



The Environmental Change Biodiversity Network Business Case Final Report



The Environmental Change Biodiversity Network (ECBN): Establishing the Impact of Air Pollution and Climate Change on UK Biodiversity

Prepared for: ECBN Steering Group

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Glossary of Terms and Acronyms

Organisations

| | |
|-------|---|
| BBSRC | Biotechnology & Biological Sciences Research Council |
| BioSS | Biomathematics & Statistics Scotland |
| BTO | British Trust for Ornithology |
| CCU | Central Coordination Unit |
| CCW | Countryside Council for Wales |
| CEH | Centre for Ecology & Hydrology |
| Defra | Department for Environment, Food & Rural Affairs |
| DoENI | Department of the Environment (Northern Ireland) |
| EA | Environment Agency |
| EEA | European Environment Agency |
| EQ | Environmental Quality Directorate (Scottish Government) |
| EPC | Environment, Planning & Countryside (WAG) |
| ERFF | Environment Research Funders' Forum |
| FC | Forestry Commission |
| FSA | Food Standards Agency |
| IPCC | Intergovernmental Panel on Climate Change |
| JNCC | Joint Nature Conservation Committee |
| MOD | Ministry of Defence |
| NE | Natural England |
| NERC | Natural Environment Research Council |
| NESD | Natural Environment Science Division (Defra) |
| NIEHS | Northern Ireland Environment & Heritage Service |
| RSPB | Royal Society for the Protection of Birds |
| SEPA | Scottish Environment Protection Agency |
| SG | Scottish Government |
| SNH | Scottish Natural Heritage |
| STAG | Science & Technical Advisory Group |
| WAG | Welsh Assembly Government |
| WASF | Water, Air, Soils & Flooding Division (Scottish Government) |
| WWF | World Wide Fund for Nature |

Designations

| | |
|------|-------------------------------------|
| AONB | Area of Outstanding Natural Beauty |
| MNR | Marine Nature Reserve |
| NNR | National Nature Reserve |
| SAC | Special Area of Conservation |
| SPA | Special Protection Area |
| SSSI | Site of Special Scientific Interest |

Programmes/surveys

| | |
|-------------|--|
| AWMN | Acid Waters Monitoring Network |
| BAP | Biodiversity Action Plan |
| BBS | Breeding Bird Survey |
| BMS | Butterfly Monitoring Scheme |
| CS | Countryside Survey |
| CSM | Common Standards Monitoring |
| ECBN | Environmental Change Biodiversity Network |
| ECN | Environmental Change Network |
| ECN SG | Environmental Change Network Steering Group |
| EOF | Environmental Observation Framework |
| HAP | Habitat Action Plan |
| ICP Forests | International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests |
| LWEC | Living With Environmental Change |
| MECN | Marine Environmental Change Network |
| UKBAP | United Kingdom Biodiversity Action Plan |
| UKCIP | UK Climate Impacts Programme |

Technical abbreviations/other terms

| | |
|---------|-------------------------------------|
| AWS | Automatic Weather Station |
| CC | Climate Change |
| FEC | Full Economic Costs |
| GB | Great Britain |
| GDP | Gross Domestic Product |
| JCoP | Joint Code of Practice |
| MoU | Memorandum of Understanding |
| NI | Northern Ireland |
| PLFA | Phospholipid fatty analysis |
| PO | Project Officer |
| PRINCE2 | PRojects IN Controlled Environments |
| PSA | Public Service Agreement |
| QC | Quality Control |
| R&D | Research & Development |
| RS | Remote Sensing |
| T&S | Travel & Subsistence |
| UK | United Kingdom |
| WP | Work package |

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Executive Summary

The organisations involved with the development of the Environmental Change Biodiversity Network (ECBN) have a common agenda to halt the loss of biodiversity, to conserve and maintain functional ecosystems capable of delivering ecosystem goods and services, maintain habitats on protected sites in favourable condition or carry out research in support of this. Increased understanding of the impacts of the major threats to biodiversity due to climate change and atmospheric pollution is needed to inform policy and management decisions. Through a co-ordinated UK wide network of long-term monitoring sites, and as an extension of the Environmental Change Network (ECN), the proposed ECBN is purpose-designed to provide a coherent shared evidence-base to support partners in addressing these needs. This would help organisations to set and fulfil conservation objectives, design effective interventions and efficiently channel resources to conserve biodiversity.

The ECBN would inform the development and implementation of climate change adaptation strategies. It would help inform development of practical conservation management measures to reduce or accommodate the impacts of climate change and promote conditions for ecosystem functioning on sites managed for their high biodiversity value whether on protected sites or where they occur in the wider countryside. Across the UK there are thousands of protected sites in need of this kind of support. It would enhance the evidence base to underpin and develop policy objectives and targets for selected UK BAP species and habitats, SSSIs and regulation of emissions, as well as informing a wider range of policy and science needs. It would inform conservation management in relation to BAP targets, Common Standards Monitoring and assessment of favourable condition/favourable conservation status.

ECBN would also inform on conservation issues in the wider countryside, as it will provide evidence to help explain and validate findings of other monitoring and provide data, capability and methods to assist with further research on ecosystem functions.

The ECBN project involves a phased extension of the ECN, to a network of 40 (+12 ECN) sites across the UK (with a narrower suite of measurements than on the ECN sites) over an initial 4 year implementation period, but depending on built in reviews, extending to 100 sites for long term monitoring of air, water, soil and biodiversity variables. Benefits could be delivered in as little as two years, but these would increase over time as the data set matures, and links are forged with other monitoring initiatives through the central data coordination unit.

This Business Case provides participants with a clear statement of the benefits of the ECBN, its users and anticipated uses. It makes the case for the ECBN in terms of value for money with respect to the evidence base and in comparison to other monitoring initiatives. It provides compelling reasons for why ECBN needs to be established now. Costs, funding requirements and risks are set out based upon a proposed implementation plan and funding model. Some elements, such as funding formulae and contractual arrangements now require negotiation and agreement between partners.

Drawing on its close association with ECN, the ECBN will realise added value of building on an existing framework, minimise costs and exploit economies of scale. The costs of ECBN are reasonable in comparison with other biodiversity related monitoring and modest in comparison to the annual expenditure on UK Biodiversity Action Plans.

The Business Case forms part of a Business Development Plan that proposes detailed plans for the implementation of the ECBN, beginning in 2008, as well as considering its potential long-term development. The UK Sustainable Development Strategy emphasises the importance of using sound science wisely in decision making. The Business Case and associated planning build on prior scientific and technical preparatory work and together are designed to ensure that the ECBN is taken forward in a sound, transparent and considered way through a partnership approach and with an appreciation of the objectives and long-term nature of commitments.

Business Case for the Environmental Change Biodiversity Network

1. Introduction

Making the right investment decision depends on participating organisations ensuring that from a strategic perspective, the investment results in, or contributes to achievement of policy outcomes and /or strategic objectives at the right time, in the right sequence and joined up with those resulting from other investments. This Business Case sets out the evidence in this respect for the proposed Environmental Change Biodiversity Network (ECBN) a UK wide, long-term biodiversity monitoring project.

The Business Case is a working document which is provided to assist in discussions and to help reach agreements towards implementing the ECBN. It will require periodic updating and some elements, such as funding formulae and contractual arrangements now require negotiation and agreement between parties.

Further information about plans and proposals for the ECBN is provided in two accompanying documents, the ECBN Business Development Plan and an associated Supporting Document.

2. The Environmental Change Biodiversity Network

The UK's climate is changing, and it is very likely (>90% probability) that the change in temperature in recent decades has been caused by human activity (Jenkins et al, 2007). We are already noticing the impacts of climate change on biodiversity such as a northward shift in the distributions of animal groups (Hickling et al., 2006), and these changes are expected to continue. Such impacts will be compounded by air pollution and other more site specific factors. Both climate change and air pollution remain high on the political agenda for natural resource protection and the effects on any particular species, habitat or site are currently highly uncertain. Effective management and policy responses will require reliable observation and improved prediction of impacts across the range of habitats in the UK.

Evidence is needed to improve our understanding of how the condition of habitats is being impacted by climate change and atmospheric pollution and to assess this over time. It is also necessary to be able to discriminate these impacts from each other and from other factors, including management practices, so that effective interventions to protect habitats can be delivered.

Attributing the causes of environmental change is a major shortfall in our current environmental monitoring initiatives (ERFF, 2007a). The ECN series of terrestrial sites does this, by monitoring animal populations, vegetation, soils, climate, air pollution and other variables at the same sites. It is composed of 12 intensively studied sites in widely different habitats, climates and pollution regimes. This is effective for developing scientific understanding of processes at these sites. However a larger network is required to provide generalised information to inform the development of biodiversity policy and management. Following consideration of evidence presented in various studies, strategies and proposals, Defra and partners

commissioned CEH and partners to produce a proposal and technical specification to further develop the ECN, by adding a second tier of terrestrial sites, to help monitor and understand the impacts of atmospheric pollution and climate change on biodiversity. This study (Morecroft et al., 2006) produced a proposal for what is now known as the Environmental Change Biodiversity Network (ECBN).

2.1 Description of ECBN

The proposed ECBN includes a range of habitats on high biodiversity value sites, mainly National Nature Reserves, across the UK and would operate as an extension of the ECN. It would allow relationships to be identified between aspects of biodiversity and changes in the physical environment, caused by air pollution and climate change, and enable generalisations to be made about biodiversity trends, as well as specific trends at individual designated sites.

A relatively long run of data needs to be obtained before the new Network would be capable of distinguishing trends in biodiversity from year-to-year natural variability and explaining these in terms of air pollution or climate change. As a comparison, ECN is starting to show important trends after 15 years. The proposed ECBN would, however, produce early benefits in terms of identifying changes in spatial patterns in biodiversity in response to climate and air pollution and identify the impacts of extreme events (and the effects of climate change may well be driven by extremes, such as droughts). Analysis of year to year variability would also start to reveal potential vulnerabilities to longer term changes. A number of important additional benefits would also start to be produced, such as a contribution to validation of Common Standards Monitoring, information on carbon storage of semi-natural habitats, educational information and a network of site management staff engaged in climate change issues.

There are national schemes to provide environmental data and trends on air pollution and climate change and these can be used to explain biodiversity trends by interpolation but this is often imprecise, particularly for soil variables. Co-measurement of animal populations, vegetation, soil, climatic and air pollution variables at the same sites maximises the chances of explaining biodiversity trends and minimises the risk of attributing change to the wrong cause.

A key set of variables has been identified for measurement at each site according to standardised protocols. These were considered to offer the greatest potential returns for end user needs, practicality and cost effectiveness and include measurements of climate, atmospheric deposition, soil chemistry, vegetation, butterflies and birds. It is proposed that vegetation and soil be monitored on a rolling programme of three and six years respectively.

The monitoring methodology mainly follows ECN protocols, but adaptation of existing techniques or development of new techniques (e.g. for coastal site monitoring) would be considered where these offer substantial advantages or efficiency gains.

It is intended that CEH manage the ECBN, collate data, develop analysis procedures and report findings. Monitoring would be carried out by a combination of local site staff, trained volunteers and specialist teams /contractors visiting sites on a periodic basis. Monitoring will be supported by country co-ordinators, from the statutory conservation agencies.

Links with existing monitoring networks will be maximised by, for example, sharing sites and data to give added value and better value for money. The ECBN seeks to make maximum use of existing data collation systems. For example, the Butterfly Monitoring Scheme would co-ordinate data collection as part of their wider sampling, using existing data handling and collation systems, and provide the relevant outputs to the ECBN for analysis and reporting.

Data handling procedures used for the existing ECN would be used as far as possible for ECBN, including the existing ECN centralised data management facility at CEH, the Central Coordination Unit (CCU). Maximising freedom of information would be a priority and partners would encourage use of the data, which, wherever possible, will be made readily available to the wider scientific community and others.

2.2 Vision & Objectives

2.2.1 Introduction

The ECBN partners have a common agenda to halt the loss of biodiversity to conserve and maintain functional ecosystems capable of delivering ecosystem goods and services and to maintain habitats on protected sites in favourable condition. Increased understanding of the impacts of the major threats to biodiversity due to climate change and atmospheric pollution is needed to inform policy and management decisions.

Partners are working to establish a coherent shared evidence-base to underpin their work in this respect. This would help organisations to set and fulfil conservation objectives, design effective interventions and efficiently channel resources to conserve biodiversity.

The ECBN has been developed to deliver this evidence, bridging the gap between science and conservation management by:

- Both detecting and attributing causes of change;
- Providing results that are applicable at national to local site level, and;
- Contributing to efforts to tackle wider European and global impacts.

One of the key benefits would be that the ECBN can inform the development of adaptive management so that practical conservation management measures can be developed to reduce the impacts of climate change and promote conditions for ecosystem functioning on habitats managed for their high biodiversity value both on protected sites and in the wider countryside.

The partners have a shared vision for the ECBN.

2.2.2 Vision for the Environmental Change Biodiversity Network

Our vision is for an effective, coherent, multi-stakeholder organisation of site based observation of biodiversity, linked to other observation initiatives, that will help us to discriminate and understand the impacts of climate change, atmospheric pollution and other environmental pressures and provide the evidence base for development of adaptive management in policy and practice.

