contracts in the period of this *Report* (Figure 6). The overall trend has been for stabilisation of income from NERC, the Department of the Environment, UK Government agencies and the public/private sector. Contracts from the Ministry of Agriculture, Fisheries and Food (MAFF) and the EU have continued to increase, particularly in the areas of land use change and climate change impacts. Government plans for the formation of an Environment

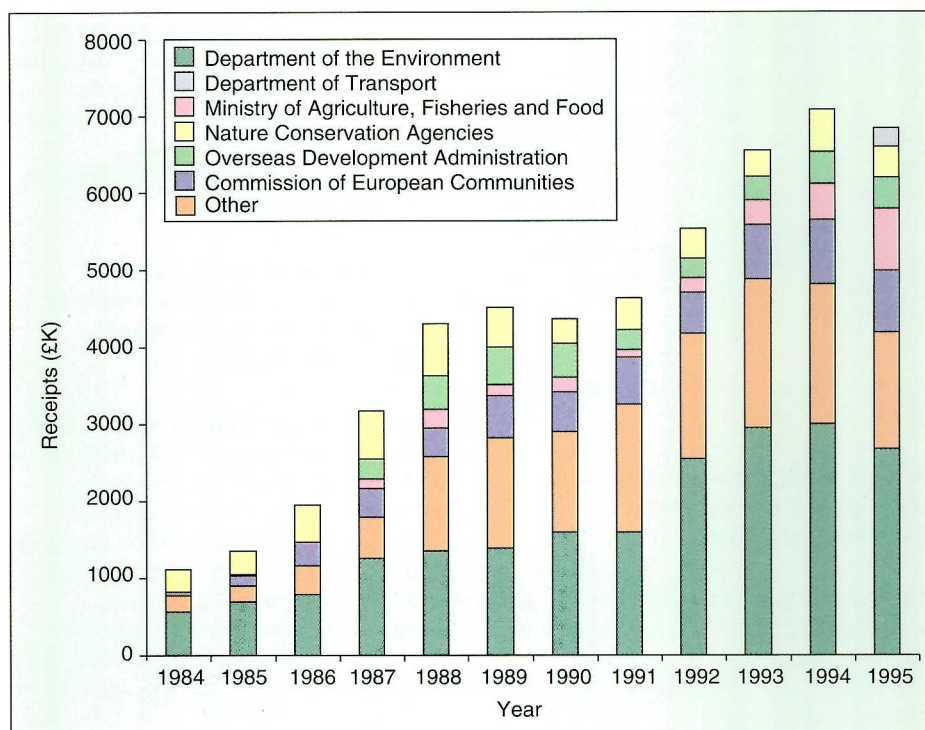


Figure 6. Long-term pattern of ITE receipts from major customers (at constant prices – 1984–95 using Gross Domestic Product indices)



Agency also led to increased support for hazard assessment of industrial chemicals and acid pollutants late in the financial year.

The financial position has been sustained at the cost of an unprecedented commitment to preparing grant applications and tender documents. Major effort was directed at NERC programmes to secure extensions to TIGER projects and develop new initiatives under the Large-Scale Processes Special Topic. Success in these endeavours indicates that ITE will benefit from more open competition for NERC's responsive-mode (non-thematic) funding. In addition, there have been major tendering exercises directed at the EU Fourth Framework Programme, MAFF's Open Contract Programme, the Overseas Development Administration's Natural Resources Systems Programme, and several smaller initiatives by the conservation agencies. The ever-increasing competition does take a toll of staff resources – nearly 25% of the time of senior staff is directed to non-research activities and 10% of overall staff effort. The sharp competition is also beginning to influence the nature and extent of collaboration across the research sector.

In spite of the above pressures, ITE's key output indicators continue to increase. Over 400 scientific papers were published in 1994–95, along with nearly 30 books and 200 contract reports. Notable increases occurred in publications relating to the public understanding of science (Figure 7). There was also a significant increase in licences for data and software – over 150 organisations have now secured access to these products. A computer-based collation of national datasets on land use were also released in the form of the Countryside Information System in collaboration with DoE.

### Applications of ITE research in 1994–95

#### Access to land use change data through the Countryside Information System

The Countryside Information System (CIS) is a PC-mounted computer package which stores and presents environmental information about Great Britain (GB). It was commissioned by the Department of the Environment (DoE) and is now being marketed by CEH. The main objective is to provide ready access to large national and

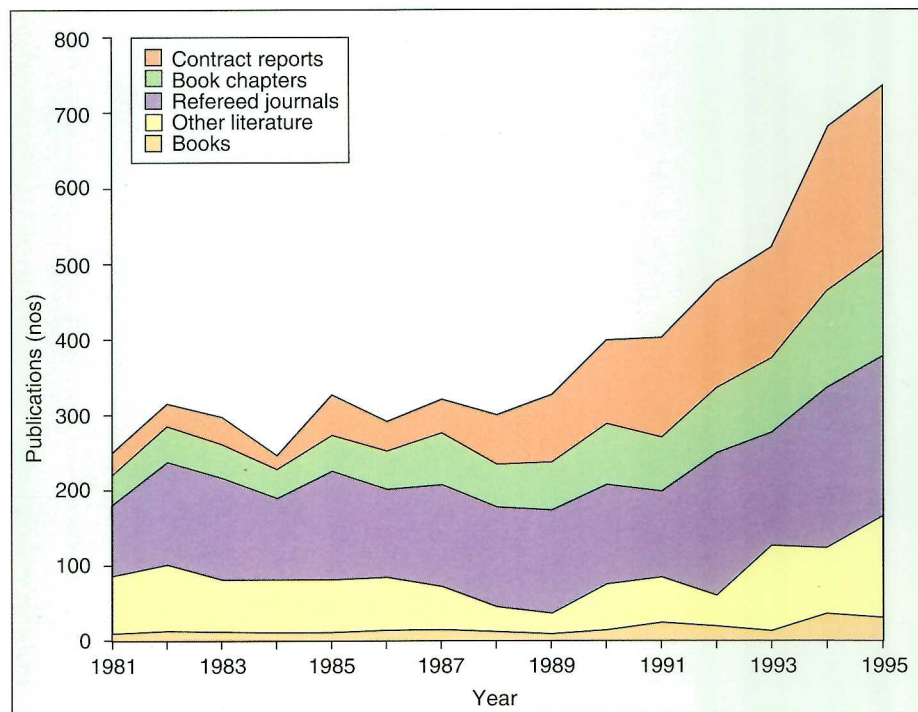


Figure 7. Trends in output of ITE publications

regional datasets. The principal datasets are those from Countryside Survey 1990, including the Land Cover Map of GB. Information is referenced by the 1 km squares of the National Grid, allowing users to interrogate combinations of datasets for any selected part of Britain. Progressively, other datasets are being identified and incorporated. For example, the Ordnance Survey has incorporated a set which describes the distribution of features such as roads, towns and woodlands. Users can also add their own datasets using the software facilities provided. The outputs are presented in tabular, graphical or cartographic form and can be loaded into other mapping packages.

#### Development of methods for monitoring the state and trends of biodiversity for the European Environment Agency

The European Environment Agency (EEA) has been established by EU to provide objective and reliable environmental information which is harmonised at the European level. This information is required by the European Commission and the EU Member States for the preparation, implementation and monitoring of their environmental policies. The objective of the EU nature conservation policy is to maintain biodiversity, to which the EU is committed through the Biodiversity Convention, formulated at the United Nations Conference on Environment and

Development (UNCED) in Rio de Janeiro in 1992, and the Fifth Environment Action Programme.

Biodiversity research initiated by the EEA in 1995 is aimed at an audit of present information resources, identification of gaps in knowledge, and establishment of methodologies for assessing and monitoring biodiversity. The programme is being implemented under contract to the EEA by the European Topic Centre for Nature Conservation, a consortium of ecological research organisations led from Paris. ITE staff are playing a lead role in the consortium on the basis of over a decade's experience in co-ordinating information on European biotopes.

#### Environmental implications of chemicals released during industrial or commercial accidents

With support from the DoE, ITE has been studying the environmental and ecological consequences of industrial and commercial accidents, such as fires and chemical spills, when many chemicals are released. These include the environmentally important dioxins and dioxin-like compounds that are strictly regulated because of health concerns.

In a special international study of published evidence relating to accidents involving chlorinated materials, ITE found that considerable amounts of dioxins and dioxin-like compounds could be released

from accidents. However, none of the dioxin emission inventories that governments in various parts of the world use as one of the foundations for regulating dioxin emission appears to include a term to cover accidental release. The study has also suggested that the scientific underpinning of estimates of the emission and deposition of dioxins and dioxin-like compounds needs strengthening because current estimates are based on too few measurements. ITE is discussing with DoE the steps needed to determine the magnitude and importance of accidents in calculating the environmental budgets of dioxins and dioxin-like compounds.

### **Establishing the critical levels of nitrogen saturation in European coniferous forests**

ITE has been working with European partners towards determining the contribution of nitrogen pollution to the acidification of surface waters in acid-sensitive areas and assessing the risk of damage to coniferous forests as a consequence of excessive nitrogen deposition. Results have indicated that nitrogen deposition is in excess of tree requirements in many coniferous forests, and may be reducing the effectiveness of reductions in sulphur emissions for the recovery of previously acidified waters. A direct relationship between deposition of oxidised nitrogen and a reduction in water quality has been demonstrated by ITE, although the main forestry tree species in the UK – Sitka spruce – appears to be tolerant of the resulting high soil nitrate concentrations and soil acidification. Mobilisation of the soil nitrogen store in response to excessive nitrogen deposition is a further complication identified in this work and will result in an acceleration of the deleterious effects on soils and water quality. The rapid recovery of water quality following experimental reductions in nitrogen inputs illustrates the potential benefits of emission controls, although the response of sensitive vegetation species is considerably slower.

### **Advancement in techniques for species translocation and habitat engineering**

The growing urgency of the need to conserve wildlife has resulted in an increasing use of species translocations and introductions. These have a variety of objectives, including

- establishing new populations or supplementing declining populations of

rare or threatened species (eg the Species Recovery Programme of English Nature),

- increasing the biodiversity of communities with currently low conservation value (eg agriculturally improved grassland and forestry plantations),
- creating or restoring plant and animal communities on sites degraded by human activity (eg by construction, quarrying, pipeline or mining projects),
- relocating communities to new sites to prevent their destruction by these human activities

In 1994, ITE completed a large habitat engineering project funded by Mott MacDonald Civil plc to 'prevent and mitigate' the loss of semi-natural habitat during the construction of a section of the M3 motorway between Bar End and Compton near Winchester, Hampshire. In this project, techniques such as macro-turfing, local seed collection and establishing plug plants grown from local source material were developed to overcome the potential problems involved in establishing species-rich grassland and wetland communities. Following the initial translocation or introduction procedures, appropriate management techniques were devised to ensure the development of 'target' communities. The 'establishment' phase was completed successfully in 1995 and a monitoring programme is now in place.

### **Ecological models predict recovery of rare species**

Modelling is a key tool in modern ecology, but it remains exceptional for predictions to be tested experimentally on populations in the field. Scientists at Furzebrook have succeeded in modelling the complex interactions that exist between the large blue butterflies (genus *Maculinea*), their sequential larval hosts of specific plants and *Myrmica* ant colonies. Long-term field and laboratory measurements of 18–20 parameters affecting *Maculinea arion* and *M. rebeli* formed the basis for models of varying complexity, the most sophisticated being a mechanistic, stochastic, spatial automation model that explains 87% of between-site variation in *M. rebeli* densities at sites in the Alps and Pyrenees.

Other models have identified the key variables responsible for the extinction of *Maculinea arion* in Britain, and predicted how habitat quality could be restored on

former sites. ITE has now tested these predictions, the work being partly funded by English Nature's Species Survival Programme. By manipulating site management, the predicted habitat quality has been altered on six 5–30 ha hillside sites to give positive, but different, values for the intrinsic rate of increase and equilibrium density of the butterfly. During the past 2–12 years, *M. arion* has been introduced to five of these sites from its last colonies in north Europe, each introduced population has increased at close to the predicted rate. ITE is now confident that the scientific problem of restoring this species to Britain has been solved, and that the techniques can be applied to other species.

### **Ecological models underpin agroforestry research strategy**

Mathematical models of plant growth, microclimate, species competition and nutrient cycling are increasingly used to represent complex interactions in forestry and agriculture. The Agroforestry Modelling Project is combining elements from a number of these models to produce a modular framework which describes the dynamics of carbon, nitrogen and water in mixtures of trees and crops. It is funded by the ODA Forestry Research Programme (FRP), and is providing a process-based decision support model which is useful to agricultural extension services in the tropics, and helps the FRP to focus its future agroforestry research and data collection activities. ITE Edinburgh is joined in this Project by groups from the Universities of Edinburgh, Nottingham, Reading and Wales, and the Institute of Hydrology.

### **The international dimension**

In spite of the increased focus of science budget funding on wealth creation and quality of life in the UK, many of ITE's opportunities continue to be dominated by international initiatives. The user community in the government departments and agencies continues to support ecological research to underpin policy initiatives arising from UNCED in 1992. The most important UK programmes are the Biodiversity Action Plan, the Climate Change Programme, and Sustainable Development – Agenda 21.

The UNCED 'Statement of forest principles' led to the UK Government's review of forestry published in *Sustainable forestry the UK programme*. ITE has maintained an active programme of research in tropical forest ecology, with studies on biodiversity,





Plate 4. Mr Narishima Rao (Prime Minister of India), with Dr Melvyn Cannell and Dr Julia Wilson at the Edinburgh Centre for Tropical Forestry

regeneration techniques, environmental impacts, agroforestry modelling and experimentation, and soil/vegetation/atmosphere exchanges. Two important issues that were addressed during the year concerned the ODA's revision of their renewable natural resources research strategy, and the rationale of continuing to support tropical research within the context of a (national) remit relating to wealth creation and quality of life. Regarding the latter point, the purpose of the UK Government's aid programme is defined in the Overseas Development and Co-operation Act 1980 as 'promoting the development or maintaining the economy of a country or territory outside the United Kingdom, or the welfare of its people'. The view of ITE is that research in support of the aid programme, enhancing productive

capacity and helping to tackle environmental problems, is entirely consistent with the objectives of the 1993 White Paper in that sustainable development will lead to new market places for British products.

Much of ITE's tropical research is funded through the Overseas Development

Administration's Renewable Natural Resources Research Strategy, which aims to promote the conservation and sustainable development of renewable natural resources in developing countries. The emphasis of the strategy is on work which will have practical application; applied research and the 'transfer and adaptation of technology to the circumstances of developing countries'. The revised strategy introduces systems approaches that strengthen the continuum between demand-led strategic and adaptive research and technology, development and transfer, and focuses more on demand criteria to improve the quality, relevance, uptake and impact of research. Again, these revisions mean that the strategy is consistent with the mission of ITE, and are welcomed.

Within Europe, ITE has continued to play the lead role in the development of biodiversity programmes through membership of the European Conservation Research Institute Network (CONNECT) and in forest ecology research through the European Forest Institute. The EU took a major initiative in establishing the European Environment Agency in 1994. Long-standing



Plate 5. Baroness Chalker with Dr Julia Wilson at ITE Edinburgh



Plate 6. (L-R) Professor Bill Heal, Mr Robert Malpas, Professor Brian Staines, Sir Hector Munro MP and Mr George Kynoch MP at ITE Banchory



involvement in the CORINE Biotopes programme led to ITE taking a key role in a successful bid for the EEA Nature Topic Centre (led by the Natural History Museum, Paris). Subsequently, ITE has also secured a role in the Topic Centre for Remote Sensing of Land Cover. Extensive links have been established by ITE across Europe through a strong reputation for high-quality research and effective collaboration. Considerable effort has been dedicated to preparing proposals for the EU Fourth Framework Programme. The 'critical mass' offered by the Institute system is a key factor in the UK securing a 'juste retour' from EU programmes.

and several institutes in Aberdeen on applications of molecular techniques in vertebrate ecology and a monitoring programme for Environmentally Sensitive Areas in Scotland.

