The Environmental Change Biodiversity Network Business Development Plan

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

AFBI	Agri-Food & Biosciences Institute
BBSRC	Biotechnology & Biological Sciences Research Council
BioSS	Biomathematics & Statistics Scotland
BRC	Biological Records Centre
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
EA	Environment Agency
ERFF	Environment Research Funders' Forum
FC	Forestry Commission
FR	Forest Research
FSA	Food Standards Agency
JNCC	Joint Nature Conservation Committee
NE	Natural England
NERC	Natural Environment Research Council
NIEHS	Northern Ireland Environment & Heritage Service
SG	Scottish Government
SNH	Scottish Natural Heritage
UKAS	United Kingdom Accreditation Service
WAG	Welsh Assembly Government

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

ADMN	Acid Deposition Monitoring Network
ALTER-Net	A Long-Term Biodiversity Ecosystem & Awareness Research Network
BAP	Biodiversity Action Plan
BBS	Breeding Bird Survey
BICCO-Net	Biological Impacts of Climate Change Observation Network
BMS	Butterfly Monitoring Scheme

CQC	Countryside Quality Counts
CS	Countryside Survey
ECBN	Environmental Change Biodiversity Network
ECN	Environmental Change Network
ICP Forests	International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests
ICP Vegetation	International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops
IPM	Integrated Population Monitoring
MECN	Marine Environmental Change Network
NAMN	National Ammonia Monitoring Network
NBN	National Biodiversity Network
NEGTAP	National Expert Group on Transboundary Air Pollution
NICS	Northern Ireland Countryside Survey
NIWT	National Inventory of Woodland & Trees
NVPO	National Vegetation Phenology Observatory
OPAL	OPen Air Laboratories
SON	Surface Observations Network (Met Office)
UKCIP	UK Climate Impacts Programme

Technical abbreviations/other terms

AWS	Automatic Weather Station
DBH	Diameter at breast height
DGPS	Differential Global Positioning Systems
EU	European Union
GB	Great Britain
GB-MOVE	Empirical species niche model
GIS	Geographical Information Systems
IS	Information Systems
JCoP	Joint Code of Practice
MAGIC	Model for Acidification of Groundwater In Catchments
NDVI	Normalised Difference Vegetation Index
NI	Northern Ireland
PLFA	Phospholipid fatty analysis
PO	Project Officer
PRINCE2	PRojects IN Controlled Environments
QA	Quality Assurance
R&D	Research & Development
SEB	Sediment Erosion Bar
SET	Sediment Erosion Table
UK	United Kingdom

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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 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. 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.

The Business Development Plan builds on prior scientific and technical preparatory work and provides the framework for taking the ECBN 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.

The Business Development Plan will assist sponsoring and collaborating organisations in making decisions about their support for the ECBN and will provide partners with the information they need to progress discussions and help them reach agreements towards implementing the ECBN. It sets out plans for all aspects of implementation, and considers how the ECBN could be further developed in the

longer term. Some elements will require further consideration and negotiation, but it provides sufficient information to proceed to a technical specification for implementation and takes account of immediate and longer-term needs.

The Business Case sets out compelling reasons why the ECBN should be implemented now. ECBN is the only concept for monitoring 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.

Vision for ECBN

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.

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Version Control

Version 1. Presented to Steering Group for comment on 7th March 2008

Version 2. Incorporating Steering Group Comments, further work detailed in a contract variation and edited to a shortened version. Presented to Defra PO on 30 May 2008.

Version 3. Incorporating Steering Group Comments, Final version. Presented to Defra PO on 23 June 2008.

Version 4. Formatted final version. Presented to Defra on 14 July 2008

Producing the Business Development Plan

Rationale for a Business Development Plan

Defra and partners commissioned a 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. The study produced a proposal (Morecroft et al., 2006) for what is now known as the Environmental Change Biodiversity Network (ECBN). It developed and set out basic network design, project management, and estimated costs to create a network of sites across the UK, as an extension of the Environment Change Network (ECN), but on habitats of high biodiversity value, mainly on National Nature Reserves (NNRs).

In considering the next steps and how to implement the ECBN, Defra and partners commissioned ADAS UK Ltd to produce a Business Development Plan to provide a firm foundation for such a complex project and to support bids for funding.