The ECBN will provide multivariate observations from individual sites in a scientifically designed network across a range of habitats and environmental gradients. It will help and fill the critical scientific gap between broad-based observations in the wider countryside or observations of single or several variables at different spatial and temporal scales. The ECBN will provide an integrated data set that can be used to attribute causality, and for validation and integration of other biodiversity data that are collected at different scales.

The ECBN will enable us to provide timely information about real-time or immediate effects and to provide interpretation of signals for policy development, ecosystem assessment and practical management towards conservation of biodiversity, including setting and meeting targets and commitments and responding to observed changes.

The ECBN will provide increased efficiency and effectiveness for existing and new observation initiatives by providing links for centralised data management and review, standardised methodology to ensure compatible data sets, and by building on experience and methods already developed by the ECN.

The ECBN will achieve recognition as a source of information and collaboration through an active communications strategy, delivering web-based access to information and data to engage a wide audience, from policy and decision makers, land managers, scientists and researchers, to the general public.

The ECBN will exemplify the partnership approach of the UK BAP, and play an important role in contributing to our ability to fulfil commitments under the Convention of Biological Diversity and international, EU and domestic legislation and agreements.

2.2.3 Objectives

- Establish and maintain a co-ordinated UK wide network of long-term monitoring sites that increase our ability to detect, discriminate, understand and predict the effects of climate change and air pollution on biodiversity;
- Promote, implement and develop the ECBN through a partnership approach, building on a sound business case and plan for implementation and an appreciation of the long-term nature of commitments;
- Provide a central data management and coordination facility for the ECBN and linked initiatives to promote common standards, enable efficient co-ordination and facilitate the delivery of Network objectives through effective governance and project management;
- Share facilities, expertise and methodology with the ECN to maximise scientific value and cost efficiency.
- Build on and complement existing environmental monitoring and engage with others by encouraging participation in sharing data, data analysis and interpretation, site measurements, workshops and review groups.
- Use recognised standardised monitoring methods and protocols (Sykes & Lane, 1996), but providing method development and revision as required;

- Enable access to data and provide communication about the ECBN, measurements and protocols and uses of the ECBN data and outputs.
- Provide a robust evidence base to inform policy, scientific research and management at national, regional and local levels, also contributing to wider European and global in situ monitoring networks.

2.3 Summary of Benefits of the ECBN

One of the main purposes of the Business Case is to help sponsoring and collaborating organisations make decisions about their support for the ECBN. It is therefore important to ascertain its benefits and value for key user groups in policy, scientific research, conservation management and business and establish its benefits to the public. The main potential benefits are:

Science

Detect and attribute the effects of climate change and air pollution on major aspects of biodiversity at sites of high conservation value. This is a basic scientific question which has not yet been adequately addressed and that is directly relevant to a wide range of policy issues.

Extend the value of the ECN in providing evidence to help explain and validate findings of other monitoring, which do not have the means to attribute cause, including common standards monitoring of designated sites, but also contributing to our understanding of the wider countryside.

Provide data, capability and methods to contribute to further research on ecosystem function.

Policy & Conservation Management

Provide a robust scientific evidence base capable of informing the development and implementation of climate change adaptation strategies, including adaptive management, and assist with the assessment of risks to biodiversity associated with climate change.

Enhance the evidence available to underpin and develop policy objectives and targets for selected UK Biodiversity Action Plan BAP priority species and habitats, SSSIs and regulation of emissions as well as a wider range of policy and science uses.

Inform conservation management in relation to BAP targets, Common Standards Monitoring and assessment of favourable condition / favourable conservation status.

Create an evidence base to help channel resources effectively – towards measures and action that will be effective in a changing climate.

Fulfil role of NNRs in providing a resource for scientific research and demonstration. Stability of management allows for programmes of research or monitoring requiring long-term commitment.

Perhaps provide information on carbon storage in soils and trees for semi-natural habitats, linked with measures of aspects of biodiversity.

Business & Industry

Provision of cost-effective sites for bio-monitoring of regulated industrial sites to meet permit conditions.

General Public

Interpretation of environmental change impacts at selected popular NNRs

Real time weather data for selected NNRs available via the internet.

Enhanced public safety is provided by the operation of a fire severity index by the CCW, NE for selected NNRs.

2.4 Users and Planned Uses of ECBN Outputs

The users and planned uses of the ECBN outputs have been established through consultation with a range of stakeholder organisations (Table 2.1a). The ECBN is not necessarily seen as providing information in isolation, but as complementing the information available from other sources.

Table 2.1a: Planned Uses of ECBN Outputs identified through Consultation

| User Organisation | Users consulted | Planned uses of ECBN outputs & their relevance to users |
|--|--|---|
| Defra (UK & country level responsibilities) | Air Quality Division, Climate Change Impacts & Adaptation Team Environment Land Management (soils and agri-environment) Natural Environment Science Division Natural Environment Science Unit Science Strategy & International Division | Support & underpin aspects of Defra policy formulation and development, monitoring and reporting; in particular for biodiversity, climate change, air quality, soils, land use & management, incl. coastal management. Developing the evidence base for an ecosystems approach to policy and decision making on the natural environment. Better understanding of pressures on ecosystems and ecosystem services. Making case for climate change adaptation, evidence for national risk assessment, context for determining priorities & strategic direction for biodiversity and adaptation work. Supporting information in relation to obligations to monitor the condition of habitats and species, to prevent their deterioration and to seek their enhancement: Convention on Biological Diversity (UKBAP) Habitats and Birds Directives (SACs & SPAs), Ramsar status, PSA target for SSSI condition. Use evidence of climate change and air pollution impacts on soil function to inform indicators of soil quality, and to inform on diffuse soil pollution, soil biodiversity, soil carbon, links with climate change, trends in peat status. Development of agri-environment targets and prioritisation. Inform development of Environmental Stewardship research programme. |
| Other Government Departments (UK & GB responsibilities) | Forestry Commission MOD Estate Strategy & Policy (Sustainable Development) | Assist in reporting impacts and forming adaptation strategies for forestry in GB. Evidence base to inform future revisions to Country Forestry Strategies. Support legal compliance issues for habitats & wildlife. Inform estate stewardship through comparison and context. Understand impacts of CC and inform on adaptation strategies. |
| Devolved Government (country level responsibilities) | Scottish Government EQ Directorate - (WASF Division) Welsh Assembly Government - EPC | No specific uses identified for Scotland (see statutory conservation agency responses for details of uses supporting SG) Reporting on the outcomes of the Welsh Environment Strategy. Support setting realistic targets for agri-environment schemes. Help to explain and validate trends detected in other monitoring and in particular where this contributes to our understanding of the wider countryside. ECN |

| User Organisation | Users consulted | Planned uses of ECBN outputs & their relevance to users |
|---|---|---|
| | | already assists with this but its value would be increased by the ECBN. |
| UK statutory conservation, countryside and environment agencies (country level responsibilities, EA – England & Wales) | Countryside Council for Wales Natural England Scottish Natural Heritage Environment Agency | <p>Fulfil purpose of NNRs as sites for R&D and improve public access to information available from them (e.g. making weather information available on CCW website).</p> <p>Inform site management and adaptation strategies for NNRs and other designated sites.</p> <p>Implementing national biodiversity strategies and associated reporting (UKBAP, incl. species action plans). Possible development of further indicators.</p> <p>Information to support assessment of impact of projects & plans (e.g. power stations) on Natura sites & SSSIs.</p> <p>Assist reporting on favourable condition status of SSSIs – e.g. understanding effects of external pressures on sites, improved evidence on critical loads & effects of air pollutants.</p> <p>Delivering research priorities for environmental trends & indicators.</p> <p>Inform understanding of impacts of climate change and air pollution on soils and developing understanding of soil function / ability to support biodiversity.</p> <p>Inform on research needs in support of Environmental Stewardship and support agri-environment scheme targeting of measures.</p> <p>Support coastal policy and efficient use of resources.</p> <p>Duties to monitor the effects of climate change on priority habitats & species.</p> <p>Channelling resources effectively - to deal with the causes of change that evidence suggests can be influenced.</p> <p>Permitting under Pollution Prevention & Control regulations. Extend evidence base for regulating emissions and enable air pollution impacts to be distinguished. Provide context for site specific bio monitoring data.</p> |
| Advisory Body | JNCC | Inform the choice of attributes for CSM sampling. |
| Universities & Research Institutes | Forest Research Centre for Ecology & Hydrology Universities: (Oxford University Centre for the Environment & University of Liverpool School of Biological Sciences) | <p>Evidence base on cause and effect to support information needs of FC.</p> <p>R&D to support national capability in monitoring and survey, particularly in co-ordination and in the management, analyses and interpretation of data.</p> <p>Contribute to CEH research themes: Biodiversity, Climate Change & Biogeochemistry.</p> <p>Using data to support further R&D identifying cause and effect and identifying drivers of ecological change.</p> <p>Data for quantifying climate change impacts and possibly ecosystem services.</p> <p>Improved understanding of spatial and temporal patterns in biological and physical variables and the relationship between them.</p> <p>Test and refine models of climate change and air pollution impacts.</p> <p>Investigate interactive effects of climate change and nitrogen deposition on soils, plant communities and animal populations.</p> <p>Test for associations between plant and soil responses to environmental change.</p> |
| Non Governmental Organisations | RSPB Woodland Trust | <p>Raising public awareness of the issues and encouraging action.</p> <p>Providing underpinning information for Advocacy campaigning in support of investment for adaptation of wildlife to impacts of CC.</p> <p>Site management: developing adaptation strategies.</p> <p>Interest in establishing link b/n phenological change & vegetation community composition – link to modelling impacts.</p> <p>Evidence to support view that SSSI condition assessment needs reconsidered in light of inevitable change.</p> |

| User Organisation | Users consulted | Planned uses of ECBN outputs & their relevance to users |
|---------------------------------------|---|--|
| | | <p>Support view that resources must be channelled effectively - to take account of drivers of change that evidence suggests can and can't be influenced.</p> <p>Differentiate drivers on designated sites from those in the wider countryside.</p> <p>Identify unforeseen change as it happens.</p> |
| UK long-term environmental monitoring | Monitoring schemes (listed in the Business Plan) & ERFF EOF | <p>Help to explain trends seen (all schemes) - including population and geographical changes. ECN already assists with this but its value would be increased by the ECBN.</p> <p>Fill existing gaps in a spatial context (e.g. ECN and Butterfly Monitoring Scheme) and temporal context (e.g. Countryside Survey).</p> <p>Quality assurance of less frequent monitoring (Countryside Survey).</p> <p>For nitrogen deposition impacts - help to explain why predictions from robust models do not always concur with observations from monitoring schemes.</p> <p>Relating changes in soil with changes in above ground biodiversity was seen as potentially important for schemes focussed primarily on vegetation</p> <p>Using ECBN sites or data for new and existing research linked to other schemes (e.g. by linking remotely sensed phenology with the GB Land Cover Map, validating and extending models of ecosystem change derived from ECN and development of the EEA's indicators and UK biodiversity indicators).</p> <p>Assessing changes in site management in response to climate change.</p> <p>Impact of invasive non-native plant species.</p> <p>Potential for producing UK maps by interpolation, provision of a model for a European monitoring network.</p> |

2.4.1 Monitoring Schemes

A more detailed description of the analysis of responses from monitoring schemes indicating interest for a series of identified end-uses of ECBN is provided in Section 3.2.2 of the Business Plan.

2.4.2 Other Known and Potential Users

Table 2.1b summarises the likely interest in the ECBN of key organisations actively involved in the development of the ECBN but who were unable to respond to the consultation. SEPA and BTO were unable to meet the consultation timeframe due to other commitments; in the case of SEPA due to changes in ECBN Steering Group membership during the consultation period. NIEHS have expressed tentative support in recent email correspondence.

Table 2.1b: Other Known and Potential Users

| User Organisation | Potential interest in ECBN outputs |
|-------------------|--|
| SEPA | Similar responsibilities and interests to those expressed by the EA. |
| BTO | Comparing bird population trends with changes in the physical environment, vegetation and butterfly populations. |
| NIEHS | Similar responsibilities and interests to those expressed by CCW, NE & SNH. |
| Met. Office | AWS producing real time data (planned for Wales). Establishing a fire severity index for selected NNRs. |

There are other potential users of the ECBN outputs who have been identified over the course of the project but who have not yet been consulted, including:

- Other Universities,
- National Park Authorities,
- Association of AONBs,
- Local Government Association,
- National Trust, WWF, Wildlife Trusts
- Regional Development Agencies,
- Department of Environment Northern Ireland,
- The Native Woodland Survey of Scotland (FC monitoring scheme).

2.5 When Will Benefits be Realised?

CEH has estimated how long it will be before they can provide useful information for various planned outputs from the ECBN. For many outputs, their value then increases year on year. This information is provided to help users establish the likely sequence in which outputs and benefits will be realisable and is provide in Table 2.2.

The ECBN is designed to detect and interpret trends in biological data in response to changes in climate and air pollution. Both physical and biological processes are operating on timescales of decades and the ECBN will inevitably only begin to develop its full potential beyond the first 10 years. A power analysis study conducted under the earlier network design project (Morecroft et al., 2006) showed that for some biological variables, large but realistic, differences in trends between different groups of sites could start to be detected at approximately 12 years, with a site network containing 40 new sites. More subtle differences would however require longer time or more sites to be included in the ECBN.