T M Roberts

### **Personal achievements**

Professor O W Heal retired as Director of ITE (North) – a post he had held since 1987. Bill Heal will be remembered for his research contribution to understanding ecosystem processes in general, and soil ecology/nutrient cycling in particular. As a scientific administrator, he played a key role in managing ITE through a difficult period in the late 1980s. He was also a leading advocate of co-ordinated environmental monitoring programmes at national and international scales, and was largely responsible for the establishment of the Environmental Change Network and NERC initiatives in Arctic Ecology. Other leading contemporary ITE scientists who retired in 1994–95 included K H Lakhani (Biometrics), T C E Wells (Plant ecology), J M Sykes (Woodland ecology) and R C Welch (Invertebrate ecology). Notable staff developments included promotion to IMP Grade 6 for Dr J A Thomas (ITE Furzebrook) and the award of a DSc for Dr A S Dawson (ITE Monks Wood) from the University of Wales. Dr A J Gray (ITE Furzebrook) was appointed as Vice-President of the British Ecological Society.

The Institute was honoured by several visits from key politicians. Dr M G R Cannell and Dr J Wilson (ITE Edinburgh) met the Prime Minister of India – Mr Narishma Rao – during his visit to the Edinburgh Centre for Tropical Forestry (Plate 4). Baroness Chalker – the Minister for Overseas Development – also visited ITE Edinburgh to review the research undertaken by the Tropical Forest Ecology Section (Plate 5). Sir Hector Munro – Scottish Minister for Agriculture and the Environment – along with the NERC Chairman, Sir Robert Malpas, visited the Banchory Research Station in September 1994 (Plate 6). The visitors launched collaborative projects with the University

# Appendix 1. Staff at 31 March 1995

## DIRECTORATE

### INSTITUTE OF TERRESTRIAL ECOLOGY

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(Grade 5)  
SSO Dr L S Anderson  
PS Mrs D Harman  
  
**Administration Officer** Mrs J S Parsell  
(HEO)

EO Mrs J I Green  
EO Miss S L Stapleford  
EO Mrs S Stefanelli  
AO Mr N Childerley  
AO Miss C Hodgson  
AO Ms J Mann  
TYP Mrs J V Kimber

### Monks Wood

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PS Mrs M J King

### Administration

EO Mrs C F Rugden  
(Station Secretary)  
AO Miss R Cooper  
AO Mrs R Morgan  
AA Ms W A Forrest  
TYP Mrs J M Gaunt  
TYP Mrs E M Guernin  
IB10 Mr R H E Phillips  
IB18 Mr A Turk  
SGB1 Mrs A S Southwood  
HKPR Mrs I S Wylie

### Science

Grade 5 Dr I Newton  
Grade 6 Prof J Sheail  
Grade 7 Dr L A Boorman  
Grade 7 Dr K R Bull  
Grade 7 Dr A S Dawson  
Grade 7 Mr R M Fuller  
Grade 7 Mr P T Harding  
Grade 7 Dr M O Hill  
Grade 7 Mr K H Lakham  
Grade 7 Dr D Osborn  
Grade 7 Mr P Rothery  
Grade 7 Dr R C Welch  
Grade 7 Dr B K Wyatt  
  
SSO Dr C P Cummins  
SSO Mr B C Eversham  
SSO Dr L G Firbank  
SSO Dr M C French

SSO Mr A J Frost  
SSO Dr A McLeod  
SSO Dr D Moss  
SSO Dr T W Parr  
SSO Mr C D Preston  
SSO Dr R F Shore  
SSO Mr T H Sparks  
SSO Mr A G Thomson  
  
HSO Mr H R Arnold  
HSO Mr N J Brown  
HSO Dr P D Carey  
HSO Miss R Cox  
HSO Dr J Eastwood  
HSO Mr P Freestone  
HSO Ms F Gerard  
HSO Mr J N Greatorex-Davies  
HSO Dr G B Groom  
HSO Miss J R Hall  
HSO Dr S A Hinsley  
HSO Mr P D Howe  
HSO Dr E A Leeson  
HSO Dr A Meharg  
HSO Mr T J Moffatt  
HSO Mr J O Mountford  
HSO Dr R J Pakeman  
HSO Mr R F Pywell  
HSO Dr S M Redpath  
HSO Dr J R Treweek  
HSO Dr J M Weeks  
HSO Mr I Wylie  
HSO Mr M G Yates  
HSO Mrs T J Yates  
  
SO Mr P E Bellamy  
SO Mr M Brown  
SO Mrs J M Croft  
SO Ms C Davies (PT)  
SO Miss H Dyke  
SO Mr P K Hankard  
SO Mr H M Malcolm  
SO Miss S Manchester  
SO Mr D G Myhill  
SO Mr J Wright  
SO Mr S Wright

ASO Mr R A Garbutt  
ASO Mrs J M Ulyett  
ASO Mrs S Wallis  
ASO Miss C L Wyatt

HPTO Mr M Barwise

### Library

ALIB Mrs M Palmer

### Merlewood Research Station

GRANGE-OVER-SANDS  
Cumbria LA11 6JU  
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AO Miss J M Joinson  
AO Miss R Pounder  
IB14 Mr R Lethbridge

### Science

Grade 7 Dr R G H Bunce  
Grade 7 Dr A F Harrison  
Grade 7 Dr A D Hornill  
Grade 7 Dr B J Howard  
Grade 7 Dr P Ineson  
Grade 7 Mr D K Lindley  
Grade 7 Mr T W Parr  
Grade 7 Dr A Scott  
  
SSO Mr C J Barr  
SSO Dr H E Jones (PT)  
SSO Mr J A Parkinson  
SSO Mr C Quarmby  
SSO Mr J D Roberts

SSO	Mr A P Rowland
SSO	Dr A Sanchez
HEO(C)	Ms A J M Lane
HSO	Mr J K Adamson
HSO	Mr C B Benefield
HSO	Mr D G Benham
HSO	Mr N A Beresford
HSO	Mr P A Coward
HSO	Mr N Cox
HSO	Miss C J Hallam
HSO	Dr D C Howard
HSO	Mrs D M Howard
HSO	Mrs G Howson
HSO	Mrs V H Kennedy
HSO	Mr R Scott
HSO	Mr C Woods
SO	Miss C L Barnett
SO	Miss M K Gillespie
SO	Miss A L Hodgson
SO	Mrs J M Poskitt
SO	Miss S M C Robertson
SO	Miss D L Singleton
ASO	Mrs J Parrington (PT)
ASO	Mr M J Rossall
ASO	Mr D Sleep
ASO	Mr K Taylor
ASO	Mr D Wilson
	Dr J C Frankland (PT)
<b>Library</b>	
LJB	Mr J Beckett
AO	Mrs J Dobson (PT)
<b>CEH</b>	
HEO	Mrs P A Ward
PTO	Mr C Hankinson (Safety Technician)
AO(C)	Mrs K Goodsir

### Edinburgh Research Station

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EO	Mr T J Gray
AO	Mrs A M Campbell (PT)
AO	Mr G Hartley
AO	Mrs D S Innes
PS	Mrs S L Howat
TYP	Mrs M J Ferguson
SGB2	Mr J Wallace
IB8	Mr D A McEwan

<b>Science</b>	
Grade6	Prof D Fowler
Grade7	Dr J N Cape
Grade7	Dr J H M Thornley (PT)
Grade7	Dr A D Watt
Grade7	Dr J Wilson
SSO	Dr J Arah
SSO	Mr B G Bell
SSO	Dr A Crossley
SSO	Mr J D Deans
SSO	Dr R C Dewar
SSO	Dr A J Friend
SSO	Mr G J Lawson
SSO	Dr P A Mason
SSO	Dr R Milne
SSO	Dr L J Sheppard
SSO	Mr R I Smith
HSO	Dr J M Dick
HSO	Dr A Gillies
HSO	Dr K J Hargreaves
HSO	Mr F J Harvey
HSO	Mr K Ingleby
HSO	Mr I D Leith
HSO	Dr D C Mobbs
HSO	Mr R C Munro
HSO	Mr T D Murray
HSO	Dr U Skiba
HSO	Dr M A Sutton
SO	Mrs J Binnie
SO	Miss C Milford
SO	Mrs M B Murray
SO	Dr C E R Pitcairn
SO	Mr R L Storeton-West
ASO	Mr T A W Brown
ASO	Mr C McBeath
PTO	Mr G B Elphinstone

#### Library

ALIB	Miss S Scobie
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#### CEH

SEO	Mr I C Smith
-----	--------------

### Furzebrook Research Station

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Grade7	Mr R T Clarke
Grade7	Dr R E Daniels
Grade7	Dr G W Elmes
Grade7	Dr A J Gray
Grade7	Dr R E Kenward
Grade7	Dr J A Thomas
Grade7	Dr L K Ward
Grade7	Dr N R C Webb
SSO	Dr S McGrorty
SSO	Dr C J Reading
SSO	Mr R G Snazell
HSO	Dr J M Bullock
HSO	Dr R W G Caldwell
HSO	Ms S Le V dit Durell (PT)
HSO	Mr B Pearson
HSO	Dr A F Raybould
HSO	Mr W E Rispin
HSO	Mr R J Rose
HSO	Mrs J C Wardlaw (PT)
SO	Miss K Hodder
SO	Miss R Mogg
SO	Miss I L Moy
SO	Miss E A Warman

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SGB2	Miss R A Roger

#### Science

Grade6	Dr H Kruuk
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Grade7	Dr M P Harris
Grade7	Dr R Moss
Grade7	Mr D Welch
SSO	Dr N G Bayfield
SSO	Mr R P Cummins



<i>SSO</i>	Mr D D French
<i>SSO</i>	Dr M Marquiss
<i>SSO</i>	Mr R A Parr
<i>SSO</i>	Mr I S Paterson
<i>SSO</i>	Mr N Picozzi
<i>HSO</i>	Mr T R Barton
<i>HSO</i>	Dr D N Carss
<i>HSO</i>	Mr D C Catt
<i>HSO</i>	Mr J W H Conroy
<i>HSO</i>	Dr S E Hartley
<i>SO</i>	Mrs G M McGowan
<i>SO</i>	Mr D Scott
<i>ASO</i>	Mr K Nelson
<i>PTO</i>	Mr J A Morris
<b>Library</b>	
<i>AO</i>	Mrs R Ratcliffe

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### **Administration**

<i>EO</i>	Miss D E Owen
<i>AO</i>	Mrs G Langhorne (PT)
<i>TYP</i>	Mrs J Cooper(PT)

### **Science**

<i>Grade7</i>	Dr T W Ashenden
<i>Grade7</i>	Mr G L Radford
<i>Grade7</i>	Dr B Reynolds

<i>SSO</i>	Dr L S Anderson
<i>SSO</i>	Dr A Buse
<i>SSO</i>	Mr C R Rafarel
<i>SSO</i>	Mr P A Stevens

<i>HSO</i>	Dr B A Emmett
<i>HSO</i>	Mr S Hughes
<i>HSO</i>	Dr C Stirling

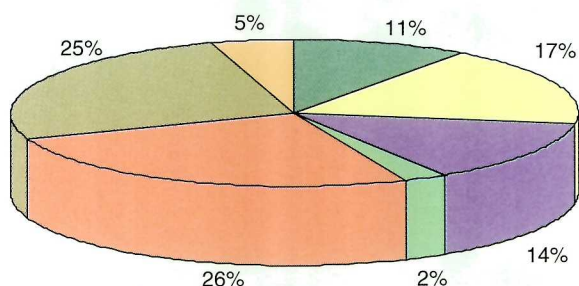
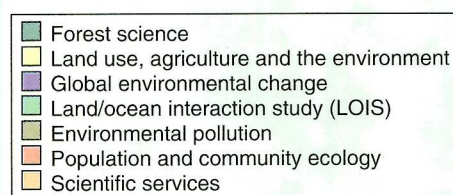
<i>Postdoc</i>	Dr C Freeman
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<i>SO</i>	Mrs S A Bell
<i>SO</i>	Mr P Geissler
<i>SO</i>	Mr D A Norris
<i>SO</i>	Mr T G Williams

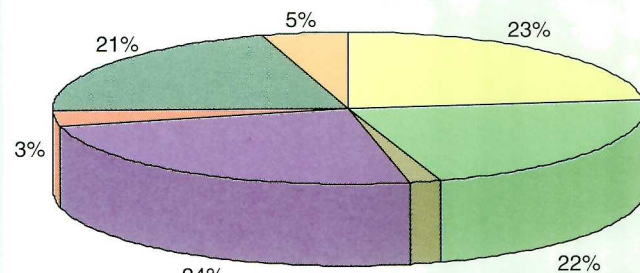
<i>ASO</i>	Mrs A Brittain
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## Appendix 2. Finance and administration

The following diagrams indicate levels of funding for the Institute, and provide details of expenditure.

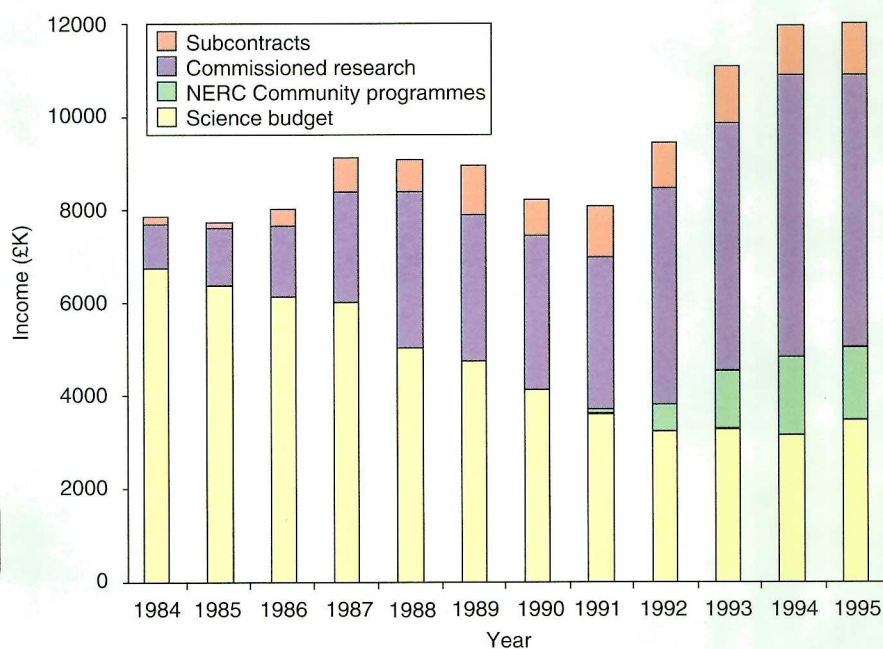
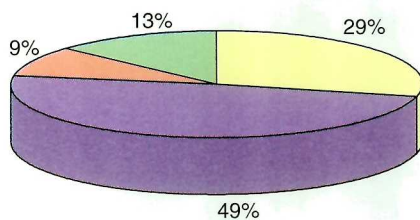