The Business Development Plan

The Business Development Plan sets the framework for the proposed ECBN both in the short and longer-term. It has been produced by ADAS UK Ltd, Team Projects & CEH. The Business Development Plan comprises three parts; one of which, the Business Case, has been produced as a stand-alone report. This is because it is a working document that will require periodic updating and will be circulated to assist in discussions and to help reach agreements towards implementing the ECBN.

Part 1: Implementing the ECBN

Part 2: Development of the ECBN

Part 3: Business Case for the ECBN (separate document)

A separate Project Supporting Document describes the methods and the various tasks undertaken in the project. Most of the information it includes is largely for reference. It has been produced as a separate report to keep the Business Development Plan documents to a reasonable length.

The Business Development Plan sets the framework for implementation and the long-term development of the ECBN. It provides the information needed to produce a specification so that partners can implement the ECBN. It defines the ECBN, its purpose and deliverables; identifies an effective organisational structure; sets out plans for communication, data management, risk management and quality assurance.

The Business Case

The Business Development Plan includes a Business Case, providing participants with a clear statement of the benefits of ECBN, its users and uses, establishes value for money and sets out funding requirements. The Business Case is designed as a standalone document to enable others to use it in bids for funding and it therefore includes information from Parts 1 and 2.

To reduce the duplication of information between the Business Case and other parts of the Business Development Plan there is cross-referencing between the two documents. It should be noted that Section 1 in this document is largely repeated in the Business Case.

Project Supporting Document

The Business Development Plan is accompanied by a Supporting Document, which describes the various tasks, such as the consultation process undertaken to identify the benefits and anticipated uses of ECBN. The Supporting Document also contains some products of planning such as the Risk Register (at the time of publication), Terms of Reference for the ECBN Steering Group, a specification for further statistical work to inform site selection and costs for coastal sites.

Key Tasks

Introduction

The Business Development Plan was produced over a relatively short period (November 2007 to May 2008) and has involved consultation, desk study, email correspondence, telephone calls and meetings. The project provided a secretariat to the Steering Group. The process of producing the Business Development Plan has facilitated communication between potential sponsors, users and other participants. The two key tasks in delivering the Plan were:

Consultation (further detail in Appendix 1 of the Project Supporting Document)

Twenty one organisations and 35 long-term monitoring schemes and associated co-ordination initiatives were consulted by means of a short questionnaire to identify specific planned uses, interests in a range of more general outputs arising from ECBN, potential interest in coastal monitoring and in the inclusion of further measures. Questions also sought to identify any added value that could be gained by co-operation with other monitoring schemes. In many cases, the organisations producing responses to the consultation were also responsible for the monitoring schemes consulted. The consultation demonstrated willingness to support or participate in the project and helped identify potential users and uses of the data that the ECBN could generate. The consultation process has been key to identifying the science to policy benefits of the ECBN. There was an 80% response rate to the consultation.

Review of Costs

The cost estimates produced by Morecroft et al. in 2006 have been reviewed by CEH and presented in the Business Development Plan in more detail (see Business Case Section 3). Knowledge and experience gained by CCW and NE when setting up pilot sites in England and Wales during 2006/7 has led to improved information on capital costs, agency and site staff time and costs of analytical services. Central co-ordination costs and salary costs have been reviewed and updated. In addition, costs for coastal habitats have been produced.

Part 1: Implementing the ECBN

Part 1 of the Business Development Plan presents the rationale for ECBN, describes the proposed approach. Results of consultation and other work to establish the relationship with other long-term environmental monitoring projects and co-ordination initiatives are presented. Plans for implementation are then provided taking account of the current status of the ECBN following pilot work. The co-ordination structure, plans for communication and reporting requirements are presented.

1. Rationale and Description of the proposed ECBN

The UK's climate is changing, and it is very likely that the change in temperature in recent decades is 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, 2007). 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).

The proposed ECBN includes a range of habitats on high biodiversity value sites, mainly on National Nature Reserves, across the UK and would operate as an extension of the ECN. The 12 existing ECN (www.ecn.ac.uk) terrestrial sites would form an essential core to ECBN. The ECBN would include these and at least a further 40 sites on semi-natural ecosystems, to form a purpose designed monitoring network for detecting and distinguishing ecological responses to atmospheric pollution and climate change.

The habitats identified as being highest priority for inclusion were: acid grasslands, dwarf shrub heath, broad-leaved mixed & yew woodland, calcareous grassland, bogs, montane habitats and coastal habitats (sand dunes and saltmarsh).