Some benefits would start to accrue from a much earlier stage, for example it will be possible to compare the species composition of similar vegetation types under different climatic or air pollution regimes or identify impacts of extreme events such as a drought. There would also be a range of other advantages realised at an early stage, including improving site knowledge and public understanding of science.

Table 2.2: Sequence in which Initial ECBN Outputs / benefits will be made Available

| Specific planned outputs / benefits | When benefits are likely to <u>begin to be realised</u> |
|--|--|
| Fulfil role of NNRs as sites for R&D | Immediate |
| Real time weather data (provided by CCW for Wales only) | 1 year |
| Fire severity index (provided by CCW for Wales and partially in England only) | 1 year |
| Enhanced UK central capability and facilities for research of ecosystem function. | 1-2 years |
| Development of methodology for monitoring coastal sites | 1-2 years |
| Information and data to help raise public awareness of the issues | 2 years |
| Provision of source data for further research (incl. modelling) & monitoring projects, including historical data from some sites | 2 years, with value increasing over time |
| Helping to interpret changes detected in other monitoring schemes (e.g. explaining butterfly population trends in terms of weather events) | 2 years with increasing value over time. |
| Information available to support assessment of impacts of projects & plans on Natura 2000 sites | 3 years e.g. background info on air pollution |
| Channelling resources effectively – to drivers of change that evidence suggests can be influenced | 3 years (if for example we find a site has v. high air pollution). But otherwise 10 years+ |
| Evidence to support CSM method development | 4 years with increasing value over time |
| Understanding ecosystem processes on designated sites | 4 years with increasing value over time. |
| Explaining biodiversity trends in the context of climate change and air pollution to underpin policy and help explain findings of other monitoring | 4 years (spatial patterns) with increasing value over time. |
| Reporting on biodiversity trends | 4 years with increasing value over time |
| Reporting impacts of climate change on NNRs | 4 years with increasing value over time. (at 4 years will not be much) |
| Identifying spatial patterns in the impacts of air pollution and testing critical loads maps. | 4 years, with increasing value over time. |
| Provision of information to allow assessment of risks arising from climate change | 4 years, with increasing value over time. |
| Differentiate drivers of change on high value biodiversity sites from those operating in the wider countryside | 4 years, with increasing effectiveness over time |
| Reporting air pollution impacts on NNRs | 4 years, with increasing value over time (at 4 years will only be spatial patterns). |
| Relating changes in soil (incl. carbon content) with changes in above ground biodiversity | 8-11 years+ to start detecting changes in soil properties |
| Detecting the recovery of soil and plant communities since the decline in acid deposition | 10y+ |

2.6 Relationship with the Environmental Change Network (ECN)

The UK ECN is a long-term, integrated environmental monitoring and research programme managed by CEH. It was started in 1992 as a multi-agency programme with the aim of establishing a well-designed and cost-effective national network to identify, assess and research environmental change nationally and to provide a basis for European and international collaboration. The partners intend that CEH manage the ECBN (section 2.1). The ECBN would form part of the wider ECN programme. The mission of ECN is fully compatible with that of the ECBN, namely:

“To develop and maintain a multi-agency network and early-warning system to detect, present, interpret and predict long-term ecosystem change and help society mitigate and adapt to global change.”

2.6.1 Shared Facilities & Opportunities This Presents

Once established, the ECBN will in effect be an extension to the ECN concept. The relationship between the ECBN and ECN is fundamental as they will share many of the existing resources including protocols and data management. There will be a need for separate data analysis and reporting for the ECBN which it is planned to deliver via a dedicated ECBN Central Coordination Unit (CCU). There will however be a partial overlap of staff and sharing of resources with ECN which will be cost-effective and any new methodological or procedural developments will benefit both schemes and potentially others too. ECN already has links to other key monitoring schemes, such as the Butterfly Monitoring Scheme, Breeding Bird Survey and Rothamsted light trap network. The consultation indicated that it would be beneficial to continue and develop these links with the ECBN. There are further mutual benefits to be gained (Table 2.3).

Table 2.3: Further mutual benefits of sharing ECN facilities

| Opportunities presented to ECN by ECBN | Opportunities presented to ECBN by ECN |
|---|--|
| Extending the number of sites allowing replication of habitats, allowing conclusions to be generalised | Results from the ECBN could be placed in the context of longer timescales to account for temporal variability |
| Filling gaps in coverage for important habitats, including potential to incorporate coastal sites | It will be possible to read across to ECN variables not recorded in the ECBN – e.g. to assess the value of carabids as indicators for other taxa. |
| Provide a wider range of sites, allowing a wider range of environmental conditions to be included in the ECN programme. | The ECN offers long experience and expert advisers in environmental monitoring, data analysis and interpretation. |
| Models of ecosystem change developed from ECN could be tested using Network data | The ECN offers strong partnerships over the long term., which will help avoid problems in setting up and running the Network |
| Enhanced ability to inform conservation policy and management | Enhance capacity of ECN to provide validation and interpretation of other less intensive monitoring - as ECN is recognised as supplying comparison and validation of results of other monitoring, such as Countryside Survey, or Butterfly Monitoring. |
| | Understanding of ecological processes derived from more detailed series of measurements at ECN sites and their strong links to experimental research. |
| | Tried and tested methodology |

2.6.2 ECN, MECN and ECBN

The Marine Environmental Change Network (MECN) is run as a separate programme to ECN; the two networks are however working together to develop appropriate integration. The proposed coastal component of ECBN which it is intended to develop during the implementation phase could be a particularly effective link between the two.

2.7 Synergies with Strategic Initiatives

The development of the ECBN has taken into consideration existing monitoring activities to help realise efficient and effective use of limited resources and to help ensure that the data collected would be compatible and fit for purpose.

The development of the ECBN has taken place at a time when a range of relevant strategic initiatives have also been under development. As they develop, these initiatives will provide direction and frameworks against which the benefits of the ECBN can be realised within a broader context than is currently possible. They should also provide the information needed to show whether the nature and sequencing of outputs from ECBN fits well with other planned research and monitoring and help establish how ECBN and other monitoring can be joined up. We have established the synergies with strategic initiatives, as far as is possible at this stage, and these are summarised below.

2.7.1 Environmental Observation Framework (EOF) - Emerging Strategy for UK Environmental Monitoring & ERFF Horizon Scanning Study

ERFF are leading the development of a UK Environmental Observation Framework (EOF) to define and resolve UK monitoring issues. The EOF involves key funders and senior policy makers across government and the devolved administrations and was launched in April 2008. As it develops, it will provide a strategic decision-making framework for all UK environmental observation/monitoring activities. EOF will enable funders and users to see the entire observation/monitoring portfolio, understand the motivations of its various components, and provide a framework for optimising the investments and measurements made (e.g. for research, policy and regulatory needs). The EOF also aims to improve data accessibility and quality.

The validity of the Business Case will be periodically reviewed against the findings and recommendations of the EOF as they emerge and the EOF will be looking to the ECBN as an example of good practice to share with other sectors.

Using the findings of the strategic analysis of UK environmental monitoring (ERFF, 2007a), which raised issues now being addressed by the EOF, it is clear that the ECBN will help address known gaps in UK monitoring, will avoid pitfalls and take into account many of the issues identified (Appendix 1).

To help inform future research agendas and environmental management strategies, a long-term horizon scanning study commissioned by ERFF identified eleven of the most important dimensions of uncertainty for the environment that may impact on the UK in the next twenty years (ERFF, 2007b). These dimensions, agreed by ERFF members, will sit above individual members' strategies and provide a shared view of the future to guide how members identify priorities. The timescale of availability of trends from the ECBN outputs (approx. 12 years) is broadly in line with the timescale

over which the uncertainties may impact. We anticipate the ECBN will help inform understanding and address information requirements for two of these, namely:

- Changing ecosystems – and in particular “establishing the impacts of changing atmospheric composition on terrestrial ecosystem functions”
- Reducing uncertainty around climate change – and in particular “credible information on the regional and local effects of climate change” and, in realising the opportunity for the UK to “support world class science and demonstrate how improved modelling can help develop practical responses to climate change”.

2.7.2 JNCC Terrestrial Biodiversity Surveillance Strategy

The JNCC are developing a surveillance strategy to fit within the wider ERFF EOF. The strategy, currently in draft form, seeks to improve the value of the evidence provided by the long term sampling of biodiversity to meet three objectives:

Objective 1 Measuring the overall goals set for biodiversity in UK and country strategies;

Objective 2 Detecting the impacts of the pressures affecting biodiversity through changes in biodiversity status, in order to help set measures and strategies for taking action; and,

Objective 3 Assessing the status of the wide range of species and habitats covered by the sum of the policy, legislative and international conservation commitments.

As part of the second objective, long-term sampling should help detect declining / unfavourable conservation status of biodiversity, as well as contributing to understanding the reasons and predicting future vulnerabilities. The JNCC are aware of gaps in evidence for the major impacts of pressures. The ECBN is designed to identify the drivers of change, the extent to which they are acting on the ecosystems of the targeted habitats and identify the responses to these impacts. It is therefore very relevant to objective 2 for designated sites of high biodiversity value and for targeted habitats where they occur in the wider countryside and can be managed to maintain or improve their conservation value, for example as part of an agri-environment scheme.

The ECBN is also relevant to objective 3 in the context of providing information on cause and effect to support reporting on policy, legislative and international conservation commitments. For example in relation to the PSA target for achieving 95% favourable condition on SSSIs – if this is not met then evidence on cause and effect is needed, so resources can be channelled effectively to meet commitments, especially if the causes that are impeding achievement of targets are external to the sites.

2.7.3 Living with Environmental Change (LWEC)

The Fifth Treasury Challenge focuses on global change and the pressures this will bring to natural resources. LWEC has been developed with ERFF and is the response by the major UK funders of environmental research, including NERC, to this challenge. It is a ten-year programme, which will provide the information needed to effectively manage and protect vital ecosystem services and improve the tools and knowledge needed to build resilience, mitigate problems, and adapt to environmental change. It is designed to meet many of the needs identified by the Stern Review

(Stern, 2006), the United Nations' Millennium Ecosystem Assessment, and will contribute to delivery of the UK strategy for sustainable development.

The ECBN is well aligned with the LWEC aim of “strengthening the evidence base for policy, not least by addressing the uncertainties that remain about the impacts of climate change”

Through knowledge exchange, development of analysis systems and capacity, data provision and collaboration with other monitoring and research ECBN is in a position to provide the information, data and skills to assist in the delivery of the first of LWEC's objectives, namely:

- To build effective mitigation, adaptation and resilience to climate change, including preparedness for changes to the intensity and frequency of extreme events, so that human health, well-being, and a healthy natural environment are ensured through use of sustainable and socially acceptable environmental management approaches and technologies.

LWEC will operate through interdisciplinary research activities, knowledge exchange actions and training opportunities. ECBN has been developed around the need for collaboration and interaction with other research initiatives and monitoring. The ECBN proposal also places importance on data sharing, reporting, communication and training workshops. As envisaged the proposed ECBN can provide the kind of results, data, skills, analysis systems and knowledge transfer needed to help deliver the desired LWEC outputs, in particular:

- “a more research-informed dialogue and debate about environmental challenges.....”
- “whole system assessments and risk based predictions of environmental change and the effects on ecosystem services...”
- “integrated analyses ofcosts, benefits and impacts of different mitigation and adaptation responses”;
- “guidance for more effective sustainable management of ecosystem services.....”

2.7.4 NERC Science Strategy

NERC's science strategy (NERC, 2007) is managed through seven environmental science themes. These themes are championed by theme leaders and partnerships across the research and stakeholder community are encouraged. The ECBN is most closely aligned with the Biodiversity theme, which is championed by Lloyd Peck and is aimed at understanding the role of biodiversity in key ecosystem processes. NERC recognise that environmental change makes this research more pressing because it can lead to a loss of biodiversity, thereby affecting the resilience of ecosystems.

2.8 Why Implement the ECBN Now?

In the context of designated land of high conservation value:

- There is clear evidence that climate change is taking place and early signs of change in biological systems are also apparent (IPCC, 2007). Changes have

however been relatively small to date and we are not too late to establish a solid baseline for ECBN against which future changes can be compared. This opportunity is not, however, likely to last and change may happen more quickly than we expect, especially as a result of extreme events (such as drought).

- The England Biodiversity Strategy – Taking it Forward (Defra, 2006) includes a key deliverable by 2008 to have in place monitoring systems for early detection of climate change impacts on biodiversity, including a targeted site-based monitoring network, as proposed in ECBN.
- Business critical decisions rest on demonstration of commitment to the ECBN now; or funding opportunities and efficiency gains will be missed. The EA require bio-monitoring of regulated industrial sites as a necessary step in meeting their statutory obligations under the Habitats Directive. All parties consider engagement with the ECBN as the only viable option for statistically meaningful bio-monitoring, and industry bodies have indicated that in principle they would be willing to contribute towards aspects of the ECBN. This is conditional on reassurance and evidence that ECBN will be implemented in 2008 and that the partners are committed to its long-term future. A decision is required in the next few weeks, and commitment to the ECBN is essential in order to demonstrate the level of impact of major industries on statutory sites.
- Many of the scientific methods are mature - the ECN protocols are well established, its co-variable measurements and analysis methods are now yielding results. The ECBN benefits from these resources and builds its scientific approach and rationale on the findings of previous research.
- Conservation agencies are reporting that SSSI PSA targets are unlikely to be achieved – this problem is not going to be resolved until the interaction of causes are understood; the causes need to be identified quickly to ensure resources are channelled effectively.
- Horizon scanning and strategic initiatives such as LWEC identify ecosystem change and climate change as priorities for research and are planning for the information needs of the future. If implemented now ECBN will generate clear trends within the timescales these initiatives are planning for.
- This network fills current known data gaps in monitoring, for example for impacts of climate change, effects of air pollutants and coastal changes.
- It is important to maintain momentum; the technical proposal and now costing, business case and planning are current, but will not remain so indefinitely. CCW and NE have started to establish sites and there is now an opportunity to capitalise on this.