Percentage breakdown of total project costs by the NERC environmental issues

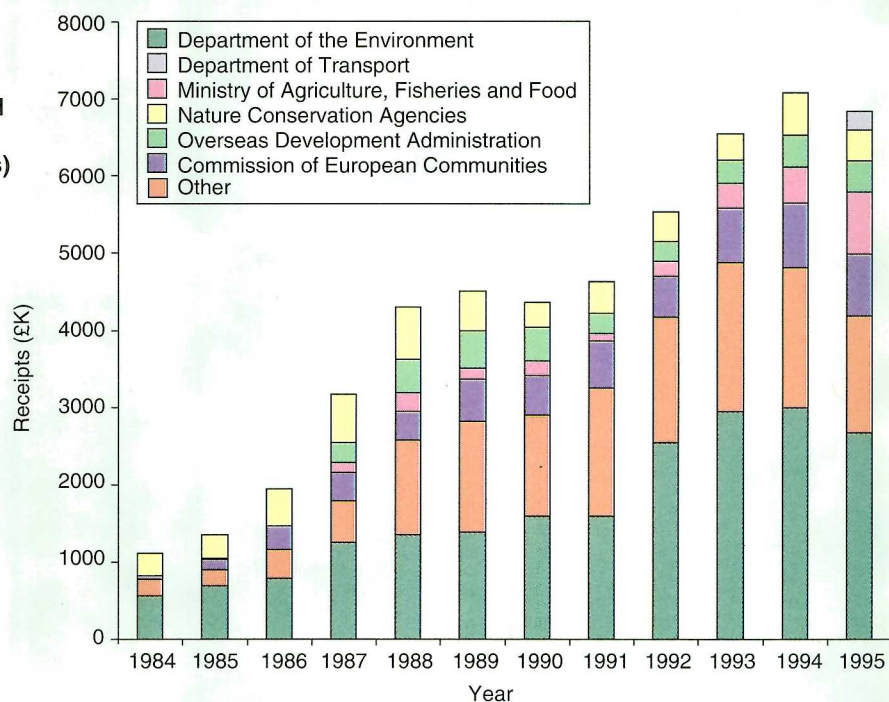


The graph illustrates trends in income (at constant prices – 1984-94 revalued to 1995 using Gross Domestic Product indices)

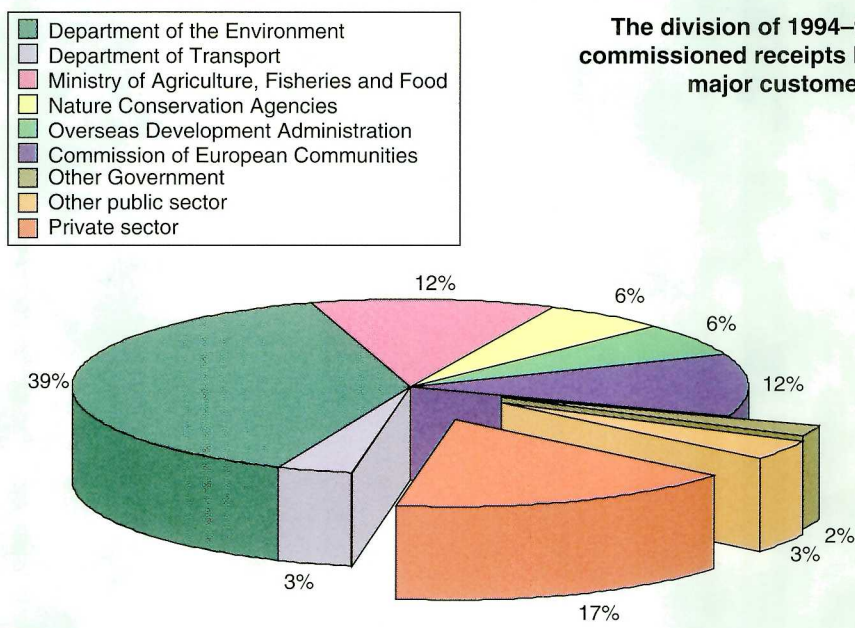
The pie chart shows the percentage breakdown for 1995



**The long-term pattern of receipts from major customers (at constant prices – 1984–94 revalued to 1995 using Gross Domestic Product indices)**



**The division of 1994–95 commissioned receipts by major customers**

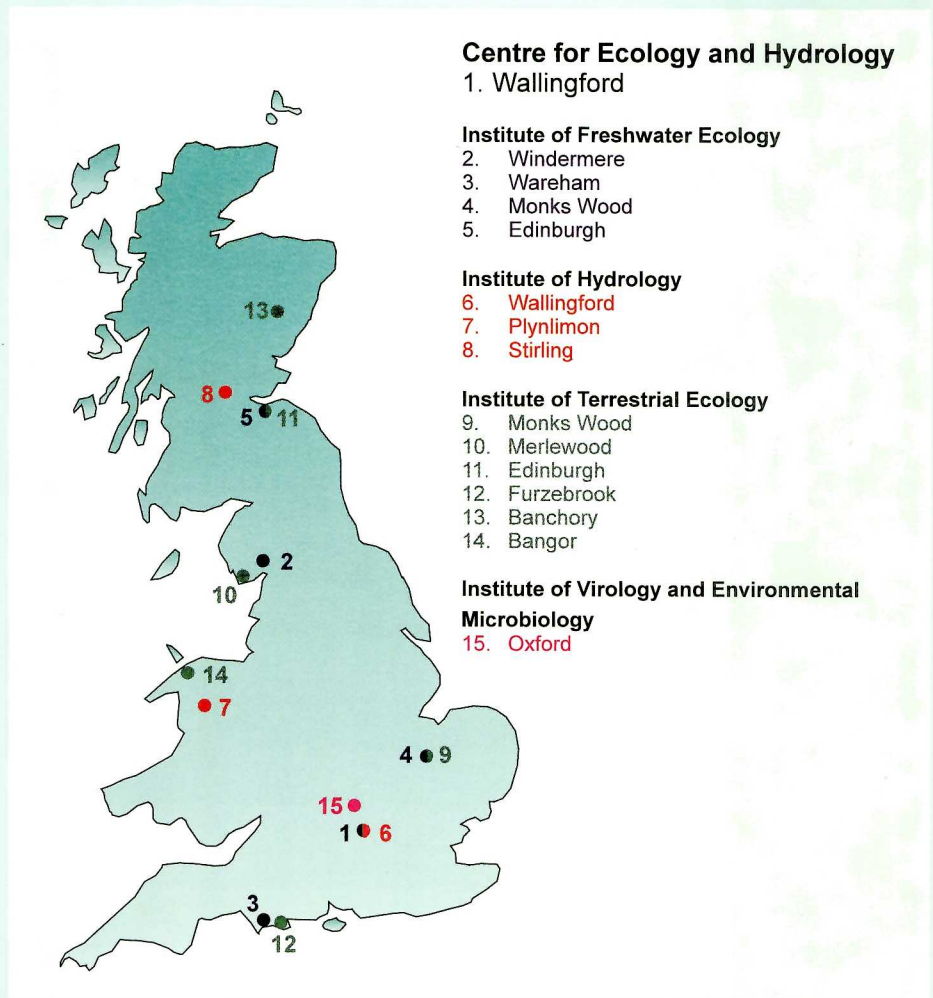






## Centre for Ecology & Hydrology

During the year of this Report, ITE became part of the new NERC Centre for Ecology and Hydrology.



Location of CEH sites



Location of recent research contracts undertaken by CEH Institutes

The Institute's position within the UK Research Council system is shown below. ITE is an integral part of the Natural Environment Research Council, which also supports a wide range of basic and strategic research in Higher Educational Institutions. ITE is a component Institute of the Centre for Ecology and Hydrology (CEH), and is able to draw on the expertise of colleagues within the other Institutes.

## UK GOVERNMENT

Department  
of Trade and  
Industry

Office of  
Science &  
Technology

## RESEARCH COUNCILS

Natural  
Environment

Biotechnology  
& Biological  
Sciences

Economic  
&  
Social

Medical

Engineering  
& Physical  
Sciences

Particle  
Physics &  
Astronomy

Council for  
the Central  
Laboratory

## CENTRES

Centre for  
Ecology and  
Hydrology

Centre for  
Coastal and  
Marine  
Sciences

British  
Geological  
Survey

British  
Antarctic  
Survey

Southampton  
Oceanography  
Centre

## INSTITUTES

Institute of  
Terrestrial  
Ecology

Institute of  
Freshwater  
Ecology

Institute of  
Hydrology

Institute of Virology  
& Environmental  
Microbiology

## RESEARCH STATIONS

Monks Wood

Merlewood

Edinburgh

Furzebrook

Banchory

Bangor



## Appendix 3. Research projects at 31 March 1995

### MONKS WOOD

#### Programme 2 Land use, agriculture and the environment

<b>T02053-5 Ecological data management and GIS</b>	<b>K R Bull</b>
T02053a2 GIS research and applications development	N J Brown
T02053e2 Data cataloguing and management	B K Wyatt
T02053p1 Tablefit sales	M O Hill
T02053t1 Global land use and cover classifications study	B K Wyatt
<b>T02054-5 EIC Biological Records Centre - biodiversity data centre</b>	<b>P T Harding</b>
T02054a5 EIC-BRC botanical recording	C D Preston
T02054h5 EIC-BRC Butterfly Monitoring Scheme	T J Yates
T02054i5 EIC-BRC database and atlas of aquatic plants	C D Preston
T02054n5 BRC - Co-ordinating Commission for Biological Recording (CCBR) Programme	P T Harding
T02054q5 BRC - liaison on biological recording	P T Harding
T02054r5 BRC - zoological recording	B C Eversham
T02054s5 BRC - database management	J C M Dring
T02054t5 BRC - database development	J C M Dring
T02054u1 BRC - output and advice to Nature Conservation Agencies	P T Harding
T02054v2 BRC - taxonomy and identification	C D Preston
T02054w1 Extension of CORINE biotopes recording to central Europe	D Moss
T02054x5 EEC CORINE project biotopes	D Moss
T02054y1 Birds Directive updating databank concerning sites of importance for birds	D Moss
T02054z1 Birds Directive computensation of Special Protection Area data	D Moss
<b>T02055-5 Environmental impact assessment</b>	<b>J R Treweek</b>
T02055i2 The interpretation of ecological information in environmental impact assessment	J R Treweek
<b>T02057-5 Historical aspects of environmental management</b>	<b>J Sheail</b>
T02057a5 Historical aspects of environmental perception	J Sheail
T02057c1 Provision of assistance to the Queen's Award Office	J Sheail
<b>T02059-5 Grassland dynamics and management</b>	<b>J Sheail</b>
T02059g2 Population studies on terrestrial orchids	T C E Wells
T02059k1 Species recovery - fen violet ( <i>Viola persicifolia</i> )	C D Preston
T02059l2 Effects of increased UV-B radiation on woodland and grassland species	A R Mcleod
T02059m5 Field expernents to investigate ecological aspects of wetland restoration	J R Treweek
T02059n5 ESA catchment models	J R Treweek
T02059o1 Review of heathland and limestone/chalk grassland management	T C E Wells
T02059p1 Management and restoration of species-rich grassland	T C E Wells
T02059q1 Multi-site expernents on the restoration of herb-rich grassland	T C E Wells

T02059r1 Reversion of intensive arable land to grass heath and <i>Calluna</i> heath (HLO1)	R J Pakeman
T02059s1 Effects of water management actions	J R Treweek
T02059t2 Invertebrate colonisation of recreated grassland	R C Welch
T02059u1 Co-ordination of ESA wetlands research	J Sheail
T02059v1 Control of injurious weeds in herb-rich grassland	T C E Wells
<b>T02070-2 Successional models for predicting ecological effects of changing agricultural practices</b>	<b>M O Hill</b>
T02070a2 Development of successional models	M O Hill
T02070b2 Plant dispersal within and between habitats	M O Hill
T02070c2 Neighbourhood relationships in establishment of herb-rich grassland	P D Carey
T02070d2 Population and community dynamics of arable weeds	L G Firbank
T02070j1 Integrated bracken control and vegetation restoration	A J Frost
T02070l5 Landscape ecology in changing agricultural landscapes	L G Firbank
T02070m4 The effects of organic farming on wildlife populations	L G Firbank
T02070n1 Agronomic and environmental evaluation of set-aside - modelling	M O Hill
T02070o1 Agronomic and environmental evaluation of set-aside - management	L G Firbank
<b>T02072-5 Remote sensing for ecological research</b>	<b>R M Fuller</b>
T02072a5 Land cover mapping (BNSC)	R M Fuller
T02072b1 Supply of land cover data	R M Fuller
T02072c2 Testing and development of analytical methods for remote sensing interpretation	R M Fuller
T02072d2 Expernental studies of ecological variables	R M Fuller
T02072e2 Evaluation of new types of imagery	R M Fuller
T02072f2 Spectral responses of vegetation	R M Fuller
T02072g2 Recording test sites	R M Fuller
T02072h3 Identification and mapping of humid tropical forest types from ATSR-2	R M Fuller
T02072i5 Darwin initiative remote sensing, GIS, Sango Bay, Uganda	R M Fuller
T02072j1 CORINE land cover map of Great Britain trial (feasibility study)	R M Fuller
T02072k1 A spatial resolution study for a high-resolution land surface processes mission	R M Fuller
<b>T02074-5 Biogeographical studies of GB</b>	<b>B C Eversham</b>
T02074a2 Biodiversity and landscape patterns	B C Eversham
T02074b2 Biogeography of species dynamics	B C Eversham
T02074c5 Classification of species distributions	C D Preston
T02074d2 Ecological studies	B C Eversham
T02074e2 Methods for biogeographic analysis	B C Eversham
<b>T02079-5 EIC Biological Records Centre - biodiversity data centre (continued)</b>	<b>P T Harding</b>
T02079a1 Editing bryophyte Red Data Book	C D Preston
<b>Programme 3 Global environmental change</b>	
T03057e6 Radar remote sensing for tropical forestry inventory and carbon balance	G B Groom

T03087b6	Ecological factors controlling species distribution and abundance	L G Firbank	<b>T07070-5 Ecotoxicology</b>	<b>D Osborn/S Dobson</b>
T03088b6	Landscape dynamics and climate change dispersal models and GIS	B K Wyatt	T07070a2	Avian ecotoxicology S Dobson
T03088j6	Effects of climate change at regional and global scales remote sensing of disturbance in biomes as a measure of their sensitivity to change	B K Wyatt	T07070d2	Detecting subtle impacts of pollutants on individuals D Osborn
T03091n6	Small-scale mobile open-air CO <sub>2</sub> fumigation system	A R McLeod	T07070h2	Ecotoxicology chemical analysis M C French
T03091p6	Review of FACE systems	A R McLeod	T07070k2	Ecotoxicology of terrestrial invertebrates J M Weeks
T03091r6	Effects of increased UV-B on the vegetation of natural ecosystems	A R McLeod	T07070q5	Recognition of biochemical perturbations by proton nuclear magnetic resonance spectroscopy J M Weeks
T03091s6	Swiss FACE experiment	C P Cummins	T07070r2	Bioavailability and environmental fate of organic chemicals A Meharg
T03091v6	Effects of UV-B radiation of oak and its leaf litter decomposition	A R McLeod	T07070s2	Urban ecology and pollution D Osborn
			T07070t2	Effects of liming on moorland ecology R F Shore
			T07070u2	Small mammal ecotoxicology R F Shore
			T07070v2	Amphibian ecotoxicology C P Cummins
			T07070w2	CONNECT ecotoxicology J M Weeks

### **Programme 5 Land/ocean interaction study (LOIS)**

T05060a6	A coastal zone terrestrial GIS for the LOIS community	K R Bull
T05060d6	Flux studies at coastal sites	L A Boorman
T05060e6	Remote sensing of intertidal biotopes	A G Thomson
T05060f6	LOIS analytical chemistry	A A Meharg
T05060g1	Further development of airborne remote sensing techniques	A Thomson
T05060i6	Documentary evidence of changes in the fluxes between the Tweed and the Wash	J Sheail