A relatively long run of data needs to be obtained before the proposed ECBN 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 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 network of sites across the UK is required to enable comparisons to be made for a particular habitat across the widest range of contrasting geographic regions, climatic zones and prevailing levels of atmospheric pollution.

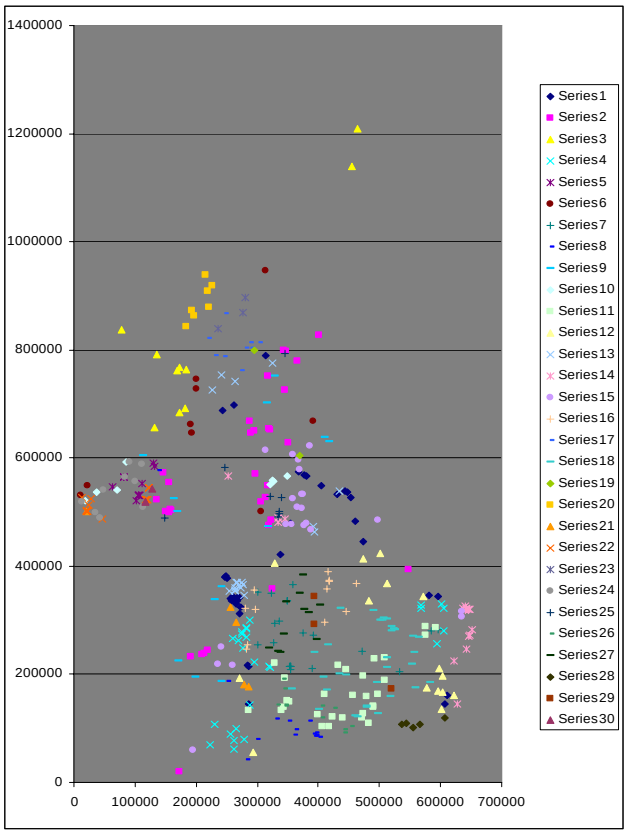
The larger the site network, the greater the chances of detecting small differences and over shorter periods of time. To strike a balance between the chance of detecting change and costs incurred in running an unnecessarily large network, statistical power analysis (using existing data from a number of initiatives) was used to estimate the number of sites needed to be able to identify differing trends between different groups of sites within a realistic timeframe. This is only one example of a possible analysis which might be carried out, but it is tractable for a power analysis and provides a guide for decision making.

A clustering exercise (Morecroft et al, 2006), using nitrogen and sulphur deposition estimates, meteorological baseline data and climate change scenarios was used to group a “long-list” of about 880 potential sites and define the 'environmental space' that could be represented (Figure 1 and Appendix 4, Project Supporting Document).

Power analysis suggested the best option would be to establish a network of around 100 sites. Statistically this represents a sample size, with a high probability of detecting biologically meaningful differences in trends in a range of variables for vegetation, birds and butterflies between contrasting groups of sites in about 12 years. Since the number of sites imposes a multiplication factor on costs, the analysis was repeated, accepting a slightly lower probability of detecting biologically meaningful trends, to determine the minimum number of sites that would be needed to detect change within this time frame. Under this second scenario around 40 new sites and the 12 ECN sites would be required.

Phased implementation was considered the best way forward; allowing future review of the required number of sites to be informed by initial experiences and statistical review of findings following implementation. A phased implementation would start with the minimum number of sites (40 sites plus 12 ECN sites), and expand as necessary. This would help keep initial costs down, help guide expansion at a later date and enable the statistical analysis to be repeated using data from the small network, to test to what extent a larger network would provide additional information or statistical confidence.

Figure 1: Clusters of Environmental Space Identified Using the "Long List" of Potential Sites



Co-ordinators from the conservation agencies shortened the "long-list" of sites taking into account practical considerations (e.g. accessibility, staffing etc) to a list of about 100 potential sites that would enable comparisons to be made for a particular habitat across contrasting geographic regions, climatic zones and prevailing levels of atmospheric pollution. These sites were mainly on NNRs. The majority of clusters were represented in the short list, although there were some gaps. There was a reasonable representation of the habitats of interest, again with some gaps.