3. Cost of Implementation of the ECBN

This section presents the cost of implementing the ECBN. The total FEC over the first 4 years is £2.35 million. A detailed presented of costs is shown in Appendix 2, based on the assumptions presented below.

3.1 Assumptions & Presentation of Costs

For the implementation phase, which it is proposed begins in 2008 and spans the first four years of activity, it is intended to phase in 40 ECBN sites across the UK, in

addition to the 12 existing ECN sites (Table 3.1). This is the minimum number of sites recommended to achieve a fully functioning Network (Morecroft et al, 2006).

Table 3.1: Cumulative Numbers of Sites during the Implementation Phase

| | Year 1 2008/09 | | Year 2 2009/10 | | Years 3 & 4 2010 -2012 | |
|------------------|--------------------------|-----------------------------|--------------------------|-----------------------------|---------------------------|-----------------------------|
| | <i>Sites Implemented</i> | <i>Sites to be equipped</i> | <i>Sites Implemented</i> | <i>Sites to be equipped</i> | <i>Sites Implemented</i> | <i>Sites to be equipped</i> |
| Wales | 13 | - | 13 | - | 13 | - |
| England | 10 | (5) | 15 | - | 15 | - |
| Scotland | 1 | (3) | 4 | (4) | 8 | - |
| Northern Ireland | 0 | (0) | 0 | (4) | 4 | - |
| <i>Subtotal</i> | <i>24</i> | <i>(8)</i> | <i>32</i> | <i>(8)</i> | <i>40</i> | <i>-</i> |
| ECN sites* | 12 | n/a | 12 | n/a | 12 | n/a |

*ECN sites: Wales 1; N. Ireland 1; Scotland 3; England 7

Previous cost estimates (Morecroft et al. 2006) have been reviewed by CEH taking account of the experience gained in setting up pilot sites to provide improved information on capital costs, CCU and agency staff time and salary costs and costs of analytical services. Costs are split between one-off start-up costs and ongoing costs for:

- Pay costs
- Overheads on pay costs,
- Consumables,
- Equipment
- Travel & Subsistence
- Sub-contracts consultancy,
- Other costs

Within these categories further breakdowns of cost are provided.

FECs have been calculated using the following assumptions on overheads using rates provided by the organisations involved:

- Central Management – 115% of pay costs
- Site staff –33.3% of pay costs
- National Agency Co-ordinators –28% of pay costs

Site staff costs include the time spent on monitoring which may in some cases be carried out by volunteers (e.g. on bird surveys). The pay cost projections are not index linked. In the Full Economic Costs volunteer input has been costed as if it were paid for. In this project there are three main types of funding:

- Contributions in kind (defined as services provided without any payment such as free volunteer activity on surveys).

- Self funded contributions (defined as paid for activity, which is paid for from the budget of the organisation which carries out the work – e.g. work by Natural England staff paid for out of a NE budget).
- Sponsored contributions (defined as activity paid for by a body which provides the money but does not carry out the work itself – e.g. work done by CEH but paid for by Defra).

Capital costs already incurred (i.e. equipment purchased) are provided (before year 1) to demonstrate the investment already made by CCW and NE.

3.2 Start Up and Ongoing Costs

Start-up costs gradually reduce over the implementation phase as the sites are established (Table 3.2), though it should be noted that agencies have already invested about £200k in equipment (and an estimated £60-80k of staff time) in setting up the 24 pilot sites. It is proposed that vegetation and soil surveys are introduced in on a rolling programme, from Year 2, with all sites surveyed once by Year 4. Ongoing costs increase as this new monitoring is introduced.

Table 3.2: Profile of Expenditure during the Implementation Phase

| Year | Start up (£) | Ongoing (£) | Total (£) |
|---------|--------------|-------------|-----------|
| 2008/9 | 116,188 | 298,517 | 414,705 |
| 2009/10 | 98,877 | 536,926 | 635,803 |
| 2010/11 | 7,834 | 637,412 | 645,246 |
| 2011/12 | 6,214 | 647,412 | 653,627 |

With a rolling programme of vegetation and soil survey of three and six years respectively the ongoing costs of a 40 site network are relatively stable and fluctuate between approximately £500,000 and £650,000 per annum.

With a 40 site network, start-up costs per site (excluding any costs attributable to the ECBN CCU) are approximately £13,100 per site and are mainly associated with the costs of setting up AWS.

With a 40 site network, ongoing costs average out a approximately £8,250 site, fluctuating between £4154, in years when there are no vegetation or soil surveys, to a maximum of £15,069 if both vegetation and soils surveys take place on a site in a particular year.

3.3 Self-funded Contributions

Self-funded contributions from the national conservation agencies are significant over the four year implementation phase at approximately £1,008,511 (43% of total FEC) and include pay costs and overheads, cost of equipment for sites, including the cost of its installation and maintenance.

3.4 Contributions in Kind

Contributions in kind by volunteers carrying out bird and butterfly monitoring are estimated at about £117,007 (5% of total FEC) representing 45% of the cost of butterfly monitoring and bird monitoring.

One of the most valuable contributions in kind would come in the form of ECN data and shared resources that enable the ECBN to operate at a reduced cost. This contribution has not been valued and added to the cost of the ECBN to avoid complicating the figures. This is discussed in the next section.

3.5 Value for Money

3.5.1 Introduction

The economic impact of climate change across the global economy will clearly be extremely large. For example, according to the Stern Review on the Economics of Climate Change, it is estimated that 5-6 degrees C of warming will on average result in a 10% loss in global Gross Domestic Product. On top of this are impacts that are currently difficult to cost in economic terms; costs of species loss being one that is not readily incorporated into GDP. However, in this business case we take a much more focussed view on the potential benefits of the ECBN. There are many policies and monitoring schemes for which ECBN might provide information but we concentrate here on the core value of the ECBN in identifying and explaining the causes of change on designated land of high biodiversity value.

Valuing biodiversity is notoriously difficult and valuing data gathered to understand the causes of biodiversity change is yet more difficult. The UKCIP published an approach to costing climate impacts and adaptation in 2004 (UKCIP, 2004). The approach works best for sectors and activities where costs can be valued at market prices; the UKCIP overview report, for example, has four case studies, none of which relate to nature conservation or natural or semi-natural habitats.

Four approaches to assessing the value of ECBN seem helpful:

1. Comparisons with the costs of other relevant environmental monitoring schemes (**Cost Comparison**).
2. The value of information to improve management (**Value for Management**)
3. Avoidance of fines for failure to meet obligations to protect the highest value designated land in the UK (**Avoidance of Fines**)
4. Value for scientific purposes (**Science Value**)

These are now considered in turn.

3.5.2 Cost Comparison

The cost of environmental research in the UK by the public sector (research councils, departments and agencies) in 2006 was about £900M (Dalton, 2006).

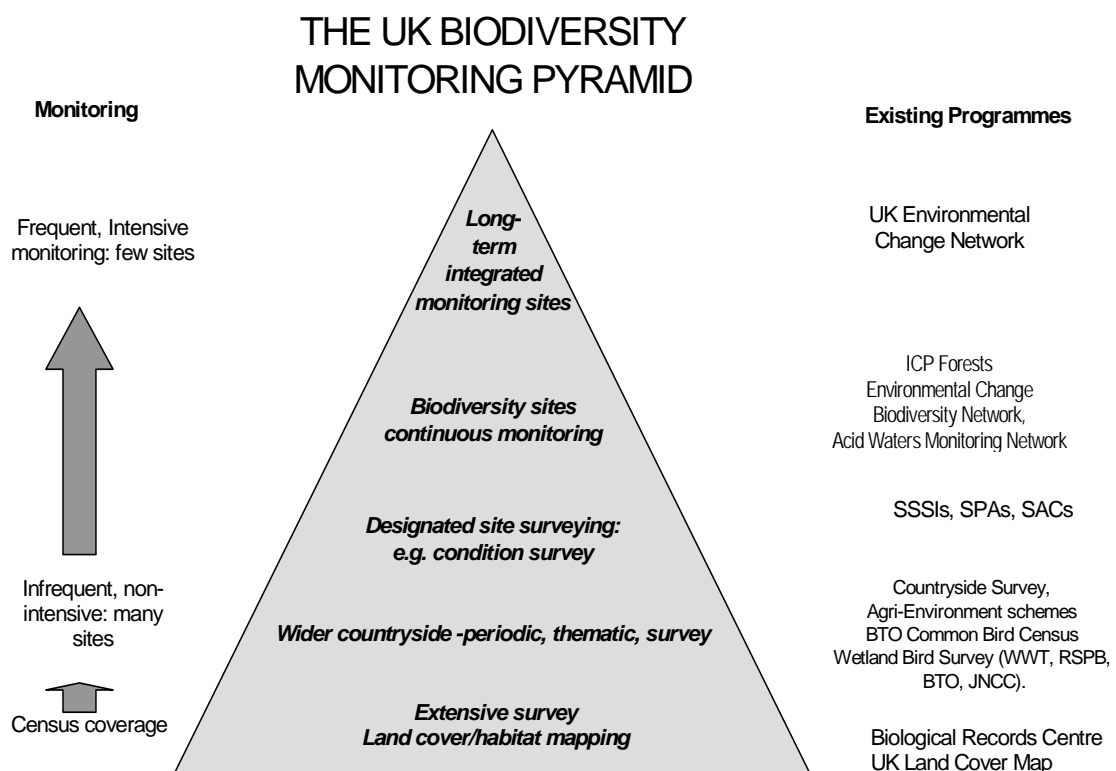
Six key UK biodiversity related monitoring activities have been selected for comparison with ECBN. Whilst none of the activities is fully comparable, there is sufficient commonality to assess whether the ongoing cost of ECBN at approx. £600-£650k per annum is of the same order as the cost of similar intensive monitoring

projects (Figure 3.1). This level of intensity of monitoring typically delivers site based multivariate data sets so that variability between sites can be accounted for and which enables analysis and interpretation towards understanding interrelationships/cause effect. This can also be used to interpret signals from other monitoring schemes, which often do not produce a site based multivariate data set.

It also allows comparisons of the cost of ECBN with very intensive monitoring (such as ECN) and extensive monitoring (such as Countryside Survey). Intensive monitoring provides high frequency, multivariate sampling of few sites to give greater precision and interpretative capacity for causes of observed changes, whereas extensive surveys encompass many sites and provide greater coverage, but tend to be less frequent or precise, often being focused on a single or few variables.

The six biodiversity related monitoring activities selected for comparison with ECBN are described in Appendix 3 together with information on their cost.

Figure 3.1: Diagram to illustrate the trade-off between detail and coverage in monitoring programmes (source: courtesy of CEH)



The most intensive monitoring programme is the ECN which cost £2 million per year in 2004/5 for 12 terrestrial and 45 freshwater sites. Within the ECN the terrestrial sites are far more costly to monitor than the freshwater sites. The approximate cost for 12 terrestrial ECN sites is £1.6 million per year which is more than twice the cost of 40 ECBN sites (of about £0.65 million of ongoing cost per year) although the amount of data collected at ECN sites is far greater. Once established, the ECBN will in effect be an extension to the ECN concept. This will help to address a limitation of the ECN in that the sample of sites is relatively small compared to the range of

variation in habitats across the UK and this increase in range is achieved at a much lower cost per site.

The Acid Waters Monitoring Network and the intensively monitored ICP Forests (Level II) sites are probably most comparable with ECBN in terms of the nature and intensity of monitoring. The costs of all three are broadly comparable and on a per site basis the ECBN is the least costly (ECBN £16,250; AWMN £ 18,000; ICP £32,000) with the higher number of sites on the ECBN probably bringing economies of scale.

By comparison extensive monitoring such as Countryside Survey and designated site assessments carried out through Common Standards monitoring cost about one tenth of the cost of ECBN per site, but deal with very large numbers of sites (CS 629 sites and approx. cost per site of £1700; CSM est. 7700 designated sites and av. cost per site of £1900).

Common Standards Monitoring evaluates conditions of SSSIs, SACs & SPAs and costs between £2 and £2.5 million per year with sites being visited approx. once every six years (i.e. £15million to assess all sites). The Countryside Survey cost of about £1.1 million per year is comparable to the annual costs of either ECN or ECBN with a resurvey every eight years (i.e. a survey cost of £8 million). Its coverage of broad habitats is also much wider. The Breeding Birds Survey costs £0.78 million per year, the Acid Waters Monitoring Network £0.4 million per year and the ICP Forests (Level II) £160k per year. None of the activities is fully comparable to ECBN but the annual costs of ECBN are of the same order.