### **Programme 7 Environmental pollution**

<b>T07061-5 Hazard and risk assessment</b>	<b>D Osborn/S Dobson</b>
T07061a1	Hazard assessment of chemicals S Dobson
T07061g1	Analysis of biological and other environmental samples M C French
T07061i1	Profile on prescribed substances - dose response S Dobson
T07061k1	Task group for World Health Organisation D Osborn
T07061o1	Environmental follow-up to major industrial accidents D Osborn
T07061q1	Arsenic in gold mines J M Weeks
T07061r1	Blueprint to protect habitats (ERLs) S Dobson
T07061t1	Ecotoxicological testing on bats R F Shore
T07061v1	Media biomonitoring methodology - phase 2 development of expert system D Osborn
T07061w1	UK collaboration with IPCS S Dobson
T07061x1	Comparative environmental index D Osborn
T07061y1	Uptake and effects of dioxins on vegetation A Meharg

<b>T07062-5 The critical loads approach</b>	<b>K R Bull</b>
T07062a1	National critical loads mapping programme K R Bull
T07062i1	Critical loads maps for China K R Bull
T07062j1	Assessment of environmental effects of power stations K R Bull
T07062m1	Supply of critical loads data J R Hall
T07062o1	Power station impacts on conservation areas M Brown

<b>T07069-5 The impacts of climate change</b>	<b>K R Bull</b>
T07069a1	Application of GIS to climate change studies K R Bull
T07069b1	DOE climate change modelling programme M O Hill/ J P Grime
T07069h5	Modelling effects of climate change on species distribution M O Hill
T07069u5	Effects of rapid climatic change on plant biodiversity M O Hill

<b>T07073-5 Interactive effects of pesticides</b>	<b>A S Dawson</b>
T07073b4	Pesticide interactions biochemical effects A S Dawson

### **Programme 8 Population and community ecology**

<b>T08054-2 Population dynamics of raptors</b>	<b>I Newton</b>
T08054a2	Population ecology of sparrowhawks ( <i>Accipiter nisus</i> ) I Newton
T08054b2	Tawny owls in fragmented habitats S M Redpath
T08054c5	Wildlife and pollution I Newton
T08054d5	Raptor predation on red grouse populations S M Redpath
T08054g5	Seabird mortality incidents H M Malcolm

<b>T08056-2 Environmental control of avian breeding cycles</b>	<b>A S Dawson</b>
T08056d2	Avian photoperiodism A S Dawson
T08056e2	Deferred breeding A S Dawson
T08056f2	Puberty in starlings A S Dawson

<b>T08068-5 Molecular ecology</b>	<b>A J Gray/I Newton</b>
T08068c2	Relatedness in sparrowhawks I Newton
T08068d2	Relatedness in other birds of prey I Newton

<b>T08074-5 Ecology and management of coastal systems</b>	<b>L A Boorman</b>
T08074a5	Effects of environmental change on British salt marshes L A Boorman
T08074b2	Climate change, sea level rise and the English coast L A Boorman
T08074c5	Large-scale experimental set-back L A Boorman

<b>T08080-3 Wildlife diseases (special topic programme)</b>	<b>D Osborn</b>
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<b>T08082-5 Metapopulation dynamics</b>	<b>I Newton</b>
T08082a5	Metapopulations and habitat fragmentation I Newton
T08082b2	Metapopulation dynamics of breeding woodland birds S A Hinsley
T08082d5	Landscape ecology of birds I Newton
T08082e2	Amphibian dispersal C P Cummins

<b>T08090-4 Ecological molecular genetic initiative</b>	<b>T M Roberts</b>
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### **Programme 13 Scientific services**

T13054c2	Development of current awareness services in ITE libraries M Palmer
<b>T13055-5 Chemistry research, development and maintenance</b>	<b>M C French</b>



T13055o2	Analytical support studies	M C French
T13055p2	Computersation of Analytical Chemistry	M C French
T13055q2	Equipment maintenance in Analytical Chemistry	M C French
T13055r2	NAMAS and Quality Assurance	M C French
T13055t2	Sample management	R F Shore

#### **T13060-2 Statistical research and development in ITE South** **P Rothery**

T13060a2	Estimation of population parameters	P Rothery
T13060b2	Statistical consultancy for Monks Wood/ITE/NERC	P Rothery
T13060c2	Biometrical research	T H Sparks
T13060d2	Statistical consultancy for Monks Wood and Bangor	T H Sparks

#### **T13061-1 ITE South consultancies** **T M Roberts**

T13061a1	Small consultancies at ITE Monks Wood	S Dobson
T13061d1	Small consultancies at ITE Environmental Information Centre	B K Wyatt

## **MERLEWOOD RESEARCH STATION**

### **Programme 1 Forest science**

#### **T01051-5 Mycological and faunal processes in carbon and nutrient flux in soil and soil/root interactions** **H E Jones**

T01051a2	Role of fungi in nutrient cycling with special reference to <i>Mycena galopus</i> in forest soil	J C Frankland
T01051g2	A mechanistic approach to the study of the role of the extra-hyphae of mycorrhizal associations in nutrient uptake	H E Jones

#### **T01061-3 Farm forestry (special topic programme)** **T W Parr**

#### **T01062-5 Organic matter and nutrient dynamics in forest and upland soils** **A F Harrison**

T01062g5	Rehabilitation of <i>Acacia</i> fallow system, Sudan/Senegal (MAB)	D K Lindley
T01062h5	The scientific management of renewable natural resources in China	D K Lindley
T01062k1	<i>Acacia</i> tree fallows in Senegal	D K Lindley
T01062l2	Interactions between mineral nutrition of plants and air pollution, particularly CO <sub>2</sub>	A F Harrison
T01062m5	Application of the nutrient deficiency root bioassays to forests	A F Harrison
T01062o1	Phosphorus dynamics in alley cropping systems in the humid tropics	A F Harrison
T01062p5	Organic matter management in <i>Eucalyptus</i> forestry	H E Jones
T01062r2	The fate and behaviour of cadmium in agricultural soil/plant systems	A F Harrison
T01062t5	Effects of nutrients on species diversity in grasslands	A F Harrison
T01062u2	Factors affecting mass balance in recent peats	A F Harrison
T01062v2	Processes affecting carbon absorption in upland soils	A F Harrison
T01062w1	Review of soil biodiversity UK and European theatre	M Hornung

### **Programme 2 Land use, agriculture and the environment**

#### **T02051-5 Land use change and ecological impacts** **R G H Bunce**

T02051m5	Countryside survey 1990	C J Barr
T02051n2	Extending the use of the Merlewood land classification system liaison and collaboration	C J Barr
T02051o2	Land use data management and integration at ITE Merlewood	C J Barr
T02051p2	The application of Geographical Information Systems (GIS) to the Merlewood land use database	D C Howard
T02051w1	Northern Ireland countryside survey	R G H Bunce
T02051y1	Countryside survey information system	R G H Bunce
T02051z1	Changes in key habitat	C J Barr

#### **T02064-5 Environmental impact assessment - ITE Merlewood** **A F Harrison**

#### **T02071-5 Land use change and ecological impacts (cont'd)** **R G H Bunce**

T02071e1	Processes of land use change	C J Barr
T02071f1	Countryside Information System (Northern Ireland)	R G H Bunce
T02071g1	Ponds	C J Barr
T02071i1	Forest project	R G H Bunce
T02071j1	Centre for Agricultural Strategy LUAM model	R G H Bunce
T02071k1	Hedgerow survey, 1993	C J Barr
T02071l1	Green audit of Cumbria	D C Howard
T02071n2	Ecological factors controlling botanical diversity in the British countryside	R G H Bunce
T02071o1	Influences of agricultural practices on ingestion doses following airborne radioactive release	C J Barr
T02071p1	Concerted action meetings	R G H Bunce
T02071q1	Review of hedgerow management	C J Barr
T02071r1	Sustainable agriculture	R G H Bunce
T02071s1	UV-B project	R G H Bunce
T02071u5	Examination of the GB hedgerow network and its applicability in the USA	C J Barr
T02071v1	Information and indicators to give an overview of UK wildlife	T W Parr

#### **T02075-5 Disposal of oiled beach material (OBM) in sandy coastal environment, including low-grade dune and dune pastures** **A F Harrison**

T02075a1	Dune pasture landfarming for biodegradation of oiled beach materials	A F Harrison
T02075b1	Burial in dune pasture	A F Harrison
T02075c1	Biodegradation of buried oil residues in lysimeter tubes in an experimental garden	A F Harrison
T02075d1	Rate of biodegradation of buried oil residues in a range of selected sites in Britain	C J Barr
T02075e1	Experimental burial of oil residues for biodegradation in an ungrazed sand dune site	A F Harrison
T02075f1	Rate of biodegradation of oil beach materials buried in sand dunes at pollution sites	A F Harrison
T02075g1	Biodegradation rates of buried oil residues in lysimeter tubes in a range of soil types	A F Harrison
T02075i1	Toxicity of oil residues on plants and <i>in situ</i> observations at trial burial sites	A F Harrison
T02075j1	Illustrated guide and action plan for bio-remediation at sites of future oil spills on the GB coast	D K Lindley
T02075k1	Biodegradation and site restoration at the oiled residue dump at Pendine Sands	A F Harrison

#### **T02076-5 Land use data supply** **J W Watkins**

T02076a1	Countryside information system data-base sales	J W Watkins
T02076b1	Data leasing agreements	J W Watkins

T02076c1 Supply of data C J Barr  
T02076d1 Environmental accounts for land cover R G H Bunce

**T02077-5 Land use database consultancy C J Barr**  
T02077a1 Minor repayment work C J Barr

### Programme 3 Global environmental change

T03055c6 O<sub>2</sub> fertilization effects on decomposition processes P Ineson  
T03055e6 Field experimental study of the effects of global warming on carbon turnover in upland soils P Ineson

T03056d6 The use of DNA amplification to identify patterns of fungal colonisation of litter affected by enhanced CO<sub>2</sub> J C Frankland

T03064g6 Measurement of trace gas fluxes in forest and upland soils P Ineson

T03090c3 Arctic ecosystems and environmental change N Cox

**T03095-5 Detection of environmental change T W Parr**  
T03095a6 Environmental change network (ECN) co-ordination T W Parr  
T03095b6 ECN and TIGER co-ordination at Moor House and Upper Teesdale J K Adamson  
T03095c6 ECN and TIGER site management at Wytham M D Morecroft  
T03095d2 Effects of clearfelling on soil water chemistry S M C Robertson  
T03095f5 Rehabilitation of riparian zones in coniferous forest J K Adamson

T03098b1 Carbon sequestration in upland soils, including the impacts of forestry A F Harrison

### Programme 7 Environmental pollution

**T07050-5 Radionuclides in vegetation and soil A D Hornill**  
T07050h2 The role of the litter layer in the recycling of caesium isotopes in upland Britain A D Hornill  
T07050i2 The absorption and recycling of plutonium in plants A D Hornill  
T07050j5 Advisory and other committee work on radionuclide research A D Hornill  
T07050k5 Radioactivity in natural ecosystems - EEC II A D Hornill  
T07050l2 Radioecology computer-based bibliography J Dobson  
T07050m2 Development and calibration of mechanistic models for radionuclide uptake from soils B J Howard  
T07050o2 Monitoring of radionuclides in tidally inundated pastures A D Hornill  
T07050p2 Radionuclides around nuclear sites A D Hornill  
T07050q1 Feasibility study of rapid techniques to assess radionuclide uptake by plants V H Kennedy

**T07051-5 Radionuclide/animal transfers B J Howard**  
T07051d2 The dynamics of radionuclide uptake by sheep B J Howard  
T07051g5 Transfer of radionuclides in animal production systems B J Howard  
T07051i2 Transfer of <sup>35</sup>S to goat milk B J Howard  
T07051j2 Identification of hot spots in restricted areas N A Beresford

T07051i1 Rapid prediction of radionuclide availability N A Beresford  
T07051m2 Review of the influence of stable iodine on radioiodine transfer to milk B J Howard  
T07051n5 Radioecological studies in the CIS B J Howard  
T07051o2 Identification of grazing habits/areas which may influence radiocaesium levels in west Cumbrian sheep using global satellite techniques N A Beresford  
T07051p5 Collaborative studies on radionuclide transfer to animals in the CIS B J Howard  
T07051q1 Desk review of the transfer of radio-strontium to milk and possible counter-measures B J Howard  
T07051r2 Cs-137 variability in sheep flocks in the restricted areas of west Cumbria N A Beresford  
T07051s1 The applicability of ACFC counter-measures in the restricted areas of the UK N A Beresford  
T07051t5 Collaborative studies on radionuclide transfer to animals in the CIS B J Howard  
T07051u5 A training course in the application of GIS to radioecology B J Howard

**T07052-5 Chemistry of radionuclides A Sanchez**  
T07052d2 Radiochemical development A Sanchez  
T07052h2 Radioanalytical services A Sanchez  
T07052i2 Construction and commissioning of <sup>14</sup>C analysis rig A Sanchez  
T07052j2 ITE Merlewood radiochemistry laboratory accreditation scheme V H Kennedy

**T07054-5 Critical loads of acidity, S and N for soils M Hornung**  
T07054a5 Determination of critical loads of acidity, N and S for soils M Hornung  
T07054c1 Subcontract to Aberdeen University M Hornung  
T07054d1 Subcontract to Lancaster University M Hornung  
T07054e1 Subcontract to Nottingham University M Hornung  
T07054g5 ENCORE M Hornung  
T07054n1 Dose/response relationships for use in models to determine externalities of energy generation by the coal fuel cycle M Hornung  
T07054o5 Biological indicators for setting of critical loads for soils M Hornung  
T07054p5 Liming and faunal inoculation of forest soils J K Adamson  
T07054q2 Effects of sulphur dioxide on fungal decomposition of tree leaf litter P Ineson  
T07054r5 Enhanced NH<sub>3</sub> and SO<sub>2</sub> deposition near point sources and their impacts P Ineson  
T07054t5 Quantification of N losses by denitrification P Ineson  
T07054u1 Subcontract with MLURI M Hornung  
T07054v5 Isotopic characterisation of nitrogen pollutant inputs to forests (NIPHYS) A F Harrison  
T07054w5 Green accounting comparison of monetary valuation and the 'extasy' method M Hornung  
T07054x5 Excess nitrogen deposition and soil acidification P Ineson  
T07054y2 Solute solubilisation rates and soils hydrologic pathways M Hornung

T07057x1 Ammonia distribution and effects project (ADEPT) M Hornung

**T07074-5 Critical loads of acidity, S and N for soils (continued) M Hornung**  
T07074a5 Effects of acidifying pollutant inputs on soil phosphorus chemistry A F Harrison



### Programme 13 Scientific services

<b>T13054-2 ITE library services</b>	<b>J Beckett</b>
T13054e2 Database of ITE staff publications	J Beckett
T13055a2 Chemical support studies	J A Parkinson
T13055i2 Merlewood Analytical Section accreditation scheme	A P Rowland
T13055j2 Database for Merlewood Analytical Section records	A P Rowland
T13055l2 Analytical group methods book update and revision	J D Roberts
T13055n1 Direct contract analysis for non-CEH customers	J A Parkinson
<b>T13056-4 NERC mass spectrometer service</b>	<b>C Quarmby</b>
T13056a2 NERC mass spectrometer service	C Quarmby
<b>T13057-5 Merlewood scientific support services</b>	<b>D K Lindley</b>
T13057a2 Graphics and publications	C B Benefield
T13057b2 Biometrics and modelling support services at Merlewood	D K Lindley
T13057f1 Lecturing and liaison with Charlotte Mason College, University of Lancaster	R G H Bunce
T13057g2 Construction of lysimeter trench and greenhouse control shed	D G Benham
T13057h2 Conversion of Merlewood Analytical Section VAX-based software to PC-UNIX	A P Rowland

### FURZEBROOK RESEARCH STATION

#### Programme 2 Land use, agriculture and the environment

T02059w1 Effects of water management actions on birds	R W Caldw
T02059x5 Response of birds to field experiments on wetland restoration	R W Caldw
T02059y1 Input of bird data to ESA catchment models	R W Caldw
T02075h1 Faunal impacts in landfarming and burial sites for oiled beach materials	R E Daniels

#### Programme 3 Global environmental change

T03086f6 Effects of elevated CO <sub>2</sub> and temperature on the growth rates and life cycle characteristics of herbivorous terrestrial invertebrates	N R C Webb
T03087d6 Ecological factors controlling species distribution and abundance	J A Thomas
T03087f6 Climate-related plant migrations and invasions ecological genetics and reproductive biology as determinants of plant response to climatic change	A J Gray

#### Programme 5 Land/ocean interaction study (LOIS)

<b>T05060-6 Land/ocean interaction study (LOIS) - ITE</b>	<b>A J Gray</b>
T05060b6 Biogenic factors in sediment transport	S M McGrorty
T05060c6 Coastal vegetation and sediment dynamics	A J Gray
T05060h3 <i>Spartina anglica</i> and sediment dynamics in the RACs study area	A J Gray

### Programme 8 Population and community ecology

<b>T08057-5 Migratory wader ecology</b>	<b>J D Goss-Custard</b>
T08057a2 Predator/prey interactions between the oystercatcher and mussel	J D Goss-Custard
T08057b2 Winter feeding ecology of juvenile oystercatchers	S E A Durell
T08057m1 Determinants of the intertidal and sediments of estuaries	J D Goss-Custard
T08057o5 Shellfish and shorebirds	J D Goss-Custard
T08057p1 Shorebird densities	J D Goss-Custard
<b>T08059-5 Applied plant ecology and genetics</b>	<b>A J Gray/ R E Daniels</b>
T08059r2 Genetic structure of plant populations	R E Daniels
T08059s1 Wytch Farm development	R E Daniels
T08059t1 Reed bed nutrients	R E Daniels
T08059u2 Dynamic responses of plant populations to grazing	J M Bullock
T08059v1 Species recovery shore dock	R E Daniels
T08059x5 Review of information on species translocation, re-establishment, introduction and re-stocking	J M Bullock
<b>T08060-5 The evolutionary ecology of interacting populations: ant/plant/butterfly/parasitoid systems under different climates</b>	<b>J A Thomas/ G W Elmes</b>
T08060i2 Social structure and ecological adaptations of <i>Myrmica</i> ants	G W Elmes
T08060j2 Comparative evolutionary ecology of <i>Maculinea</i> species	G W Elmes
T08060k5 Field tests of butterfly/ant population models	J A Thomas
T08060l1 Black hairstreak beside the M1	J A Thomas
<b>T08068-5 Molecular ecology</b>	<b>A J Gray/I Newton</b>
T08068a2 Gene flow in brassicas	A J Gray
T08068b2 Ant socio-biology	G W Elmes
T08068g1 Gene flow in natural populations of <i>Brassica</i> and <i>Beta</i>	A J Gray
T08068h1 Gene flow between forage crops and wild relatives	A J Gray
T08068i5 Environmental impact of genetically modified plants	A J Gray
<b>T08078-5 Assessment, management and reconstruction of lowland communities</b>	<b>N R C Webb</b>
T08078c1 West Wellow bypass ecological appraisal	L K Ward
T08078e1 M3 Bar End to Compton ecological studies	N R C Webb
T08078g2 Demography and conservation of scrub	L K Ward
<b>T08079-5 Metapopulation dynamics, habitat templates and successional processes</b>	<b>N R C Webb</b>
T08079d5 New Forest cicada	L K Ward
T08079e2 Heathland habitat templates	N R C Webb
T08079f2 Habitat occupancy and dispersal by heathland species	N R C Webb
T08079g2 Invertebrate successions on heathland	N R C Webb
T08079h2 Dorset heaths GIS	N R C Webb
T08079k5 Survey of heaths in west Gwynedd	N R C Webb
T08079n5 Study of habitats losing wildlife interest as a result of ecological succession	N R C Webb
T08079o1 Heathland re-creation plan for Dorset	N R C Webb
<b>T08083-5 Vertebrate geodemography</b>	<b>R E Kenward</b>
T08083a1 Demography of saker falcons in central Asia	R E Kenward
T08083b5 Red squirrel conservation and ecology	R E Kenward

T08083d5	Developing software for radiotag studies	R E Kenward
T08083e2	Geodemography of large raptors	R E Kenward
T08083f2	Ecology and metapopulation dynamics of herpetofauna	C J Reading
T08083g1	Evaluation of reptile survey methodologies	C J Reading

### Programme 13 Scientific services

T13060e2	Statistical research and development at ITE Furzebrook	R T Clarke
T13060f2	Statistical consultancy for the IFE River Laboratory	R T Clarke

<b>T13061-1</b>	<b>ITE South consultancies</b>	<b>T M Roberts</b>
T13061b1	Small consultancies at ITE Furzebrook	A J Gray

## EDINBURGH RESEARCH STATION

### Programme 1 Forest science

<b>T01057-5</b>	<b>Forest modelling</b>	<b>M G R Cannell/ A D Watt</b>
T01057w2	Mechanistic models of tree and forest growth	R C Dewar
T01057x2	Modelling the population dynamics of the pine moth	A D Watt
T01057z1	Red alder demonstration plot at Glencorse	L J Sheppard
<b>T01059-5</b>	<b>Mycorrhizas and tree production</b>	<b>J Wilson</b>
T01059n1	<i>Eucalyptus</i> mycorrhizas in Chile	P A Mason
T01059q1	Mycorrhizal training	K Ingleby

<b>T01060-5</b>	<b>Tropical forestry and tree improvement</b>	<b>J Wilson</b>
T01060a2	Domestication of tropical hardwoods	J Wilson
T01060i1	Effects of silviculture on nutrient and water relations of Cameroon forests	J Wilson
T01060p5	Domestication of Cameroon fruit trees	J Wilson
T01060s1	Student training in tropical forestry	J M Dick
T01060z1	ECTF forest regeneration - Indonesia	J Wilson

<b>T01065-5</b>	<b>Tropical forestry and tree improvement (cont'd)</b>	<b>J Wilson</b>
T01065c1	Mycorrhizal consultancies to Projeto Bionte, Brazil	J Wilson
T01065h1	Agroforestry modelling and research co-ordination	M G R Cannell
T01065j1	CATIE/ITE link, Phase II Costa Rica	A D Watt
T01065k5	Sahelian trees growth, soil amelioration, water and nutrient use	J D Deans
T01065l2	Genetic variation in tropical trees application of molecular techniques	J Wilson
T01065m2	Application of process-based models to tropical forestry	J M Dick
T01065n1	Genetic diversity of Cameroon fruit trees	J Wilson
T01065o5	CEC genetic diversity of tropical trees	J Wilson
T01065p1	Vegetative propagation of <i>Calliandra calothyrsus</i>	J M Dick
T01065r2	Tropical forest ecology	J Wilson

<b>T01066-5</b>	<b>Forest modelling (cont'd)</b>	<b>M G R Cannell/ A D Watt</b>
T01066a1	Invertebrate fauna associated with birch in spruce forests	A D Watt
T01066b1	IPCC lead and contributing authors - consultancy contract	M G R Cannell

T01066c5	Long-term effects of CO <sub>2</sub> increase and climate change of European forests (LITEF)	A D Friend
T01066d5	Methane generation and consumption in rice fields	J Arah

### Programme 3 Global environmental change

T03054a6	Modelling carbon dioxide exchange at regional scales	A D Friend
T03055i6	Process-based modelling of grasslands and forests CO <sub>2</sub> and climate effects	J H M Thornley
T03057a6	Carbon balance of tropical forests	J Grace/R Milne
T03064b6	Methane emissions from UK wetlands	D Fowler
T03064h6	N <sub>2</sub> O flux measurement from agriculture and natural soils	D Fowler
T03065a6	Measurement of methane at the field/landscape scale	D Fowler
T03066d6	Tropospheric photochemistry in coastal and upland regions	J N Cape
T03091d6	Flask sampling atmospheric trace gases	B G Bell
T03091e6	Cameroon co-ordination	B G Bell
T03091k6	Impact of CO <sub>2</sub> on population dynamics of conifer-feeding insects	A D Watt

<b>T03098-5</b>	<b>Carbon sequestration in the biosphere</b>	<b>M G R Cannell</b>
T03098a1	Carbon sequestration in vegetation and soils	M G R Cannell

### Programme 7 Environmental pollution

<b>T07057-5</b>	<b>Atmospheric pollutants and trace gases</b>	<b>D Fowler</b>
T07057m1	Exchange of atmospheric ammonia with ecosystems in the UK	D Fowler
T07057n1	SO <sub>2</sub> dry deposition	D Fowler
T07057o1	Seeder/feeder deposition	D Fowler
T07057p1	Cloud deposition modelling	D Fowler
T07057q5	Methane oxidation	D Fowler
T07057r5	Exchange of atmospheric ammonia with European ecosystems	M A Sutton
T07057s2	Fine-resolution modelling of ammonia dry deposition in the UK	M A Sutton
T07057t1	Ammonia distribution and effects project (ADEPT)	M A Sutton
T07057u6	LOIS RACS-R	D Fowler
T07057v5	The LIFE contract	D Fowler
T07057w2	Land/atmospheric gas exchange	D Fowler

<b>T07058-5</b>	<b>Atmospheric pollution modelling and chemistry</b>	<b>J N Cape</b>
T07058a2	The chemical composition of rainfall	J N Cape
T07058c1	Cloud chemistry and aerosol development	D Fowler
T07058f1	DOE Programme Zero	D Fowler
T07058h1	Nitrogen oxide measurement	J N Cape
T07058i1	Anglo-Scandinavian acid deposition consultancy	D Fowler
T07058j2	Land/air exchange and atmospheric chemistry of carbon monoxide	J N Cape
T07058k2	Atmospheric chemistry	D Fowler

<b>T07059-5</b>	<b>Effects of atmospheric pollutants on trees</b>	<b>D Fowler/ J N Cape</b>
T07059b5	Open-top chamber studies on spruce and beech	D Fowler



T07059e5	Effects of acid mist on mature trees	A Crossley	T08050a2	Population regulation of cycling and non-cycling tetraonids	R Moss
T07059h5	Ammonia fumigation of forests	J N Cape	T08050c5	Population ecology of capercaillie	R Moss
T07059k5	Surface resistance emergency measurement programme (SREMP)	D Fowler	T08050f5	Adaptation of capercaillie to novel environments	R Moss
T07059n2	Pollutant effects on plants	J N Cape	T08050g2	Population genetics of mute swans	P J Bacon
T07059o1	The potential for ammonia impacts on nature conservation	D Fowler	T08050j2	Structure of moorland vegetation for red grouse	P J Bacon
T07072q5	Acidic deposition in Snowdonia	B Reynolds			
T07072r5	Acid waters survey of Wales	D Fowler			

### Programme 13 Scientific services

<b>T13059-5</b>	<b>Edinburgh scientific support services</b>	<b>M G R Cannell</b>
T13059a2	Glasshouse and nursery support and development	F J Harvey
T13059e2	Controlled environmental facilities at ITE Edinburgh	R Milne
T13059f2	Operation of the Rivox field site	F J Harvey
T13059g2	Biometrics research and consultancy at ITE Edinburgh	R I Smith
T13059m1	Local consultancies at ITE Edinburgh	M G R Cannell
T13059o2	Scientific and network support at ITE Edinburgh	B G Bell

## BANCHORY RESEARCH STATION

### Programme 1 Forest science

T01061j3	Interactions between farm forestry and the population biology and dispersion of roe deer	B W Staines
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### Programme 2 Land use, agriculture and the environment

<b>T02050-5</b>	<b>Human impact, erosion rehabilitation</b>	<b>N G Bayfield</b>
T02050d1	Monitoring at Aonach Mor	N G Bayfield
T02050h1	Upland revegetation studies	N G Bayfield
T02050q1	NIREX deep repository study	N G Bayfield
T02050r5	Impact of snow-fencing on vegetation and soils at Glas Maol	D Welch
T02050v1	Erosion control study	N G Bayfield
T02050w1	Monitoring Spey wellfield	N G Bayfield
T02051x1	Land cover database for Scotland	R P Cummins
T02070e2	Vegetation change in Scottish moorland and set-aside fields	D Welch

<b>T02073-5</b>	<b>Human impact, erosion rehabilitation (cont'd)</b>	<b>N G Bayfield</b>
T02073a1	Glen Coe bridge study	N G Bayfield
T02073b5	Status of mountain ringlet	N G Bayfield
T02073c1	Brathens consultancies	N G Bayfield
T02073d2	Scottish centre for ecological databases	R P Cummins
T02073f1	Cairngorms footpaths database	N G Bayfield
T02073g5	Scottish butterfly site register	N G Bayfield
T02073h1	Highland audit scoping	N G Bayfield
T02073i5	Blanket bog survey for EC SACs	D D French
T02073j5	Monitoring ESAs in Scotland	R P Cummins
T02073k1	Decision modelling of renewability of resources	N G Bayfield

### Programme 8 Population and community ecology

<b>T08050-5</b>	<b>Vertebrate population dynamics and upland habitat geometry</b>	<b>R Moss</b>
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<b>T08051-5</b>	<b>Population ecology of predators</b>	<b>H Kruuk</b>
T08051c5	Interactions between populations of fish predators, and fish and their food species	H Kruuk
T08051d5	Piscivorous birds in Scottish salmon rivers	M Marquiss
T08051h5	Seabird studies	M P Harris
T08051i5	Comparison of high- and low-latitude shags	M P Harris
T08051o1	Monitoring pollutants and hydrocarbons in fish and other populations in the Shetlands	J W H Conroy
T08051u1	Otter survey of Lingarabay, Harris	H Kruuk
T08051v5	Identification of key habitats essential to otter populations and an assessment of methodological techniques	H Kruuk
T08051w5	Pine marten management and conservation	H Kruuk

### T08073-5 Dynamics of upland and montane plant communities

T08073c2	Vegetation dynamics and soils	R P Cummins
T08073f2	Deer in production forests	B W Staines
T08073g2	Response of Sitka spruce to browsing and bark-stripping damage	B W Staines
T08073i2	Selection of individual plants within species by herbivores (JAEP)	B W Staines
T08073j2	The influence of vegetation pattern on the distribution and foraging strategies of hill sheep and red deer (JAEP)	D Welch
T08073k5	Blaeberry ecology	D Welch
T08073p5	Red deer at Mar Lodge	D Welch
T08073r5	Vegetation dynamics in Scottish uplands	S E Hartley
T08073u5	Pine regeneration at Ballochbuie	D Welch
T08073v5	Red deer modelling	B W Staines
T08073w1	Survey of high-altitude pine scrub in the Cairngorms	B W Staines
T08073x5	Optimising upland habitat mosaics	R Moss

### Programme 13 Scientific services

<b>T13053-2</b>	<b>Services at ITE Banchory</b>	<b>B W Staines</b>
T13053d2	Biometrics	D D French

## BANGOR RESEARCH UNIT

### Programme 1 Forest science

<b>T01064-5</b>	<b>The water, carbon and energy relations of plants in fragile habitats</b>	<b>L S Anderson</b>
T01064a2	Dryland ecophysiology	L S Anderson
T01064c2	Clonal selection for tolerance of drought and salinity in semi-arid zone trees and shrubs	J E G Good
T01064e5	Productivity of intercropped sorghum in relation to water and nutrient stresses in semi-arid agroforestry	L S Anderson
T01064f5	Nutrient cycle of semi-arid agroforestry in Nigeria	P A Stevens
T01064h5	Seasonal light and water use of banana-based interculture systems	C Stirling

- T01064l1 Researchable constraints concerning L S Anderson  
land use systems at the forest/agriculture  
interface
- T01064m1 Soil/plant interactions in lowland P A Stevens  
grasslands Great Orme