Development of ECBN has sought efficiencies in implementation through choice of data to collect and optimising design. In addition, ECBN gets economies of scale and therefore gains efficiency by making use of methodologies and systems developed for ECN. New methodological or procedural developments will benefit both schemes and potentially others too. The relation between the ECBN and ECN is fundamental in this respect as they will share many of the existing ECN resources via the CCU, including protocols and data management. Thus for ECN, CCU costs are about 20% of total costs whereas for ECBN, CCU costs are about 8% of total costs.

The use of free volunteer resources for activities such as butterfly monitoring also keep the costs of ECBN as low as possible.

To sum up, ECBN costs are in line with those expected for a monitoring scheme of its type and it compares favourably with such schemes. The ECBN annual cost is also similar to those of other major monitoring schemes. ECBN has delivered its objective of being a more economical subset of ECN measurements which can be replicated on a larger number of sites than ECN. In this way it is achieving the value for money objective with a much lower cost per site.

3.5.3 Value for Management

Another approach to considering the value for money of the ECBN is to compare it to what is spent on managing high value biodiversity sites (Table 3.3).

Table 3.3: Costs of Implementing UK Biodiversity Action Plans (BAPs) and the component Habitat and Species Plans

| | Estimated Current Expenditure (£m/year) on UK BAPs* at 2005/6 prices | | |
|------------------|--|----------------------|------------------|
| | Habitat Action Plans* | Species Action Plans | Total (for BAPs) |
| England | 169.5 | 48.4 | 217.9 |
| Scotland | 80.9 | 11.4 | 92.3 |
| Wales | 55.0 | 7.6 | 62.5 |
| Northern Ireland | 12.9 | 2.6 | 15.4 |
| UK | 318.3 | 69.9 | 388.2 |

Source: GHK Consulting (undated)

The ECBN is only relevant to small part of the above total management expenditure on BAPs because it will cover only some BAP habitats and species. Nevertheless, the total sums being spent on BAPs are large in relation to the projected expenditure on ECBN. The annual cost of ECBN is just 0.16% of the total annual spend on BAPs or 0.2% of the total for HAPs. If only a small improvement in delivery of BAPs is achieved as a result of ECBN data it should still be a good return on investment in ECBN. Given that the monitoring is specifically designed to lead to improve conservation management of such sites the return on investment should be good.

The management of the specific designated sites themselves is not the only way in which ECBN can aid management of high value biodiversity. If ECBN leads to better understanding of the causality of changes at the sites it may be possible to better manage the pressures which are leading to those changes. For example if air pollution is a pressure leading to damage, the EA through its Integrated Pollution, Prevention and Control permits and other consents may be able control pressures.

Management of Sites of Special Scientific Interest to achieve a high proportion in favourable condition is an important PSA target on which Government has to deliver results successfully.

3.5.4 Avoidance of Fines

ECBN sites are high biodiversity value sites and many have multiple designations (Table 3.4). Some designations include statutory duties to monitor of the condition of habitats & species, to prevent their deterioration and to seek their enhancement.

Table 3.4: Statutory Designations of pilot ECBN Sites

| Year 1 ECBN sites | NNR* | SSSI* | Ramsar* | SAC** | SPA** | Biosphere Reserve* | MNR* | National Park | Heritage Coast | AONB |
|-------------------|------|-------|---------|-------|-------|--------------------|------|---------------|----------------|------|
| Wales (13) | 13 | 13 | 3 | 12 | 3 | 1 | 1 | 7 | 3 | 2 |
| England (10) | 10 | 10 | | 6 | 1 | | | 3 | | 1 |
| Scotland (1) | 1 | 1 | | 1 | 1 | | | | | |

*requirement to monitor the condition of habitats & species, to prevent their deterioration and to seek their enhancement

** Natura 2000 site: Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) designated under the Habitats Directive

In principle, if ECBN helps the UK avoid fines for failing to follow international legislation and commitments to manage high nature value designated land in a satisfactory manner– the fines avoided could be considered an output from ECBN.

Working with the statutory conservation agencies, the EA has assessed the likely impact on Natura 2000 sites of the next generation of combustion plants as required under the Habitats Directive. Permits to operate require these regulated industrial sites to include a package of pollution reduction measures to ensure they do not cause adverse effects on these designated sites. Associated bio-monitoring is necessary to demonstrate that the measures adopted are safeguarding biodiversity on Natura 2000 sites and ECBN provides suitable sites for this bio-monitoring. Such bio-monitoring would assess impacts, provide a feedback mechanism capable of demonstrating that the planned outcomes of pollution control are being delivered as intended and act a safeguard mechanism providing evidence to justify further control if necessary. With such assessment, monitoring and evidence of impacts, the mechanisms would be in place to avoid incurring fines from the EU for failure to protect Natura 2000 sites.

3.5.5 Science Value

The scientific value of ECBN outputs must be considered in addition to the management related outputs (e.g. understanding policy or alternative management). Science seeks to establish cause and effect, not just correlations and trends. Hypothesising and testing the causality of phenomena is fundamental to the scientific method. A network, such as ECBN which collects sufficient data to test hypotheses about causality of change has high science value. Research using ECN data is already being used in scientific papers for refereed journals, 324 scientific publications (excluding unpublished reports) of which 170 were refereed journal papers (source: ECN website) and this gives every confidence that ECBN will also be scientifically productive.

No attempt is made here to put a monetary value on the science which ECBN data will help generate but it certainly should be promoted to potential sponsors as a valuable output of ECBN.

4. Options for Funding & Management Arrangements

4.1 Strength of the Existing Partnership

The ECBN partnership comprises organisations involved in developing the ECBN to the stage it has now reached, and who intend to contribute to, and /or remain actively engaged with the ECBN, once implemented (Appendix 4).

Scientific development underpinning the ECBN has been progressed over the past three years through key studies led by CEH and supported through partnership funding (Appendix 4) involving Defra, CCW, NE, SNH, EA, JNCC and NIEHS. Twenty-four ECBN pilot sites have been established by the statutory conservation agencies. Investment in staff costs and equipment for these pilot sites and in studies leading to the current point, together have required funding in excess of £350,000 from members of the partnership and demonstrate its strength over a sustained period.

The project has at its core the support of ECN through shared resources, including sites, data management systems and protocols.

All organisations (and in the case of Defra, several divisions and branches) in the existing partnership are members of the ECBN Steering Group, which comprises potential sponsors and key stakeholders involved with running the ECBN pilot sites and providing advisory roles, particularly in relation to monitoring methods and potential uses. This group was formed in 2005.

4.2 Funding Formula

A funding formula must enable a distribution of costs across sponsors based on a defined logic. It needs to accommodate contributions to central co-ordination, self-funded contributions (where organisations deploy their own resources) and contributions in kind. The formula also needs to take into account sponsors views and the practicalities of organising the funding. A funding formula is proposed (Appendix 5) to assist in discussions and help potential sponsors reach agreements towards implementing the ECBN. The funding formula takes into account:

- Costs which vary depending on the number of sites; and,
- Fixed costs over the implementation phase, such as for the CCU.
- It is based upon funders' current contributions to categories of cost and tries to take account of their ability to pay, but also allows the statutory conservation agencies, as potential funders, to contribute based upon the number of sites in their respective countries. To some extent this model has already been followed as CCW and NE have been funding the set-up and monitoring of sites in their respective countries.

Applying the funding formula to the scheduled implementation of sites provides initial information on the level of funding required for various aspects of the ECBN over the first four years (Appendix 5).

The exact split in the mix of costs by category will change year on year, particularly during the implementation phase.

4.2.1 Pledged Self-funding

It has been assumed that where statutory conservation agencies are currently engaged in activity they will pledge themselves to continue to do so and find the funds. It is important that this Business Case is used to help firm up those commitments with senior managers. These self-funding contributions are expressed in terms of the countries from which they originate (Table 4.1) and amount to just over £1,000,000.

4.2.2 Sponsored Contributions

At this stage, not all categories of cost have been assigned to potential funders and sponsored contributions to fund analytical services, surveys and the ECBN CCU are being sought (Appendix 5).

If statutory conservation agencies are able to make self-funded contributions for the type of costs they have incurred thus far for pilot sites and voluntary contributions are at the levels anticipated, then a further £1.2 million of funds would need to be sought over the next 4 years (Table 4.1).

Table 4.1: Funds sought over the next 4 years (if agencies provide Self-funded Contributions)

| | Self-Funded Contributions (£)** | Contributions in Kind (£)*** | Funds Sought (£)**** | FEC (£)* |
|--------------------------------------|---------------------------------|------------------------------|----------------------|-------------------|
| Wales (pay costs & site set up) | 247,082 | 72,709 | | 319,791 |
| England (pay costs & site set up) | 363,141 | 26,152 | | 389,293 |
| Scotland (pay costs & site set up) | 226,806 | 14,003 | | 240,809 |
| NI (assumed pay costs & site set up) | 171,482 | 4,143 | | 175,625 |
| CCU | | | 568,070 | 568,070 |
| Shared analytical costs | | | 286,592 | 286,592 |
| Shared survey costs | | | 369,200 | 369,200 |
| Total | £1,008,511 | £117,007 | £1,223,862 | £2,349,380 |

* Full Economic cost over the implementation phase (2008-2012)

** Self funded contributions (paid for from the budget of the organisation which carries out the work – e.g. for Wales, pay costs for agency staff & capital items paid for out of a CCW budget)

*** Contributions in kind (services provided without any payment e.g. free volunteer activity on surveys).

**** Funds sought (activity paid for by a body which provides the money but does not carry out the work itself – e.g. work done by CEH but paid for by Defra).

4.2.3 Management Arrangements: Purchasing Strategy

Natural England and CCW have already purchased a significant amount of equipment for existing sites and have collaborated on purchasing and installing these items. This has enabled them to increase the size of orders and, as a result, benefit from discounts resulting in cost savings of approximately 10% on some items. Both NE and CCW see an opportunity to extend this approach across the whole network.

With predicted spending of just under £1 million on goods and services (Appendix 2) in the first four years a saving of just 5% could reduce costs by £50,000 and there is potential for greater cost savings. Additional benefits of a co-ordinated purchasing strategy include common specifications allowing for ease of integration as well as quality management. There is agreement from the ECBN steering group that group purchasing of certain goods and services would be to the benefit of all partners. Both capital items (Automatic Weather Stations, diffusions tubes, equipment for vegetation surveys) and analytical services (for wet deposition, ammonia and soil) lend themselves to group purchasing which can be co-ordinated either by:

- One body leads on purchasing a particular category of goods or services and the group partners buy from that contract, or
- One body leads on all purchasing and the group partners buy from those contracts and contribute to procurement costs.

Other goods and service will require further consideration and investigation to establish whether it is effective to adopt group purchasing, this includes soil & vegetation surveys, installation of AWS, calibration and servicing of AWS (which could include the participation of Forest Research for their forest meteorology AWS network) and outsourced butterfly surveys.

4.3 How to Take the ECBN Forward

The ECBN needs champions who will take it forward. In this respect everyone involved can fulfil that role in a variety of ways. Considerable work has already taken place in promoting the ECBN to key personnel and ensuring the role of ECBN is recognised in organisational strategies and development plans and in seeking funding support from organisations. However, it is now necessary for an organisation to take the lead and press the proposal for ECBN forward by leading negotiations with partners to secure funding pledges and staffing commitments and to communicate that organisations need to make key personnel available to work on the project.

The point must be reached where partners are ready to take the necessary contractual steps so that a single tender contract can be prepared for CEH to make a costed proposal to run the ECBN CCU secure in the knowledge that agreements have been reached to ensure monitoring data will be delivered from sites.

Defra is willing to take up this leading role because:

- It has a UK wide responsibility for the environment,
- It leads on negotiations for most international environmental commitments of the UK,
- It funds some of the other potential partners and needs to draw together pledges from within Defra itself,
- It chairs the ECBN Steering Group and has taken the lead in commissioning and co-ordinating contractual arrangements for preparatory studies.
- It has the clear view that ECBN should happen.

Defra would work with individuals representing other government departments and agencies on the ECBN Steering Group to draw up agreements and contractual arrangements to set ECBN on a more formal basis.

A written understanding of the agreement between parties is required. This would embody and bind the partnership and include aspects such as agreeing the role of the CCU. A memorandum of understanding (MoU) is an agreement between departments or agencies defining the roles and responsibilities of each and funding. Effectively it is a contract – but contracts are not permissible between two parts of the same government. The term "Partnership" is used in writing MoUs and engenders risk sharing, open communications and trust with the common aim of sharing benefits established at the outset.

The commissioning of the ECBN CCU includes the tasks of drafting the tender specifications, obtaining approval to tender, tender preparation by CEH and review of the submitted tender by representatives of the partnership followed by post tender negotiations and formalising the MoU. The tender process would gain the commitment of CEH to provide resources of manpower and facilities for the ECBN CCU and potentially co-funding, in return for agreed sums and commitment from the partnership to participate and deliver data from the network of sites.

Industry funding for bio-monitoring will depend upon MoUs being in place as this will be the mechanism whereby they gain the assurance that partners are committed to

the ECBN in the long term. Industry is seeking a minimum of a five years commitment by partners of the ECBN.

It is anticipated that this whole process of negotiation within the partnership and putting in place contractual arrangements would take about five months with the result that the CCU would not be operational before September of the current (2008/9) financial year at the earliest (Appendix 7).