### Programme 3 Global environmental change

- T03086d6 Ecophysiological responses to CO<sub>2</sub> T W Ashenden  
enrichment and other climatic factors in a wide  
sample of functional types of British plants
- T03087e6 Growth and developmental T W Ashenden  
responses to CO<sub>2</sub> enrichment under different  
temperature and nutrient regimes in a  
wide sample of functional types of British  
plants
- T03087u6 The effect of climate change on J E G Good  
woodland ecosystems - experimental studies  
on CO<sub>2</sub> and temperature effects on  
oak/sycamore - herbivorous insect  
interaction
- T03091c6 Methane and nitrous oxide fluxes M C Press/  
from mire soils and plants responses J A Lee/  
to nitrogen supply and carbon T W Ashenden  
dioxide enrichment
- T03091v6 Effects of UV-B radiation of oak and A R McLeod  
its leaf litter decomposition

### Programme 7 Environmental pollution

- T07064-5 Air pollution/climate change T W Ashenden  
research**
- T07064l5 Critical loads of N and S deposition T W Ashenden  
to semi-natural vegetation
- T07064m5 Effects of increasing concentrations T W Ashenden  
of carbon dioxide on grassland communities
- T07064p2 Effects of acid fog on upland T W Ashenden  
vegetation
- T07064q2 Environmental facility development C R Rafarel
- T07064r2 Effects of climate change on upland T W Ashenden  
ecosystems
- T07064v2 Database management at ITE Bangor A H Thomas  
(environmental pollution and climate change)
- T07064w2 Carbon/nitrogen relations at elevated H Harmens  
CO<sub>2</sub> on grasses of contrasting types
- T07072-5 Upland nitrogen dynamics B Reynolds**
- T07072a5 Nitrogen critical load experiment B A Emmett
- T07072d5 Estimation of atmospheric inputs to B Reynolds  
catchments
- T07072h5 Biochemical consequences of climate C Freeman  
change upon riparian wetlands
- T07072i5 Modelling upland nitrogen dynamics B Reynolds
- T07072j5 Solute pathways in upland catchments B Reynolds
- T07072m2 Climate change and microbial ecology C Freeman  
a university support project
- T07072n5 Nitrogen processes in upland forest soils B A Emmett
- T07072p5 Project definition study, Welsh acid P A Stevens  
waters resurvey
- T07072q5 Acidic deposition in Snowdonia B Reynolds
- T07072r5 Acid waters survey of Wales D Fowler
- T07072s1 Dynamic modelling of critical loads B Reynolds
- T07072t2 Database management at ITE Bangor A H Thomas  
(biogeochemistry and land use)
- T07072u2 Nitrogen in upland ecosystems P A Stevens
- T07072v2 Catchment hydrochemical studies B Reynolds

### Programme 8 Population and community ecology

- T08077-5 Upland ecology G L Radford**
- T08077e1 Effects of grazing on upland invertebrates A Buse  
in Snowdonia
- T08077g2 Climate and high-altitude invertebrates A Buse
- T08077h5 A GIS for conservation in Wales G L Radford
- T08077i1 Environmental assessment of four G L Radford  
British Gas sites
- T08077j5 Tir Cymen - evaluation and monitoring G L Radford
- T08077k5 Assessment of critical loads exceedance G L Radford  
in Wales
- T08077l5 Population biology of *Lloydia serotina* J E G Good
- T08077m2 GIS development for Wales G L Radford
- T08077n1 MAFF ESA research on upland scrub in J E G Good  
in Wales
- T08077o1 ESA R&D - Wales coastal belt G L Radford
- T08077p1 ESA R&D - Wales shepherding trials G L Radford
- T08077q2 Database management at ITE Bangor A H Thomas  
(upland and overseas ecology)
- T08077r5 Upland woodlands in Wales J E G Good

### Programme 13 Scientific services

- T13055s2 Laboratory equipment maintenance and S Hughes  
quality assurance in analytical chemistry at Bangor
- T13061-1 ITE South consultancies T M Roberts**
- T13061c1 Small consultancies at ITE Bangor J E G Good

# Appendix 4. Publications by ITE staff, 1994–95

## 1. Refereed papers in journals

- Ashenden, T.W. & Edge, C.P.** 1995 Increasing concentrations of nitrogen dioxide pollution in rural Wales *Environmental Pollution*, **87**, 11–16
- (Baker, J.R., Mitchell, P.L., Cordey, R.A.), Groom, G.B., (Settle, J.J. & Stileman, M.R.)** 1994 Relationships between physical characteristics and polarimetric radar backscatter for Corsican pine stands in Thetford Forest, UK *International Journal of Remote Sensing*, **15**, 2827–2849
- (Bardgett, R.D., Marsden, J.H.) & Howard, D.C.** 1995 The extent and condition of heather on moorland in the uplands of England and Wales *Biological Conservation*, **71**, 155–161
- Barr, C.J., Bunce, R.G.H. & Heal, O.W.** 1994 Countryside Survey 1990 a measure of change *Journal of the Royal Agricultural Society of England*, **155**, 48–58
- Baxter, R., Ashenden, T.W., Sparks, T.H. & (Farrar, J.F.)** 1994 Effects of elevated carbon dioxide on three montane grass species I Growth and dry matter partitioning *Journal of Experimental Botany*, **45**, 305–315
- Baxter, R., Gantley, M., Ashenden, T.W. & (Farrar, J.F.)** 1994 Effects of elevated carbon dioxide on three grass species from montane pasture II Nutrient uptake, allocation and efficiency of use *Journal of Experimental Botany*, **45**, 1267–1278
- Beresford, N.A., (Mayes, R.W., Crout, N.M.J.), Howard, B.J. & (Kanyar, B.)** 1994 Dynamic behaviour of  $^{110m}\text{Ag}$  in sheep tissues *Health Physics*, **66**, 420–426
- (Blackwell, P.) & Bacon, P.J.** 1993 A critique of the territory inheritance hypothesis *Animal Behaviour*, **46**, 821–823
- (Block, W.), Webb, N.R., (Coulson, S., Hodgkinson, I.D. & Worland, M.R.)** 1994 Thermal adaptation in the Arctic collembolan *Onychurus arcticus* (Tullberg) *Journal of Insect Physiology*, **40**, 715–722
- (Bryan, N.D., Livens, F.R.) & Horrill, A.D.** 1994 Biogeochemical behaviour of plutonium and americium and geochemical modelling of the soil solution *Journal of Radioanalytical and Nuclear Chemistry Articles*, **182**, 359–366
- Bull, K.R., Lakshani, K.H. & Rowland, A.P.** 1994 Effects of chemical preservative and temperature storage conditions on cations and anions in natural water *Chemistry and Ecology*, **9**, 47–62
- Bullock, J.M., (Clear Hill, B., Dale, M.P. & Silvertown, J.)** 1994 An experimental study of the effects of sheep grazing on vegetation change in a species-poor grassland and the role of seedling recruitment into gaps *Journal of Applied Ecology*, **31**, 493–507
- Bullock, J.M., (Clear Hill, B. & Silvertown, J.)** 1994 Demography of *Cirsium vulgare* in a grazing experiment *Journal of Ecology*, **82**, 101–111
- Bullock, J.M., (Clear Hill, B. & Silvertown, J.)** 1994 Tiller dynamics of two grasses – responses to grazing, density and weather *Journal of Ecology*, **82**, 331–340
- Bullock, J.M., (Mortimer, A.M. & Begon, M.)** 1994 The effect of clipping on interclonal competition in the grass *Holcus lanatus* – a response surface analysis *Journal of Ecology*, **82**, 259–270
- Bullock, J.M., (Mortimer, A.M. & Begon, M.)** 1994 Physiological integration among tillers of *Holcus lanatus* age-dependence and responses to clipping and competition *New Phytologist*, **128**, 737–747
- Bullock, J.M., (Clear Hill, B., Silvertown, J. & Sutton, M.)** 1995 Gap colonization as a source of grassland community change effects of gap size and grazing on the rate and mode of colonization by different species *Oikos*, **72**, 273–282
- (Burt, M.L., Wadge, G.) & Scott, W.A.** 1994 Simple stochastic modelling of the eruption history of a basaltic volcano Nyamuraga, Zaire *Bulletin of Volcanology*, **56**, 87–97
- Cannell, M.G.R. & Dewar, R.C.** 1995 The carbon sink provided by plantation forests and their products in Britain *Forestry*, **68**, 35–48
- Cape, J.N., Smith, R.I. & Fowler, D.** 1994 The influence of ozone chemistry and meteorology on plant exposure to photo-oxidants (In *Oxygen and environmental stress in plants*, edited by R.M.M. Crawford, G.A.F. Hendry & B.A. Goodman) *Proceedings of the Royal Society of Edinburgh B*, **102**, 11–31
- Cape, J.N., Sheppard, L.J. & Binnie, J.** 1995 Leaf surface properties of Norway spruce needles exposed to sulphur dioxide and ozone in an open-air fumigation system at Liphook *Plant Cell and Environment*, **18**, 285–289
- Carey, P.D., (Watkinson, A.R.) & Gerard, F.F.O.** 1995 The determinants of the distribution and abundance of the winter annual grass *Vulpia ciliata* ssp. *ambigua* *Journal of Ecology*, **83**, 177–187
- Carss, D.N. & (Brockie, K.)** 1994 Prey remains at osprey nests in Tayside and Grampian, 1987–1993 *Scottish Birds*, **17**, 132–145
- Catt, D.C., (Dugan, D., Green, R.E., Moncrieff, R.), Moss, R., Picozzi, N., (Summers, R.W. & Tyler, G.A.)** 1994 Collisions against fences by woodland grouse in Scotland *Forestry*, **67**, 105–118
- (Chalmers, K.J.), Newton, A.C., (Waugh, R.), Wilson, J. & (Powell, W.)** 1994 Evaluation of the extent of genetic variation in mahoganies (Meliaceae) using RAPD markers *Theoretical and Applied Genetics*, **89**, 504–508
- Chapman, S.B. & Rose, R.J.** 1994 Changes in the distribution of *Erica ciliaris* L. and *E. x watsonii* Benth. in Dorset, 1963–1987 *Watsonia*, **20**, 89–95
- (Cherrill, A.J.) & Lane, A.** 1994 Bracken infestation of rough grazing land in the



catchment of the River Tyne, northern England *Watsonia*, **20**, 105–114

(Chernill, A J), Lane, A & Fuller, R M 1994 The use of classified Landsat-5 Thematic Mapper imagery in the characterization of landscape composition: a case study in northern England *Journal of Environmental Management*, **40**, 357–377

(Chernill, A J) & Lane, A 1995 The survey and prediction of land cover using an environmental land classification *Applied Geography*, **15**, 69–85

(Chernill, A J, McClean, C), Lane, A & Fuller, R M 1995 A comparison of land cover types in an ecological field survey in northern England and a remotely sensed Land Cover Map of Great Britain *Biological Conservation*, **71**, 313–323

Clarke, J L, Welch, D & (Gordon, I J) 1995 The influence of vegetation pattern on the grazing of heather moorland by red deer and sheep I The location of animals on grass/heather mosaics *Journal of Applied Ecology*, **32**, 166–176

Clarke, J L, Welch, D & (Gordon, I J) 1995 The influence of vegetation pattern on the grazing of heather moorland by red deer and sheep II The impact on heather *Journal of Applied Ecology*, **32**, 177–186

(Colville, R N, Choularton, T. W., Gallagher, M W, Wicks, A J, Downer, R M., Tyler, B J), Hargreaves, K J, Storeton-West, R L, Fowler, D, Cape, J N, (Dollard, G J, Davies, T J, Jones, B M R., Penkett, S A, Bandy, B. J. & Burgess, R. A.) 1994 Observation on Great Dun Fell of the pathways by which oxides of nitrogen are converted to nitrate *Atmospheric Environment A*, **28**, 397–408

(Cotrufo, M F), Ineson, P. & Rowland, A P 1994 Decomposition of tree leaf litters grown under elevated CO<sub>2</sub>: effect of litter quality *Plant and Soil*, **163**, 121–130

Davis, B N K, Brown, M J, Frost, A J., Yates, T. J. & Plant, R A 1994 The effects of hedges on spray deposition and on the biological impact of pesticide spray drift *Ecotoxicology and Environmental Safety*, **27**, 281–293

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Deans, J D, Billington, H L & Harvey, F J 1995 Assessment of frost damage to leafless stem tissues of *Quercus petraea*: a reappraisal of the method of relative conductivity *Forestry*, **68**, 25–34

Dick, J McP & (Aminah, H) 1994 Vegetative propagation of tree species indigenous to Malaysia *Commonwealth Forestry Review*, **73**, 164–171

Dick, J. McP, Blackburn, D G & McBeath, C 1994 Stem respiration in leafy cuttings of *Prosopis juliflora* during the rooting process *New Forests*, **8**, 179–184

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(Duncan, A J), Hartley, S E & (Iason, G R) 1994 Fine-scale discrimination of forage quality by sheep offered a soyabean meal or barley supplement while grazing a nitrogen-fertilized heather (*Calluna vulgaris*) mosaic *Journal of Agricultural Science*, **123**, 363–370

(Duncan, A J), Hartley, S E & (Iason, G R) 1994 The effect of

monoterpene concentrations in Sitka spruce (*Picea sitchensis*) on the browsing behaviour of red deer (*Cervus elaphus*) *Canadian Journal of Zoology*, **72**, 1715–1720

(Duyzer, J) & Fowler, D. 1994 Modelling land atmosphere exchange of gaseous oxides of nitrogen in Europe *Tellus*, **46B**, 353–372

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Elmes, G W, Thomas, J A, (Hammerstedt, O, Mungura, M L, Martin, J. & Van der Made, J G) 1994 Differences in host specificity between Spanish Dutch and Swedish populations of the endangered butterfly *Maculinea alcon* (Denis & Schiff) (Lepidoptera) *Memorabilia Zoologica*, **48**, 55–68

Emmett, B A, (Hudson, J A), Coward, P A. & Reynolds, B 1994 The impact of a riparian wetland on streamwater quality in a recently afforested upland catchment *Journal of Hydrology*, **162**, 337–353

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(Enksson, S. P) & Weeks, J M 1994 Effects of copper and hypoxia on two populations of the benthic amphipod *Corophium volutator* (Pallas) *Aquatic Toxicology*, **29**, 73–81

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corridors or refugia? *Biodiversity and Conservation*, **3**, 538–545

(Ferns, P N) & Hinsley, S A 1994 Effects of raptors on the activity of sandgrouse *Journal of Raptor Research*, **28**, 236–241

Firbank, L G., Telfer, M G., Eversham, B C & Arnold, H. R 1994 The use of species-decline statistics to help target conservation policy for set-aside arable land *Journal of Environmental Management*, **42**, 415–422

Freeman, C., (Fiebig, D M. & Lock, M. A.) 1993 [<sup>14</sup>C]acetate incorporation, an indicator of lipid biosynthesis within intact river biofilms *Journal of Aquatic Ecosystem Health*, **2**, 329–334

(Freeman, C., (Gresswell, R., Guasch, H., Hudson, J., Lock, M. A.), Reynolds, B., (Sabater, F. & Sabater, S.) 1994 The role of drought in the impact of climatic change on the microbiota of peatland streams *Freshwater Biology*, **32**, 223–230

Freeman, C. & (Lock, M. A.) 1995 Isotope dilution analysis and rates of P<sup>32</sup> incorporation into phospholipid as a measure of microbial growth rates in biofilms *Water Research*, **29**, 789–792

Freeman, C., (Chapman, P J., Gilman, K., Lock, M. A.), Reynolds, B. & (Wheater, H S.) 1995 Ion exchange mechanisms and the entrapment of nutrients by river biofilms *Hydrobiologia*, **297**, 61–65

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(Glover, B J.), Gillies, A C M. & (Abbott, R. J.) 1995 Use of the polymerase chain reaction to investigate the delimitation of two agronomically important species of *Stylosanthes* (Aubl.) Sw *Botanical Journal of Scotland*, **47**, 83–96

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- Hinsley, S A & (Ferns, P N ) 1994 Time and energy budgets of breeding males and females in sandgrouse *Pterocles species Ibis*, **136**, 261–270
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**Treweek, J R , Mountford, J O (eds), Manchester, S J , Pywell, R.F , Sparks, T H , (Tallowin, J R B , Smith, R E N , Donaghy, D T. & Gowing, D J.G.)** 1995 *Wetland restoration techniques for an integrated*

approach, phase III survey and experimentation Second annual report March 1995 68pp Ministry of Agriculture, Fisheries and Food

**Urfi, A J** 1994 *Report of Marie Curie bursary holder* September 1994 Commission of the European Communities

**Ward, L K** 1994 *Evaluation of juniper sites in England and south Wales the EC Species and Habitat Directive 1992* March 1994 45pp Joint Nature Conservation Committee

**Ward, L K.** 1994 *English Nature Species Recovery Programme – New Forest Cicada (Cicadetta montana Scopoli) (Hemiptera Cicadidae) progress report 1994* 41pp English Nature

**Ward, L K & Stevenson, M J** 1994 *M3 Bar End to Compton botanical monitoring Arethusa Clump chalk grassland restoration 1993* May 1994 58pp Mott MacDonald Civil Ltd

**Ward, L K & Stevenson, M J.** 1994 *M3 Bar End to Compton botanical monitoring flood meadow restoration 1993* August 1994 35pp Mott MacDonald Civil Ltd

**Ward, L K & Stevenson, M. J.** 1994 *M3 Bar End to Compton botanical monitoring Arethusa Clump chalk grassland restoration 1994* November 1994 68pp Mott MacDonald Civil Ltd

**Ward, L K & Stevenson, M J.** 1995 *M3 Bar End to Compton botanical monitoring flood meadow restoration 1994* January 1995 31pp Mott MacDonald Civil Ltd

**Watkins, J W., Culling, A S & Howard, D. C** 1994 *Forestry project – subdivisions of ITE Land Classes and counties* August 1994 Forestry Consortium

**Watkins, J W., Culling, A S & Howard, D C.** 1994 *Forestry project – supplement to subdivisions of ITE Land Classes and counties* August 1994 Forestry Consortium

**Watt, A , (Stork, N ), McBeath, C , (Bolton, B , Mboglen, M , Srivastava, D. & Fanguem, J.)** 1995 *Ecology of insects in Cameroon plantation forests* Final report January 1995 Overseas Development Administration

**Webb, N R** 1994 *Habitat fragmentation and heathland species supplementary report* June 1994 26pp English Nature

**Webb, N R** 1994 *Study of biotopes and habitats losing wildlife interest as a result of ecological succession* November 1994 Council of Europe

**Weeks, J & (Williams, M )** 1994 *Preliminary field trial of a method for the rapid assessment of invertebrate stress from mining-related arsenic and heavy metal contamination Wanderer Gold Mine, Zimbabwe* 13pp Overseas Development Administration

**Weeks, J M., Davis, B N K , Shore, R F , Dobson, S , Dawson, S & Hankard, P** 1994 *Pesticides and biodiversity* April 1994 64pp World Wildlife Fund UK

**Welch, D , Scott, D , Staines, B W. & Stolte, A** 1994 *Study on effects of wintering red deer on heather moorland* December 1994 46pp Scottish Natural Heritage

**Welch, D , Staines, B , Scott, D & Stolte, A** 1994 *Monitoring the effects of fencing out red deer at Ballochbuie pinewood 1993* report May 1994 22pp Balmoral Estates

**Wells, T C.E & Cox, R** 1993 *The long-term effects of cutting on the yield, floristic composition and soil nutrient status of chalk grassland* September 1993 82pp English Nature

**Wells, T C.E , Pywell, R F & Welch, R C** 1994 *Management and restoration of species-rich grassland* Final report 144pp Ministry of Agriculture, Fisheries and Food

**Wells, T C E , Preston, C D , Mountford, J O & Croft, J M** 1995 *Species Recovery Programme fen violet (Viola persicifolia Schreber) 2nd progress report* March 1995 37pp English Nature

**(Wright, J F.), Moss, D , (Gunn, R J.M , Blackburn, J H , Winder, J M , Symes, K L , Gneve, N J., Furse, M.T ) & Clarke, R T.** 1994 *Testing and further development of RIVPACS (phase 2)* Progress report for the period January 1994 – June 1994 June 1994 22pp National Rivers Authority

**(Wright, J.F , Gunn, R J M , Blackburn, J H., Gneve, N J , Symes, K L ), Moss, D., (Furse, M T ,**

**Winder, J M. & Bass, J A B.)** 1995 *Extension of RIVPACS to Northern Ireland* Final report March 1995 86pp Department of the Environment (Northern Ireland)



## Appendix 5. ITE publications

HMSO publishes for the Institute, and acts as an agent for a substantial backlist of ITE titles. Unless specified otherwise, all books are paperback with prices shown net (as per the Net Book Agreement), and are available from HMSO bookshops

### Forest science

<b>Cumbrian woodlands</b> (ITE symposium no 25)			
J K Adamson (ed)			
94pp	0 11 701421 4	£7 10	1989
<b>The ecology of even-aged forest plantations</b>			
E D Ford, D C Malcolm & J Atterson (eds)			
582pp	0 904282 33 3	£9 00 (Hardback)	1979
<b>Effect of birch on moorlands</b>			
J Miles			
18pp	0 904282 47 3	£1 50	1981
<b>Environmental aspects of plantation forestry in Wales</b>			
(ITE symposium no 22)			
J E G Good (ed)			
77pp	1 870393 02 3	£3 25	1987
<b>A field key for classifying British woodland vegetation: Part I</b>			
R G H Bunce			
103pp	0 904282 68 6	£3 00	1982
<b>A field key for classifying British woodland vegetation: Part II</b>			
R G H Bunce			
95pp	0 11 701417 6	£7 95	1989
<b>Identification of ectomycorrhizas</b>			
(ITE research publication no 5)			
K Ingleby, P A Mason, F T Last & L V Fleming			
112pp	0 11 701461 3	£30 00	1990
<b>Pasture woodlands in lowland Britain</b>			
P T Harding & F Rose			
94pp	0 904282 91 0	£5 00	1986
<b>The temperate forest ecosystem</b>			
(ITE symposium no 20)			
Yang Hanxi, Wang Zhan, J N R Jeffers & P A Ward (eds)			
189pp	1 870393 01 5	£7 50	1987
<b>Trees and wildlife in the Scottish uplands</b>			
(ITE symposium no 17)			
D Jenkins (ed)			
196pp	0 904282 97 X	£3 50	1986
<b>Tropical trees: the potential for domestication and the rebuilding of forest resources</b>			
(ITE symposium no 29)			
R R B Leakey & AC Newton (eds)			
284pp	0 11 701562 8	£40 00	1994

### Land use, agriculture and the environment

<b>Agriculture and conservation in the hills and uplands</b>			
(ITE symposium no 23)			
M Bell & R G H Bunce (eds)			
164pp	1 870393 03 1	£5 00	1987
<b>Agriculture and the environment</b>			
(ITE symposium no 13)			
D Jenkins (ed)			
195pp	0 904282 73 3	£3 50	1984
<b>Angling and wildlife in fresh waters</b> (ITE symposium no 19)			
P S Matland & A K Turner (eds)			
84pp	0 904282 99 6	£4 00	1987
<b>The biology and management of the River Dee</b>			
(ITE symposium no 14)			
D Jenkins (ed)			
160pp	0 904282 88 0	£6 00	1985
<b>Britain's railway vegetation</b>			
C Sargent			
34pp	0 904282 76 7	£3 50	1984
<b>Distribution of freshwaters in Great Britain</b>			
I R Smuth & A A Lyle			
44pp	0 904282 25 2	£2 00	1979
<b>Historical ecology: the documentary evidence</b>			
J Sheail			
22pp	0 904282 34 1	£2 00	1980
<b>Land use change: the causes and consequences</b>			
(ITE symposium no 27)			
M C Whitby (ed)			
201pp	0 11 701553 9	£35 00	1992
<b>Managing set-aside land for wildlife</b>			
(ITE reserch publication no 7)			
L G Furbank			
146pp	0 11 701568 7	£9 95	1993
<b>Moorland management: a study of Exmoor</b>			
G R Miller, J Miles & O W Heal			
130pp	0 904282 79 1	£4 50	1984
<b>Rural information for forward planning</b>			
(ITE symposium no 21)			
R G H Bunce & C J Barr (eds)			
115 pp	1 870393 05 8	£5 50	1988
<b>The use of land classification in resource assessment and rural planning</b>			
R S Smuth			
43pp	0 904282 62 7	£3 00	1982
<b>Vegetation change in upland landscapes</b>			
D F Ball, J Dale, J Sheail & O W Heal			
45pp	0 904282 64 3	£2 00	1982

## Global environmental change

### Climatic change, rising sea level and the British coast

(ITE research publication no 1)

L A Boorman, J D Goss-Custard & S McGroarty

24pp 0 11 701429 X £2 75 1989

### Climatological maps of Great Britain

E J White & R I Smith

37pp 0 904282 69 4 £2 00 1982

### The greenhouse effect and terrestrial ecosystems of the UK

(ITE research publication no 4)

M G R Cannell & M D Hooper (eds)

56pp 0 11 701488 5 £2 45 1990

## Environmental pollution

### Acidification and fish in Scottish lochs

P S Maitland, A A Lyle & R N B Campbell

71pp 1 870393 04 X £3 50 1987

### Critical loads: concepts and applications

(ITE symposium no 28)

M Hornung & R A Skeffington (eds)

134pp 0 11 701666 7 £30 00 1993

### Early diagnosis of forest decline

J N Cape, I S Paterson, A R Wellburn, J Wolfenden, M Mehlhorn,

P Freer-Smith & S Fink

68pp 1 870393 07 4 £5 00 1988

### Effects of air pollutants on agricultural crops

F T Last, D Fowler & P H Freer-Smith

27pp 0 904282 90 2 £2 00 1985

### Methods for studying acid precipitation in forest ecosystems

I A Nicholson, I S Paterson & F T Last (eds)

36pp 0 904282 36 8 £3 00 1980

### Pollution in Cumbria

(ITE symposium no 16)

P Ineson (ed)

92pp 0 904282 96 1 £52 50 1986

### Predatory birds, pesticides and pollution

A S Cooke, A A Bell & M B Haas

74pp 0 904282 55 4 £4 00 1982

### Radionuclides in terrestrial ecosystems

K L Bocock

27pp 0 904282 42 2 £2 00 1981

## Population and community ecology

### Atlas of mammals in Britain

(ITE research publication no 6)

H R Arnold

145pp 0 11 701667 5 £12 50 1993

### Bedford Purlieus (ITE symposium no 7)

G F Peterken & R C Welch (eds)

209pp 0 904282 05 8 £1 00 1975

### Biological recording of changes in British wildlife

(ITE symposium no 26)

P T Harding (ed)

78pp 0 11 701560 1 £19 50 1992

### Birds of St Kilda

M P Harris & S Murray

42pp 0 904282 27 9 £6 50 1989

### Butterfly research in ITE

M L Hall

28pp 0 904282 46 5 £1 50 1981

### Coast dune management guide

D S Ranwell & R Boar

105pp 0 904282 93 7 £3 00 1986

### Conserving otters

D Jenkins

14pp 0 904282 44 9 £1 00 1980

### Distribution and status of bats in Europe

R E Stebbings & F Gniffith

142pp 0 904282 94 5 £2 50 1986

### Ecology of quarries

(ITE symposium no 11)

B N K Davis (ed)

77pp 0 904282 59 7 £2 00 1982

### Handbook of European sphagna

R E Daniels & A Eddy

262pp 0 11 701431 1 £10 50 1990

### Heather in England and Wales (ITE research publication no 3)

R G H Bunce (ed)

40pp 0 11 701422 2 £2 95 1989

### Spartina anglica – a research review

(ITE research publication no 2)

A J Gray & P E M Benham (eds)

80pp 0 11 701477 X £8 75 1990

### The status of the Atlantic salmon in Scotland

(ITE symposium no 15)

D Jenkins & W M Shearer (eds)

127pp 0 904282 92 9 £3 00 1986

### Woodlice in Britain and Ireland: distribution and habitat

P T Harding & S L Sutton

152pp 0 904282 85 6 £5 00 1985

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## Scientific services

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### Chemical analysis in environmental research

(ITE symposium no 18)

A P Rowland (ed)

104pp 0 904282 98 8 £7 00 1987

### Cotton strip assay: an index of decomposition in soils

(ITE symposium no 24)

A F Harrison, P M Latter & D W H Walton (eds)

176pp 1 870393 06 6 £12 50 1988

### Ecological mapping from ground, air and space

(ITE symposium no 10)

R M Fuller (ed)

142pp 0 904282 71 6 £6 00 1983

### Register of permanent vegetation plots

M O Hill & G L Radford

32pp 0 904282 86 4 £2 00 1986

The following titles have been published by the Biological Records Centre at ITE Monks Wood, and are available from Publication Sales, ITE Merlewood

## Provisional atlases

### Provisional atlas of the insects of the British Isles: Part 4, Siphonaptera, fleas

R S George

72pp 0 900848 70 7 £1 00 1974

### Atlas of the non-marine Mollusca of the British Isles

M P Kerney

105pp 0 904282 02 3 £3 00 1976

### Provisional atlas of the nematodes of the British Isles: Parts 1-3. Longidoridae, Trichodoridae and Cricematidae

D J F Brown, C E Taylor, B Boag, T J W Alphey & K J Orton-Williams

74pp 0 904282 04 X £2 00 1977

### Provisional atlas of the insects of the British Isles: Part 8, Trichoptera Hydropsychidae, caddisflies (Part 1)

J E Marshall

35pp 0 904282 18 X £2 00 1978

### Provisional atlas of the insects of the British Isles: Part 5, Hymenoptera: Formicidae, ants

K E J Barrett

51pp 0 904282 39 2 £3 00 1979

### Provisional atlas of the lacewings and allied insects (Neuroptera, Megaloptera, Raphidioptera and Mecoptera) of Britain and Ireland

C W Plant

203pp 1 870393 18 X £6 50 1994

### Provisional atlas of the marine dinoflagellates of the British Isles

J D Dodge

142pp 0 904282 53 8 £4 00 1981

### Provisional atlas of the mycomycetes of the British Isles

B Ing

104pp 0 904282 67 8 £1 00 1982

### Provisional atlas of the marine algae of the British Isles

T A Norton

67pp 0 904282 89 9 £3 50 1985

### Provisional atlas of the Sepsidae (Diptera) of the British Isles

A Pont

33pp 1 870393 00 7 £3 00 1986

### Provisional atlas of the insects of the British Isles: Part 9, Hymenoptera: Vespidae, social wasps

M E Archer

18pp 0 904282 38 4 £2 50 1987

### Provisional atlas of the centipedes of the British Isles

A D Barber & A N Keay

127pp 1 870393 08 2 £7 00 1988

### Provisional atlas of the ticks (Ixodoidea) of the British Isles

K P Martyn

62pp 1 870393 09 9 £4 00 1988

### Provisional atlas of the click beetles (Coleoptera: Elateroidea) of the British Isles

H Mendel

89pp 1 870393 11 2 £5 50 1990

### Provisional atlas of the Larger Brachycera (Diptera) of the British Isles

C M Drake

131pp 1 870393 14 7 £5 00 1991

### Provisional atlas of the long-palped crane flies (Diptera: Tipulinae) of Britain and Ireland

A E Stubbs

134pp 1 870393 16 3 £5 00 1992

### Provisional atlas of the Cryptophagidae-Atomariinae (Coleoptera) of Britain and Ireland

C Johnson

34pp 1 870393 17 1 £5 50 1993

### Provisional atlas of the ptychopterid crane flies (Diptera: Ptychopteridae) of Britain and Ireland

A E Stubbs

91pp 1 870393 19 8 £2 50 1993

## Final atlas

### Atlas of the non-marine Mollusca of the British Isles

M P Kerney

105pp 0 904282 02 3 £3 00 1976

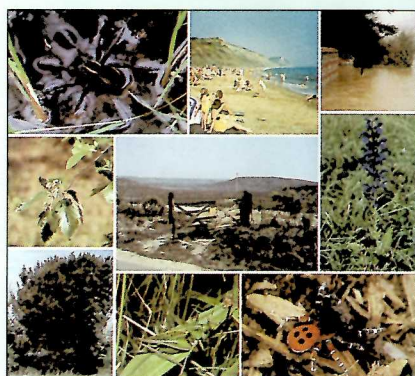
## Other title

### Recent surveys and research on butterflies in Britain and Ireland: a species index and bibliography

P T Harding & S V Green

42pp 1 870393 15 5 £2 50 1991

## New titles published by HMSO in 1994-95



### **Climate change and rare species in Britain**

(ITE research publication no. 8)

G W Elmes and A Free (editors)

Global warming is likely to change the climate of our world during the next century.