4.4 Governance

The process of producing the MoU between partners will develop the formality of governance arrangements during the implementation phase. The project involves co-operation and establishing partnerships between many organisations across the UK. It will be essential to ensure that sponsors are adequately represented, and that the project delivers end user requirements.

To realise the benefits of ECBN, the partners consider it essential that very close links are maintained with the core ECN, and that ECBN and ECN do not develop separately. There are many sponsors common to both the ECN and ECBN, who share responsibility for delivering the benefits of both networks. There are mutually beneficial opportunities for ECN and ECBN, for example to identify and establish common research requirements and increase operational efficiency and cost effectiveness. These opportunities and the benefits they would bring are recognised by the Steering Groups of both networks and it is intended that governance arrangements facilitate these opportunities being taken.

The ECBN partners are developing an efficient governance model. In terms of governance, the critical success factors for ECBN during the implementation phase are considered to be:

Accountability – ensuring that there is a single authority that is answerable for operation of/management of the ECBN.

Independence – to safeguard the interests of the ECBN (and to be seen to be doing this)

The partners propose that the ECBN be governed by its own Steering Group, at least, during the critical period of implementation so that it can be closely managed and supported. To ensure close links are maintained with ECN, it is proposed that the ECBN Steering Group reports to the annual ECN SG meeting, so that the ECN SG can provide high level direction to the ECBN SG. There are sponsoring organisations that are likely to fund both ECN and ECBN. This provides the opportunity for some sponsor representatives to sit on both Steering Groups (e.g. Defra, CCW, SNH, NE, potentially NIEHS) and which will facilitate the networks to:

- Identify strategic matters of mutual interest;
- Communicate progress and developments at the strategic level;
- Agree common research priorities and work together to achieve these; Make efficiency savings by providing co-ordinated or joint responses or providing a single representative to meetings / events of mutual interest.

Governance arrangements will be reviewed at the end of the implementation phase, both for effectiveness and lessons learned, and to ensure that an appropriate and effective approach is agreed for the follow-on phase.

The partners intend that CEH provide project management for the ECBN and propose that the ECBN has its own project manager / co-ordinator, who will be accountable to the ECBN Steering Group and assigned to an ECBN CCU that shares staff and resources with the ECN CCU. Data management would be thoroughly integrated with the ECN CCU.

CEH operate to the principles of PRINCE2 project management standards, including a compatible quality assurance programme. This “product-based” approach to project management, developed by Government, is suitable for this project. Particular regard is needed to ensure clear demarcations of responsibility, particularly in allocating project assurance roles, as it is intended that sponsor representatives (CCW, NE, SNH, and CEH) are involved in the delivery to a wider customer base. CEH follows the Joint Code of Practice for Research (JCoP) as defined by Defra, FSA, BBSRC and NERC.

The ECBN has been developed through a partnership approach. The Steering Group for the ECBN was set up in 2005. It will provide the organisational structure to provide advice and source funding, to set the strategic direction for ECBN and oversee its implementation and co-ordination of its scientific development. The Steering Group will provide advice and guidance to ensure the ECBN is designed to meet strategic policy and scientific needs and that it provides value for money. Terms of Reference for the ECBN Steering Group have been produced and agreed with the Steering Group. These are provided in the Project Supporting Document.

4.4.1 Project Assurance

Project assurance includes the need to check whether changes to the external environment affect the validity of ECBN and that its implementation remains consistent with, and continues to be likely to meet the aims and deliver the benefits described in the Business Case.

Project assurance needs to be independent of the Project Manager; therefore the Steering Group may not delegate assurance responsibilities to ECBN co-ordinator. It is recommended that the following aspects of the project be subject to periodic assurance checks by nominated members of the Steering Group. Those assurance functions that could be delivered by CEH management in whole or part are shown brackets:

- Policy, science and business user needs and expectations are being met or managed;
- Monitoring and controlling risks;
- Adherence to the Business Case;
- The right people are being involved (CEH);
- Applicable quality assurance standards and quality control procedures are adhered to for all aspects of delivery (CEH);
- Network still provides a value-for-money solution;

- Continued fit with strategic initiatives;
- Focus on the business need is maintained (CEH);
- The scope of the project is not 'creeping upwards' unnoticed;
- Network development design and methods are fit for purpose scientifically (CEH) and from the users' perspective.

4.4.2 Specialist Scientific Advice

The ECBN needs to communicate its objectives and the benefits it will deliver to the scientific community. It also needs to establish how it will draw on specialist advice with regard to developing outputs, methods and other aspects of its long-term development, how it will put in place project assurance requirements and maintain close links and collaboration with other monitoring, including the ECN.

The ECN model for a Science & Technical Advisory Group (STAG) has been considered for the ECBN during the implementation phase. The partners intend first to hold a "town meeting" early in the implementation phase to communicate to the scientific community the benefits and opportunities presented by ECBN and establish how best to draw on scientific expertise from that community before deciding on the need for a dedicated STAG.

4.5 Risks & Issues

Risk management involves having access to reliable, up to date information about risks and a framework for risk evaluation and control. Risks associated with the implementation of the ECBN are identified in the current Risk Register (v1.3) provided in the Project Support Document, together with management strategies to control them. The main risks concern:

- Lack of firm commitment of funders - many of the major funders still need to obtain high level agreement to take the project forward
- Delays in reaching agreements and implementation, leading to changes in the costs and business plan;
- Lack of long term commitment; funding from industry for bio-monitoring of air pollution seeks evidence of commitment by partners of at least 5 years.
- Impact on ECBN if Northern Ireland does not engage in the Business Planning process or join the ECBN during its implementation phase;
- Differences in opinion about the scientific approach or methods underpinning the ECBN;
- Insufficient overarching (UK level) co-ordination of ECBN during implementation phase;
- Key personnel /organisations no longer available to work on the project, incl. loss of experienced remote sensing staff from CEH;
- NERC limits on staff numbers leading to CEH not having sufficient staff resources available to take on new work;
- Insufficient synergy with other monitoring & related strategic initiatives;
- Implications of costs being incorrect or insufficiently detailed to meet sponsors needs and expectations;

- Failure to meet end user needs due to insufficient research & reporting;
- Outbreaks of animal diseases or extreme weather, which could lead to delays or gaps in reporting.

4.6 Summary of Implementation Plan

It is proposed that monitoring be carried out by a combination of site based staff and trained volunteers and specialist teams/ contractors visiting sites on a periodic basis. Monitoring will be supported by country co-ordinators, from each of the statutory conservation agencies. It is intended that CEH manage the ECBN, collate data, develop analysis procedures and report findings.

Appendix 7 presents a summary of tasks proposed for each financial year of the implementation phase and Appendix 8 lists the associated deliverables. A more detailed account of the implementation plan, including further details of the co-ordination structure, roles and responsibilities, plans for reporting and communication is presented in the Business Development Plan (Section 4).

The anticipated site set up and monitoring costs in the implementation phase are relatively high to allow for growth in the size of the ECBN to 40 sites and allow for baseline monitoring of vegetation and soils surveys on all sites. To manage costs, the support provided by the CCU has been scaled down during the implementation phase. Only basic analysis and reporting will be carried out, concentrating mainly on an annual report. Additional analyses e.g. more sophisticated statistical techniques, tailored outputs for different sponsors, should these be required, would have to be funded separately. There is provision for a final contract report (2012) summarising the achievements in the implementation phase and this will include a review of progress and findings, including comparison of spatial patterns and their interpretation, a five year plan and costed recommendations for continuation of the ECBN.

In Wales, there are plans to make real-time data available for individual NNRs on their websites and use data to provide rapid assessments (e.g. for fire risk). Promotional material will be produced to increase awareness of the ECBN.

In the longer term interpretation of data for individual sites should be possible, and for NNRs, the ECBN should inform and complement Common Standards Monitoring by identifying where climate change or air pollution may be preventing the achievement of "favourable condition".

4.7 Data Access

The ECBN Steering Group is keen to allow open access to the data as far as possible. The data from ECN and proposed ECBN are very similar - with twelve sites in common between the two networks. If CEH are to manage the data from both networks they will need a common data access policy for data from both Networks. The ECN Steering Committee has recently agreed to the development of an automated web data delivery system, which, with approval from all sponsors, and once developed, will allow easier access to data and save on administrative costs. Such a system should remove the need for the CCU to physically administer the licences and extract the data so there would essentially be no handling fees,

including for commercial companies. Users would be shown the conditions of use and click a button if they agree to them. Once they do this they would get a copy of the ECN data licence as well as the requested dataset(s). Organisations would not need a licence for their own data - they would however need a licence for data from other organisations.

4.8 Future Development of the ECBN

Review and analysis of the data collected from the initial network will be required to determine whether the existing sample provides adequate statistical power to detect the trends and relationships over a reasonable timescale. The optimal size, in terms of representation and statistical power, has been calculated at approximately 100 sites (including the 12 existing ECN sites) and the long term objective is to extend the ECBN to an optimal size through a phased implementation, depending on the growth of the partnership and availability of funding.

Coastal Habitats (saltmarshes and sand dunes) have been identified for potential inclusion in the ECBN and it is intended to tailor and develop monitoring methodology specifically for these habitats. They respond sensitively to sea level rise and their careful long term monitoring can allow them to be used as an 'early warning system' that enables the pro-active management of the coastal zone as a whole (Garbutt et al, 2006). They also have a wide geographical spread, providing opportunities to compare similar or equivalent habitats and communities throughout a range of climatic and pollution regimes.

A number of other measurements have been identified, that could be introduced at a later stage depending on technical and methodological developments. Interest was expressed by several consultees in foliar nitrogen concentration (a bio-indicator of N deposition), ozone, atmospheric sulphate & sulphur dioxide and total S deposition, soil mineralisation & nitrification (to understand total N supply available to plants), carabid beetles and other invertebrates. Vertebrate herbivores or their impact and bats were also suggested for inclusion. Many of these are either too costly or the techniques are not yet fully developed. They will be kept under review for future inclusion in the ECBN.

The focus is currently on National Nature Reserves, with sites being selected and managed by the country agencies. However, this does not preclude the addition of sites owned and managed by other organisations after the implementation stage if they meet the criteria for the ECBN and enhance the level of engagement. Such sites would need to be funded with a long-term commitment and their potential contribution to the ECBN assessed in the same way as the main sample.

5. Conclusions

5.1.1 Objective

The objective of ECBN is to establish and maintain a co-ordinated UK wide network of long-term monitoring sites that increases our ability to detect, discriminate, understand and predict the effects of climate change and air pollution on biodiversity.

5.1.2 Benefits

The ECBN will provide increased efficiency and effectiveness for existing and new observation initiatives by providing links for centralised data management and review, standardised methodology ensuring compatible data sets, and by building on experience and methods already developed by the ECN. It will also be built on a scientifically designed network of sites giving coverage of the UK across a range of habitats and environmental gradients offering increased chances of detecting signals and distinguishing effects and causality.

The ECBN will provide an integrated data set, that can be used to attribute causality and for validation and integration of the other biodiversity observations that are undertaken on a wider scale.

The ECBN will provide partners with a coherent shared evidence-base to underpin their work in safeguarding biodiversity in the UK, helping organisations channel resources – to make informed policy and practical management decisions.

The ECBN would inform the development and implementation of climate change adaptation strategies. Practical conservation management measures can then be developed to reduce or accommodate the impacts of climate change and promote conditions for conservation of biodiversity and ecosystem functioning on sites managed for their high biodiversity value and in the wider countryside. Across the UK there are thousands of protected sites in need of this kind of support. It would enhance the evidence base to underpin and develop policy objectives and targets for UK BAP species and habitats, SSSIs and regulation of emissions and inform a wider range of policy and science needs. It would inform conservation management in relation to BAP targets, Common Standards Monitoring and assessment of favourable condition / favourable conservation status.

It will provide access to an integrated data set, for other researchers and scientist to use, that could become especially important in increasing our understanding of ecosystems and living within environmental limits.

It will increase the data set and coverage of the ECN, one use of which is currently for monitoring emissions from power stations, so this use could expand with the new network, offering opportunities for efficient bio-monitoring as required under the under the Habitats Directive.

It will also increase awareness of the effects of climate change and atmospheric pollution, through a communications package, including web based information and data access, summary reports, and opportunities to commission special reports.

5.1.3 Value for Money

ECBN has been designed to minimise costs and exploit economies of scale based on the ECN model, allowing an economical subset of ECN measurements to be replicated on a larger number of sites than ECN. In this way it is achieving the value for money objective with a much lower cost per site.

ECBN costs are in line with those expected for a monitoring scheme of its type and it compares favourably with such schemes. The ongoing costs of ECBN fluctuate between £500,000 and £650,000 per annum and seem reasonable in comparison with those of other biodiversity related monitoring programmes of similar intensity.

The ECBN will benefit from contributions by volunteers to bird and butterfly surveys valued at over £117,000, reducing the overall costs to partners to £2,132,373 during the first 4 years of operation.

The costs of ECBN are modest in comparison to the annual expenditure on UK Biodiversity Action Plans. ECBN is designed to explore the causal relationships driving biodiversity change and this will have great value to the scientific community.

5.1.4 Alternatives

ECBN is the only concept for monitoring of the effects of climate change and air pollution on biodiversity which has been worked up to a proposal which is ready for funders to support. Results in this field always take time to build up into compelling evidence, whatever the precise design of monitoring activity.

Seeking other alternatives will cause delay which will certainly weaken the evidence base for important decisions over the next two decades.