It is predicted that within 50–100 years the UK might be generally 2°C warmer and, in Scotland, winters might even be 4°C milder. Such an increase is sufficient to affect all aspects of land use – farming, forestry, industry, recreation and nature conservation – and, directly or indirectly, harm many of our rare plant and animal species. It is important to consider this possibility now. Which species are at most risk? How can we mitigate the effects to ensure their survival?

This booklet summarises research into the probable effects of climate change on the distributions of rare species, its possible effects upon the natural communities of our permanent grasslands, and its impact upon the breeding success of rare birds.

28pp

0 11 701802 3

1994

£6.00

### **Ecology of blaeberry and its management in British moorlands**

D Welch, D Scott, R Moss and N G Bayfield

Blaeberry is widespread in British moorlands and sometimes is the dominant species. More usually, however, it is subsidiary to heather, occurring as an understorey species or where heather dominance has been checked, eg along paths, on steep slopes or by rock outcrops. This study was financed by the Joseph Nickerson Heather Improvement Foundation, and was motivated by the known value of blaeberry as a food for red grouse, and the apparent greater tolerance of blaeberry than heather to heavy grazing pressures. The distinctive characters of blaeberry are outlined, and reasons why blaeberry has apparently less competitive ability than heather are put forward. It is considered that blaeberry-dominant moorland in Britain has resulted either from the occurrence of regular muirburn or from the loss of tree cover in ground once woodland. The conservation of blaeberry moorland is urged, stands being relatively scarce and supporting distinctive invertebrates, besides being valuable for gamebirds and livestock.

39pp

0 870393 21 X

1994

£6.00

### **Demonstrating climate change impacts in the UK**

T W Parr and A Eatherall

This booklet was published as part of the Core Model programme on climate impacts funded by the UK Department of the Environment, and is part of the UK's contribution to climate impacts research. The emphasis of the research programme, and of this booklet, is on illustrating the development of methods of impacts research, and not on presenting results or predictions.

18pp

1 870393 23 6

1994

£9.95



The following report was published during the year for the Department of the Environment

### **Impacts of nitrogen deposition in terrestrial ecosystems**

A report by the **UK Review Group on Impacts of Atmospheric Nitrogen** outlines the current scientific consensus beginning with the emissions, atmospheric transport and transformations, followed by deposition to terrestrial surfaces and impacts on vegetation, soils and freshwaters. It reviews the evidence for direct effects of gaseous N compounds on crops, natural vegetation and trees, and summarises the current situation regarding the mapping and modelling of N critical loads and levels. The report shows that, while significant gaps in knowledge exist in some of these areas, sufficient is already known to allow the first attempts to be made to map critical loads and levels of nitrogen.



## Appendix 6. Environmental data network

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The **Environmental Information Centre (EIC)** is one of seven designated data centres within NERC with the responsibility for implementing the published NERC policy on the management and exploitation of NERC's data resource. Based at ITE Monks Wood, EIC maintains standards of data management and accessibility within the Institute, and acts as the focus for a distributed data network of regional centres and science groups at each ITE station.

The Centre is custodian of a number of key national and European repositories of environmental data, covering land characteristics, the distribution and properties of flora, fauna and habitats, and the impacts of environmental change. EIC also undertakes research into the methods of environmental data acquisition, analysis and use, particularly the application of advanced information technologies like remote sensing and geographical information systems (GIS).

EIC comprises three component units:

- The *Biological Databases Unit* compiles and manages spatially and temporally referenced databases on the biodiversity of the British Isles and databases on sites of importance for wildlife conservation in Europe.
- The *Remote Sensing Unit* uses remote sensing for applications in ecology and land use, in particular natural resource management and land use planning.
- The *Geographical Information Systems Unit* is developing and applying methods of spatial data analysis and modelling to appropriate areas of the Institute's strategic science and commissioned research programmes. The Unit also undertakes technical developments in respect of the use of GIS in ecological research and the provision of technical support for the GIS centres at other ITE stations.

The Centre is home to the **UK National Critical Loads Mapping Centre**, which maintains a database of the vulnerability of the land surface of Great Britain to the effects of atmospheric pollution. EIC is a component of two **European Topic Centres** (on Nature Conservation and on Land Cover) within the **European Environment Agency**, and also the location for a data centre which services the needs of coastal ecologists in the **NERC Land/Ocean Interaction Study (LOIS)**.

Outside EIC there are other research programmes developing large spatial and/or temporal databases which are linked into the data network. The largest of these programmes is conducted by the **Land Use Section (LUS)** at ITE Merlewood. The main function of the Section is to carry out research which explains the relationship between the distribution of plant species and human activities in Great Britain. The work includes field survey of land cover, landscape features and vegetation through monitoring of random sample points throughout GB (eg **Countryside Survey 1990**), and the main scientific activities are vegetation and land classification, like the **ITE land classification** based on environmental parameters such as climate, geology and topography. A recent product of the Section's research is the **Countryside Information System**, a PC- and Microsoft Windows-based system providing easy and flexible access to information about the British countryside. In addition to research on the ecology of land use, the **UK Environmental Change Network (ECN)** long-term monitoring programme is a joint venture with 17 sponsoring agencies which is managed at Merlewood by a Central Co-ordination Unit. The Unit also runs two of the founding sites at Moor House/Upper Teesdale in the northern Pennines, and at Wytham Woods in Oxfordshire. ECN's role is to collect, analyse and interpret data from a network of representative sites on a selected set of variables likely to be driving and responding to environmental change. Because the scope of both these research programmes is geographically extensive and multidisciplinary, large datasets have been generated. For practical reasons, therefore, the databases are managed and maintained at Merlewood by dedicated data managers, who provide formal links to EIC and serve also the programme collaborators and other external customers.

In addition to the major database centres at Monks Wood and Merlewood, there are two national centres serving Scotland and Wales, and major customers such as the conservation agencies (Scottish Natural Heritage and the Countryside Council for Wales) and the Scottish and Welsh Offices. The **Scottish Centre for Ecological Data (SCED)**, based at ITE Banchory, was established in 1993 to service requests for information that were specific to Scotland and its regions, to promote the range of ecological data available throughout ITE, and to provide expertise on national flora and fauna to help with the interpretation of the data. In the same way that SCED serves Scottish sectoral interests, so **ITE Bangor** serves requests for information in Wales and has direct access to the UK databases held by EIC and LUS.

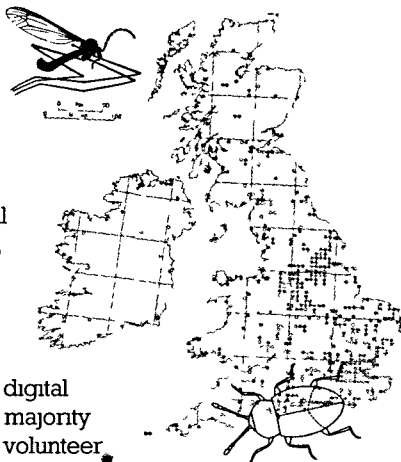
## List of databases

The Institute holds many digital (and paper-based) databases, some of which are held by individual scientists and some by EIC and other centres, some are *live* databases which are continually managed and extended by the addition of more data, and some form archives which are created after research projects have been completed

The following list of databases and related information systems is not intended to be a comprehensive list but it provides information on the major corporate databases of the Institute

### Database of the Biological Records Centre

The database comprises distributions of biological species in the British Isles. The data incorporate the taxonomic code of the organism, together with geographical co-ordinates of its location, date of observation, information on habitat and conservation status. Over 6 million records covering 15 000 species are held in digital form as Oracle tables. The majority of the data are donated by volunteer recorders and are received by national recording schemes. The Biological Records Centre is also assisted in its core activities and database functions by the statutory Conservation Agencies through a support contract administered by the Joint Nature Conservation Committee. The database is used to publish distribution atlases and to provide computerised retrieval and mapping services to a wide user community. *Further information can be obtained from EIC, Monks Wood*



### CORINE Biotopes Inventory

The database is a computerised inventory of sites of international importance for nature conservation in the European Union (EU) and Finland (data for other countries are in preparation). Records identify the location and extent of over 7000 sites, with descriptions of important habitats and biological species, rationale for notification and protection status. The inventory forms a layer of the European Union CORINE (Co-ordinated Environmental Information in the European Community) geographical information system (GIS) on the state of the environment of the EU, co-ordinated by the European Environment Agency. *Further information can be obtained from EIC, Monks Wood*



### Analytical Chemistry Databases

CHEMICAL DATA									
Station: Merlewood 00017									
A. Only the elements the soil (soil) samples									
Listed in the Appendix (Table 1)									
19. 1. 94									
Dr. A. Bennett									
March 1995									
Project: 70701a5									
Date: 19. 1. 94									
Sample: 10000000									
Element: 10000000									
Concentration: 10000000									
Unit: 10000000									
Method: 10000000									
Result: 10000000									
Error: 10000000									
Status: 10000000									
Comment: 10000000									
Notes: 10000000									
References: 10000000									
Further information: 10000000									
1 of 1									

Since the creation of the two Analytical Sections at Merlewood and at Monks Wood in the late 1950s and early 1960s, over 300 000 biological samples have been analysed for over 2 million individual determinations. Most of the data at Merlewood relate to water, soil and vegetation analyses for major and minor nutrient and trace elements and the major ions. The data stored at Monks Wood relate to both vertebrate and invertebrate tissue, soils, water and vegetation for pesticide and toxic chemical residues. The data at these Stations are not stored in a structured computerised database, but information can be obtained from the leader of the Analytical Section at the respective Stations.

### Database of Critical Loads of Atmospheric Pollutants

The database comprises estimates of the vulnerability of the land surface of Great Britain to the effects of atmospheric pollution (particularly acid deposition), on the basis of air quality and the sensitivity of receptor soils, geology, freshwaters and vegetation (trees, semi-natural vegetation and crops). The Critical Loads Database was developed by the amalgamation of data sets from the Institute of Terrestrial Ecology, the Soil Survey and Land Research Centre (SSLRC), Macaulay Land Use Research Institute (MLURI) and the University of Aberdeen. The database is managed by the Critical Loads Mapping and Data Centre (MADC) at Monks Wood and acts as the UK National Focal Centre for the Critical Loads Advisory Group (CLAG), which was set up in 1991 by the Department of the Environment to develop a national critical loads and levels programme.

Data within the basic database correspond to each of the c 250 000 1 km squares of the British National Grid. The data are held in digital forms within Laserscan Horizon and Arc/Info GIS and within an Oracle database. The MADC uses the database to map particular receptor pollutant combinations which are then combined with current deposition loads or exposure levels for that pollutant to produce critical load or level exceedance maps. Areas of potential damage can be quantified from these maps and these form a basis for relating policy on pollutant emission abatements to environmental benefits.

*Further information can be obtained from EIC, Monks Wood*

## Ecological Surveys of Great Britain



The database includes information collected in field surveys of selected 1 km squares of the British National Grid, representative of 32 distinct land classes (classified according to environmental characteristics such as geology, altitude and climate derived from maps) Information

includes botanical data (occurrence and cover within quadrats), soil type and strata, and land cover, and the data have been collected from up to 508 sample squares, surveyed in 1978, 1984 and 1990 (eg the Countryside Survey 1990, sponsored by the Department of the Environment, the British National Space Centre, and the Natural Environment Research Council) The data are regarded as being representative of the land classes and, by classifying every 1 km square of the National Grid, it is possible to make statistical predictions of the ecological characteristics of each square [see Countryside Information System] The national database comprises the land class assignment for each of c 250 000 1 km squares of the British National Grid together with the characteristics of each land class The map data are held digitally within Arc/Info GIS and the attribute information and summary data on the and classification are recorded in an Oracle database

*Further information can be obtained from LUS, Merlewood*

## Countryside Information System

The Countryside Information System (CIS) is a PC-based information system running under the Microsoft Windows operating environment, developed under contract to the Department of the Environment It provides easy and flexible access to information on land cover, landscape features, vegetation, soils and freshwater animals from the Countryside Survey 1990 The CIS stores, analyses and displays data by the 1 km squares of the British National Grid Two types of data are held census data which are available for each 1 km square in the country (eg designated and administrative areas and boundaries, Land Cover Map) and sample data which are referenced to the ITE land classification (eg land cover stock and change 1978, 1984 and 1990, and linear features stock and change 1984 and 1990) Any other types of census or sample data which can be related to the 1 km square framework can be used in the CIS Data can be output as hard copy maps, tables and simple charts, or copied within Windows to other spreadsheets, graphics or desktop publishing software

*Further information can be obtained from LUS, Merlewood*

## Land Cover Map of Great Britain

The Land Cover Map of Great Britain is a digital map derived from the classification of cloud-free satellite images from the American Landsat Thematic Mapper (TM) Seventeen key land cover classes were identified throughout Britain and, of these, eight classes were subdivided into, for example, upland and lowland variants, giving a total of 25 cover types The 25 land cover types include built-up areas, arable farmland, pastures and forestry, together with a variety of semi-natural vegetation types The classes are mapped on a 25 m raster overlay of the complete land surface of Great Britain The data are held in digital form as a 25 m raster overlay on the British National Grid and can be presented in a variety of digital exchange formats They can be summarised by 1 km squares (or other resolutions) of the National Grid and summary data are also held as Oracle tables

There are a wide range of users of the Land Cover Map in organisations concerned specifically with environmental impact assessments, pollution control, water resources management, policy and planning, and environmental management Its greatest potential can be realised through integration with other data, such as geology, soils, climate, biological records, agricultural statistics, and population census for use in decision support systems and geographical information systems

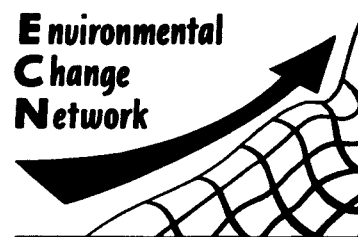
*Further information can be obtained from EIC, Monks Wood*

## Database of the UK Environmental Change Network

The Environmental Change Network (ECN) is a multi-agency, long-term monitoring programme for identifying and quantifying environmental changes associated with man's activities It aims to distinguish

man-made changes from natural variations and trends, and to give early warning of undesirable effects ECN measurements are collected regularly at a growing number of network sites (currently 10 terrestrial and 37 freshwater) throughout the UK, using standardised protocols The data cover a wide range of physical, chemical and biological parameters, including climate, air quality, water quality and flow, soil development and chemistry, invertebrates, vertebrates, vegetation, land use and site management practice Oracle and Arc/Info are used to handle the resulting temporal and spatial database, incorporating meta-information on data specifications, origins and quality

*Further information can be obtained from ECN, Merlewood*







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