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Appendix 1: How the ECBN Can Help Address Known Issues and Data Gaps in UK Monitoring Identified by ERFF

| Issues and data gaps | How design and implementation plan for ECBN addresses these points |
|---|--|
| <p>Insufficient data on long-term trends in monitoring:</p> <ul style="list-style-type: none"> • impacts of climate change • coastal changes • changes to soil biodiversity • carbon sequestration and carbon budgets | <p>The ECBN is purpose designed to increase our ability to detect, discriminate, understand and predict the effects of climate change on biodiversity for the habitats targeted. Sites with historical records will be included to extend the timescale over which some trends can be assessed. The ECBN will provide underpinning / contextual information for other climate change research (including ECN, UKCIP).</p> <p>Coastal habitats (saltmarshes & sand dunes) are being actively considered for inclusion in the ECBN, with additional measurements to assess the effects of changes in water levels, wave climate and sand movement arising from climate change.</p> <p>PLFA (a biochemical marker for key bacterial and fungal functional groups and microbial biomass), micro-arthropods to be monitored. Sampling methods to be made comparable with the recommendations from the Soil Indicator Consortium and Countryside Survey.</p> <p>Soil organic carbon and bulk density will be monitored, to assess whether the soil is gaining or losing carbon.</p> |
| <p>Trends can be slow to emerge Infrequency of data collection.</p> | <p>Statistical power analysis has been carried out to determine the percentage change detectable for a given sample size over a set time period. Some ecologically realistic differences should be detectable in the proposed Network after 12 years but others will need longer.</p> <p>The monitoring frequency of each set of measurements has been determined from scientific evidence of expected rates of change. In the future when long runs of data are available, policy reporting should be possible at any specified time interval.</p> |
| <p>Uncertainty about cause of change observed. Insufficient capacity for integrated monitoring and analysis.</p> | <p>Network is purpose-designed to identify the causes of change.</p> <p>Co-measurement of variables at each site will maximise the chances of explaining biodiversity trends in the context of climate change and air pollution and is fundamental to the design of the ECBN. Integrated analysis of air pollution, climate change and biodiversity will be carried out by the CEH Central Co-ordination Unit and partners (which also serves the R&D programme of ECN) to gain an improved understanding of ecosystem function. Data will also be made available to other researchers.</p> |
| <p>Integration issues: identifying opportunities to integrate within and between activities and means of achieving this; access to data.</p> | <p>There is already a link between this network and terrestrial ECN. The Business Plan reports on other opportunities to integrate between activities following consultation with co-ordinators of long-term environmental monitoring schemes and has actively engaged potential sponsors & stakeholders. The partners are looking to promote access to data from this Network.</p> |
| <p>Redundancy: Rate of change does not merit the intensity of monitoring stipulated by the driver(s). Quality of data collected (i.e. whether fit for purpose) and whether it is analysed, reported and used.</p> | <p>The frequency of collection necessary for each variable has been scientifically researched and related to Network sample size to achieve an optimum suited to meet the objective of the ECBN in the most cost effective way possible. The ECBN design is determined by scientific requirements not policy or legislative reporting which can be unpredictable in the long-term.</p> <p>The utility of the data to be collected in the ECBN has been thoroughly tested in ECN and planning includes the proposals for reporting and costings for routine central data analysis.</p> |
| <p>Lack of accessible knowledge to establish the most effective means of achieving monitoring objectives and when to stop / change approach.</p> | <p>The ECBN is developed from the findings of previous research and the experience gained from ECN, from which the protocols for data collection, management and analysis are derived. The proposals for the ECBN were drawn up by a range of scientific experts and funders have been fully engaged in this process and with the current Business Plan.</p> |
| <p>Earth observation data remains under-utilised</p> | <p>The ECBN plans to use satellite data to detect various aspects of vegetation phenology.</p> |

Appendix 2: Cost of Implementation of the Environmental Change Biodiversity Network in the Implementation Phase

| Summary 40 Sites | | Costs Incurred (to Nov 2007) | Year 1 | | Year 2 | | Year 3 | | Year 4 | | Total |
|---|--|---------------------------------|----------|----------|---------|-----------|--------|----------|----------|----------|------------|
| | | | Start | Ongoing | Start | Ongoing | Start | Ongoing | Start | Ongoing | |
| %CCU operation number of Sites vegetation and soils | | | 8 | 50 24 | 8 10 | 100 32 | | 15 40 | 15 40 | | |
| Pay Costs | | | | | | | | | | | |
| <i>Central co-ordination costs</i> | | | | 31,080 | | 62,160 | | 62,160 | | 62,160 | 217,560 |
| <i>Central data processing costs (butt, birds, N dep, RS)</i> | | | 10,732 | 3,954 | 753 | 3,954 | 753 | 3,954 | | 3,954 | 28,054 |
| <i>National Agency co-ordination</i> | | | | 78,144 | | 91,168 | | 91,168 | | 91,168 | 351,648 |
| <i>Site staff - (climate, wet dep, amm, site man, N dep)</i> | | | 4,351 | 5,594 | 4,351 | 7,459 | 0 | 9,324 | 0 | 9,324 | 40,404 |
| <i>Site staff - (soil, veg)</i> | | | 0 | 0 | 3,108 | 0 | 4,662 | 0 | 4,662 | 0 | 12,432 |
| <i>Site staff (butterflies and birds)</i> | | | 2,486 | 33,566 | 2,486 | 44,755 | 0 | 55,944 | 0 | 55,944 | 195,182 |
| Overheads (on pay costs) | | | 14,619 | 75,210 | 4,178 | 118,946 | 2,419 | 123,292 | 1,552 | 123,292 | 463,508 |
| Consumables (vegetation and soils) | | | | | | 200 | | 300 | | 300 | 800 |
| Equipment | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| <i>AWS</i> | | 173,414 | 64,000 | 12,000 | 64,000 | 16,000 | 0 | 20,000 | 0 | 20,000 | 196,000 |
| <i>Wet deposition (rain collector)</i> | | 34,126 | 5,600 | 0 | 5,600 | 0 | 0 | 0 | 0 | 0 | 11,200 |
| <i>Other (vegn & RS)</i> | | | 4000 | 0 | 4000 | 0 | 0 | 0 | 0 | 0 | 8,000 |
| Travel & Subsistence Costs | | | | | | | | | | | |
| <i>Surveys - soil</i> | | | | | | 2,500 | | 3,750 | | 3,750 | 10,000 |
| <i>vegetation</i> | | | | | | 12,000 | | 18,000 | | 18,000 | 48,000 |
| <i>CCU T&S</i> | | | | 5000 | | 5000 | | 5000 | | 5000 | 20,000 |
| Sub-contract and consultancy | | | | | | | | | | | |
| <i>Surveys - vegetation</i> | | | | | | 36,560 | | 54,840 | | 54,840 | 146,240 |
| <i>soils</i> | | | | | | 41,040 | | 61,560 | | 61,560 | 164,160 |
| <i>Installation and service of AWS</i> | | | 8,000 | 19,200 | 8,000 | 25,600 | 0 | 32,000 | 0 | 32,000 | 124,800 |
| <i>Analytical facilities (wet dep, ammonia)</i> | | | | 24,768 | | 33,024 | | 41,280 | | 41,280 | 140,352 |
| <i>Analytical facilities (soil)</i> | | | | | | 36,560 | | 54,840 | | 54,840 | 146,240 |
| <i>Statistical analysis</i> | | | | 10,000 | | | | | | 10,000 | 20,000 |
| Other costs | | | | | | | | | | | |
| <i>Planning Permission for AWS</i> | | | 2,400 | | 2,400 | | 0 | | 0 | | 4,800 |
| Total (start-up + ongoing) | | | £116,188 | £298,517 | £98,877 | £536,926 | £7,834 | £637,412 | £6,214 | £647,412 | |
| OVERALL COST BY YEAR | | | | £414,705 | | £635,803 | | £645,246 | | £653,627 | £2,349,380 |

Appendix 3: Description of Selected Comparitors of UK Monitoring/Surveillance

| Name | Frequency | Description | Cost (all assumed to be FEC) |
|---------------------------------------|-----------------------------------|--|---|
| Environmental Change Network (ECN) | From near continual to multi year | 12 terrestrial and 45 freshwater sites provide long term data sets of variables thought to be of environmental importance, to allow integration and analysis of these and identify natural and man induced changes and distinguish between short term fluctuation and long term change. Species and habitat level sampling covering vertebrates (birds, bats, frogs), invertebrates (butterflies, spiders, ground predators, spittle bugs, tipulids), vegetation - mapping and plant quadrat sampling. | £2 million per annum. |
| Countryside Survey (CS) | Approx. 8 year period. | Field survey and mapping of stratified random sample of 1km squares across GB to determine land use change, change in area and distribution of broad habitats, some detailed habitat types (hedgerows, arable field margins and upland heaths), vegetation, soils and aspects of freshwaters. Currently designed to detect status at country level (629 squares in total) . | £1 million to £1.1.million per annum (i.e. c £8m per survey spread over 8 yr period) |
| Common Standards Monitoring (CSM) | Sites assessed on 6 year cycle | 6 year cycle of evaluating condition of features on SSSI/SAC/SPA suite across UK with a standard way of reporting condition but country led means of detecting it. est. 7700 designated sites monitored. Covers all species and habitats listed as designated features on protected sites (SSSIs & SPAs/SACs). | £2 million to £2.5million per annum (i.e. c. £12-15 m for all sites -spread over 6 yr period) |
| Breeding Bird Survey (BBS) | Annual | Assess trends in density and abundance of common and widespread bird species across the UK, wider countryside and urban areas. Delivered mainly by volunteers. Summer transect counts of birds in randomly selected 1km squares, requiring 3 visits. Also collecting data on mammal sightings and signs. In 2006, 3,295 x 1km squares surveyed. | £784,000 per annum |
| Acid Waters Monitoring Network (AWMN) | Monthly | Now 11 lake and 11 stream sites. Routine collection of data on the biota and chemistry of selected stream and lake sites located in parts of the UK susceptible to acidification. | £400,000 approx per annum. |
| ICP Forests – Level II | Annual | There are 20 sites in the 'Level II' network which detects environmental change in UK forests and provides the means of explaining changes in forest growth. Plots established in working forests under normal forest management. Since 2006, there are 5 intensively monitored sites (with which costs of ECBN are compared). Variables sampled at most Level II plots: tree foliar chemistry, soil analysis, increment of trees, tree crown condition, meteorology, atmospheric deposition, air quality, phytopathology, ground vegetation, deadwood, litterfall quantification and chemical analysis, soil solution, soil minerals. | £160,000 per annum for the 5 intensively monitored sites |

Source: For CSM, ECN, BBS & CS 2007, JNCC spreadsheet produced as part of the Proposal for a Terrestrial Biodiversity Surveillance Strategy (Draft version 0.3 12/1/2008). ECN costs from CEH. For AWMN and description of Level II forests, ERFF database of monitoring (www.erff.org.uk/data/) For Level II Forests costs – pers. comm.

Appendix 4: Interests of Participants in the Existing Partnership

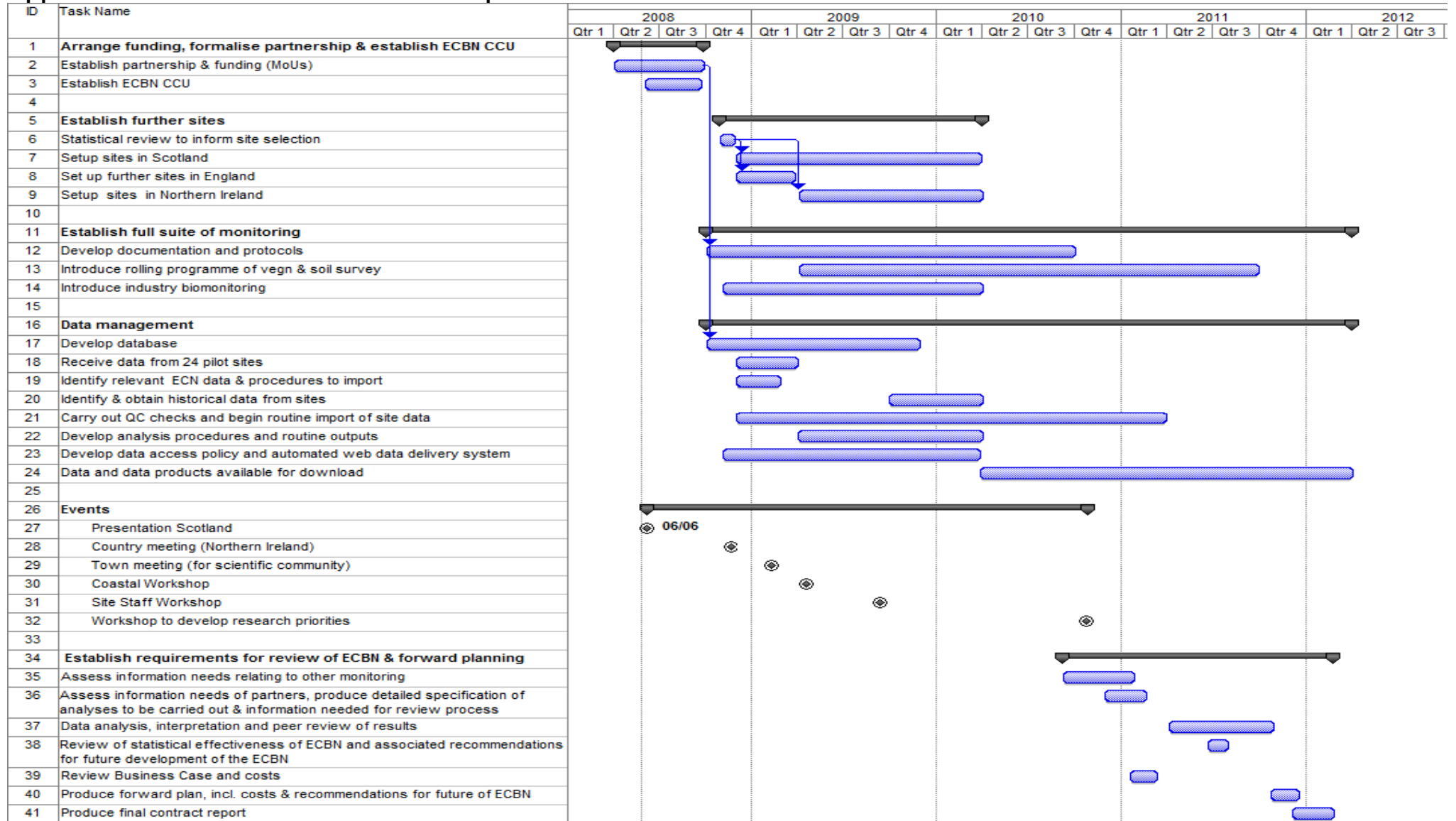
| Participant | Involvement & Interests in ECBN |
|------------------------|---|
| Defra | Principal funder of the design study (CR0322) and Business Development Plan. Various divisions have an interest in the ECBN. Defra NESD are co-ordinating a bid for funding for implementation. |
| CCW | Co-funder of the Business Development Plan. Co-funder of design study (CR0322). Have provided staffing for co-ordination and site set-up on all 13 NNRs they intend to include in the implementation phase. Have invested in equipment for these sites. Have maintained strong links with Natural England to co-ordinate choice of sites and achieve efficiencies in the purchase of goods and services. Seeking further funding for involvement in the implementation phase. |
| NE (English Nature) | Co-funder of the Business Development Plan. EN was co-funder of study on air pollution (CPEA20) and design study (CR0322). Have provided staffing for co-ordination and site set-up for 10 NNRs and seeking further funding to increase the number of NNR sites in English to 15 during the implementation phase and continue their involvement. Have invested in equipment for these sites. Have maintained strong links with CCW to co-ordinate choice of sites and achieve efficiencies in the purchase of goods and services. |
| SNH | Co-funder of the Business Development Plan and active participant in design study. Have set-up 1 site on an NNR and identified further candidate Scottish NNR sites. Are actively assessing these for intended inclusion of further 7 sites in the implementation phase. Have strong interest in using statistical analysis to ensure optimal choice of further sites to achieve good representation across UK. Seeking support and funding to provide co-ordination, equipment and some aspects of monitoring. |
| EHS NI / DoENI | Co-funder of the study on air pollution (CPEA20). EHS NI have expressed tentative support in recent email correspondence. They see the benefits for EHS to become more actively involved, though require time to properly assess the information available and have suggested a presentation or workshop for NI to facilitate participation. Have requested continued involvement in Steering Group. |
| EA | Co-funder of the Business Development Plan and study on air pollution (CPEA20) and active participant in design study. Have indicated willingness in principle to contribute funding pending the outcome of negotiations over inclusion of biomonitoring in permit conditions. |
| NERC (CEH) | CEH was Principal contractor for design project and is partner in the Business Development Plan. Potentially able to co-fund some of the Central Coordination Unit staff time, where aims align with CEH and NERC priorities. |
| JNCC | Advisory role and active participant in design project and Business Development Plan. |
| SG | Engaged through the consultation. Have requested continued involvement through representation on the Steering Group. |
| WAG | Engaged through the consultation. Have requested continued involvement through representation on the Steering Group. |
| SEPA | Active participant in design study. Have indicated willingness in principle to contribute to future developments and consider funding some aspects. |
| FC | Potentially willing to engage with ECBN sites containing woodland. |
| ERFF | Corresponding member of the Steering Group with advisory role on aligning ECBN within the EOF. |

Appendix 5: Suggested Funding Formula (Implementation phase)

| Country | Category of Cost | Full Economic Cost (£) - Total £2,349,380 | | | | Potential Sponsors ¹ | | | | | | | | | |
|------------------|---|---|---------|---------|---------|---------------------------------|------|----|-----|------------------|-----------------|-----|----|------|-------|
| | | Year 1 | Year 2 | Year 3 | Year 4 | DEFRA | NERC | NE | CCW | WAG ³ | EA ² | SNH | SG | SEPA | EHSNI |
| Wales | Capital set-up, maintenance, agency staff pay costs | 60,340 | 62,023 | 62,360 | 62,360 | | | | | | | | | | |
| | Vegetation & soil survey | 0 | 37,497 | 44,996 | 44,996 | | | | | | | | | | |
| | Analytical services | 13,416 | 28,269 | 31,239 | 31,239 | | | | | | | | | | |
| England | Capital set-up, maintenance, agency staff pay costs | 121,110 | 80,418 | 80,806 | 80,806 | | | | | | | | | | |
| | Vegetation & soil survey | 0 | 43,266 | 51,919 | 51,919 | | | | | | | | | | |
| | Analytical services | 10,320 | 32,618 | 36,045 | 36,045 | | | | | | | | | | |
| Scotland | Capital set-up, maintenance, agency staff pay costs | 54,029 | 91,282 | 40,747 | 40,747 | | | | | | | | | | |
| | Vegetation & soil survey | 0 | 11,538 | 27,690 | 27,690 | | | | | | | | | | |
| | Analytical services | 1,032 | 8,698 | 19,224 | 19,224 | | | | | | | | | | |
| Northern Ireland | Capital set-up, maintenance, agency staff pay costs | 16,671 | 62,814 | 45,999 | 45,999 | | | | | | | | | | |
| | Vegetation & soil survey | 0 | 0 | 13,845 | 13,845 | | | | | | | | | | |
| | Analytical services | 0 | 0 | 9,612 | 9,612 | | | | | | | | | | |
| | ECBN Central Co-ordination Unit | 113,397 | 148,764 | 148,764 | 157,145 | | | | | | | | | | |
| | Contributions in Kind (volunteers) | 24,391 | 28,618 | 31,999 | 31,999 | | | | | | | | | | |

1. Potential partners, still to be agreed, are considering the categories of cost in the unshaded boxes.
2. Industry contribution mediated by the Environment Agency.
3. May consider funding specific reporting requirements for Wales.

Appendix 6: Outline Timetable for the Implementation Phase



Appendix 7: Summary of Tasks in Each Financial Year of the Implementation Phase

| Organisational Tasks | Scientific Tasks |
|---|---|
| Year 1 (2008/9) | |
| <ol style="list-style-type: none"> 1. Build high level support & secure funding. 2. Appoint agency coordination staff and arrange contract to establish CCU. 3. Agree roles and responsibilities, particularly in relation to the purchase of goods & services. 4. Set up procurement contracts to put in place co-ordination structure. 5. Produce detailed implementation plan. 6. Develop relations with Northern Ireland. 7. Country based presentations to facilitate engagement. 8. "Town" meeting for scientific community. 8. Extend monitoring on pilot sites to full suite of data collection (except vegn. & soils) 9. Identify and set up 3 additional sites in Scotland and 5 in England & identify 4 sites for NI. 11. Progress report – summary of first six months of operation. | <ol style="list-style-type: none"> 1. Review representation of environmental space by statistical analysis to inform site selection. 2. Refine details of methodology for measurements to be implemented from outset - where necessary; 3. Develop documentation (protocols etc.) for site managers. 4. CCU receives and checks data from 24 pilot sites. 5. Prepare for vegetation and soil monitoring and analysis. 6. Develop protocols for data transfer and start to design new database structures. 7. Development and implementation of QC checks. 8. Real time meteorological data made available for Welsh NNRs. 9. Fire severity index available (Welsh NNR and some English NNRs) 10. Hold workshop and review options for coastal sites. 11. Begin development of automated web data delivery system (in conjunction with ECN) |
| Year 2 (2009/10) | |
| <ol style="list-style-type: none"> 1. Routine monitoring of sites in GB 2. Hold workshop for site staff. 3. Set up 4 sites in NI; 4. Begin soil and vegetation monitoring. 5. Review country reporting requirements. | <ol style="list-style-type: none"> 1. Develop data access policy and procedures. 2. Develop procedures for initial processing of air pollution, remote sensing, butterfly and bird data. 3. Routine importing of site data. 4. Data start to be entered into database; 5. Revise documentation in light of feedback from site managers; 6. Database structures finalised (at least in provisional form). 7. Start to obtain historical data, where available, and import. |
| Year 3 (2010/11) | |
| <ol style="list-style-type: none"> 1. Establishment requirements for review and reporting in 2011/12. 2. Review Business Case and costs. 3. Begin planning for next five years. | <ol style="list-style-type: none"> 1. Assess information needs for other monitoring. 2. Hold workshop to identify research priorities. |
| Year 4 (2011/12) | |
| <ol style="list-style-type: none"> 1. Review of programme establishment. 2. Publication of report on progress, findings and future development, incl. costings; | <ol style="list-style-type: none"> 1. Preliminary analysis of data for spatial trends; 2. Statistical review of network effectiveness and power to detect trends. |

Appendix 8: Key Deliverables in the Implementation Phase

Timings are indicative, but will depend on when the project actually commences and speed of implementation in different countries.

Governance & Promotion:

Memorandum of Understanding for sponsors (outset).
 Procurement Contract(s) for group purchasing (Year 1).
 ECBN presentation – Scotland & Northern Ireland (Year 1)
 Contract to Commission further statistical analysis – BioSS (Year 1)
 Specification of additional reporting requirements (Year 4)
 Review of Memorandum of Agreement and Memorandum of Understanding for sponsors (Year 4).
 Specification of future work required from ECBN CCU (Year 4)

Detailed implementation Plan (at outset – Year 1)

To include:

1. Communication Plan
2. Quality plan
3. Schedule of work
4. Risk register
5. Budget
6. Proposed schedule of meetings, reports & milestones.

The implementation plan should identify specific workstreams / work packages. To provide some structure the main deliverables are listed below under three simplified workstreams, these are:

- WP1. Establish monitoring on sites & develop & refining methods (incl. coastal)
- WP2. Data management
- WP3. Analysis, reporting & development of the Network

WP1. Establishing monitoring on sites & developing & refining methods

Report of statistical analysis from BioSS (Year 1)

Agreed list of further sites to be setup during the implementation phase (Year 1)

For all sites, fuller details of habitats, historical data and previous monitoring (Year 1)

Agreed outputs & reporting format for Industry bio-monitoring (Year 1)

Agreed list of measurements (identifying any that only scheduled to occur on a subset of sites) & associated start date for monitoring for each site (include measures identified in Table 1 of the Business Development Plan) – (Year 1)

Detailed site-based plans for soil & vegetation monitoring (Year 2)

Plan to manage protocol distribution & updates incl.

- List of protocols (handbook of protocols) to be issued from outset (Year 1)
- Agreed list of new protocols required and those requiring development – associated timetable to progress, with proposed issue date(s) - (Year 1)

Raw datasets delivered to CCU - England and Wales (excl. historical data). (Year 2)

Report of coastal workshop, incl. planned next steps (Year 1 or 2)

Report of site staff workshop & revised documentation following feedback from site-staff (Year 2)

WP2. Data management

Specifications for Quality Control

Quality checked raw data (excl. historical data).

Quality checked raw historical data.

Data from ECN terrestrial sites

Specification for database structure

Import routine for site data

Data processing procedures including.

- Routine processing of site data
- Formal agreements and (if necessary) contractual arrangements to implement outsourced specialist data processing.
- Documentation of procedures for specialist processing of air pollution, remote sensing, butterfly and bird data
- Bespoke processes to analyse data to meet reporting specifications

Automated web data delivery system & associated documentation

Data and data products available for download

WP3. Analysis, reporting & development of the Network

Agenda & minutes of Steering Group meetings (ongoing)

Bi-monthly high-light reports (ongoing)

Bio-monitoring report for industry (annual?)

Preliminary report of first 6 months of operation (Year 1)

New website pages for ECBN (Year 1) and subsequent updates (ongoing)

Fire severity index (Year 1)

Real time weather data available on CCW website (Year 1)

Annual report (Years 2 & 3)

Report of information needs from other monitoring to support analyses (Year 3)

Workshop, report & recommendations - to identify research priorities (Year 3)

Specification of content & analyses for review of the implementation phase & forward planning (Year 3)

Specification of any separate additional reporting requirements (e.g. country reporting) – (Year 3)

Specification of further BioSS work to assess statistical effectiveness of Network (Year 4)

Report of results of specified analyses (Year 4).

Final contract report (Year 4)

Report of statistical effectiveness of Network & recommendations for development of the Network (Year 4)

Final contract report (Year 4) - to incl. review of implementation phase, costed five year forward plan, recommendations for the future of ECBN, incl. management arrangements and relationship with ECN

Review & update the ECBN Business Case (Year 4)