A key set of variables has been identified for measurement at each site according to standardised protocols drawn mainly from the ECN. These proposed measurements are presented in Appendix 1 together with the rationale for each, the method and frequency of monitoring. These measurements 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 adaption 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 would be supported by country co-ordinators, from the statutory conservation agencies.

Links with existing monitoring networks would 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.

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. Relationships with Other Monitoring & Co-ordination Initiatives

2.1 Relationship with the Environmental Change Network

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. 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 and these are described in section 2.6.1 of the Business Case.

2.1.1 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 could be a particularly effective link between the two.

Strategic initiatives should 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. In this context, a recent ECN / MECN workshop (2008) identified that a key challenge in making sure evidence from long-term research is available, mainly related to the problems of policy makers not appreciating the time-frames and logistics of long-term monitoring. A key tool was identified as being a timeline of environmental policy drivers (i.e. relevant to marine, freshwater and terrestrial ecosystems) to which a list of research and observation requirements could be added. A draft version was developed within the workshop.

2.2 Relationship with Other Long-term Environmental Monitoring Schemes and Related Co-ordination Initiatives

The proposed ECBN is expected to have important links with other extensive biodiversity surveillance or monitoring schemes in the UK because it would provide multivariate, integrated data, which could be used to help to explain the probable causes of changes detected by other monitoring, which may only report on one or a few variables (e.g. butterfly monitoring). In addition, there are potential links with schemes focussed specifically on climate change and air pollution, and with long-term research projects.

A list of 35 such schemes (Appendix 2) was identified from the ERFF list of monitoring schemes (ERFF 2007a). Scheme co-ordinators were consulted about potential links with ECBN by questionnaire (provided in the Project Supporting Document together with further details of the method used). This included eight key schemes that were considered to have potential for sharing resources such as data collation and analysis. In total, 29 replies were received and included in the overall analysis reported below.

2.2.1 Links with Key Monitoring Schemes

The Butterfly Monitoring Scheme (BMS) would have strong links with the ECBN. A large proportion of the proposed sites for the ECBN already have butterfly transects (some to monitor key species on the site) and are included within the BMS. Field data would be collected by a combination of site staff and volunteers, depending on circumstances local to each site. Ideally, all field data would be collected by volunteers but they are often difficult to find. Local BMS co-ordinators can assist with locating volunteers. BMS also has direct existing links with ECN, which could continue with the new ECBN. Butterfly data are sent from ECN sites to the BMS for analysis before forwarding to the CCU. ECBN data could help to explain trends seen in the wider BMS, by relating to vegetation trends. The inclusion of upland sites in ECBN could also usefully fill gaps in the BMS coverage.

The Breeding Bird Survey (BBS) line transect census method would be applied in ECBN and would also be carried out by a combination of site staff and volunteers. Morecroft et al. (2006) noted that trends would be most efficiently analysed by the British Trust for Ornithology (BTO), which runs the BBS. This would need to be done under contract to the BTO. The BTO were collaborators in the original project but unfortunately the BTO response to the consultation was not received at the time of writing and the opportunity needs to be followed up.

The National Ammonia Monitoring Network (NAMN) is also linked to ECN by the incorporation of ECN sites within the network and operation of NAMN equipment by ECN site staff. ECBN sites will need to use passive sampling methods as they do not require a mains power supply. The NAMN also provides atmospheric concentration data to ECN sites for local use. Similar arrangements ECBN and there is potential for co-analysis and interpretation of data. NAMN could potentially provide ECBN with laboratory analysis for ammonia measurements.

Opportunities to link with the Met Office's **UK Surface Observations Network** (SON) are currently limited because their main requirements are for real time weather data. Real time data have only been available intermittently from two ECN sites and are

unlikely to be installed at all ECBN sites, at least initially, because of higher costs. CCW have indicated their intention to provide real time data within the next year. Meteorological data from the complete ECBN would therefore only be of peripheral interest to the UK SON. The Met Office is not actively seeking new weather stations but if one was required in the vicinity of an ECBN site it could provide a suitable location, thus opening the opportunity for reciprocal sharing of local data. Links with the SON should be re-evaluated once the full sample of ECBN sites is fully established and if monitoring of real time weather data becomes a more practicable option in the future.

The International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) uses similar field sampling methods to those proposed for ECBN. Sharing of datasets and expertise might be mutually beneficial. There are currently five intensively monitored Level II sites in the UK (reduced from eleven previously) and these data are merged with the wider European network. Merging Level II data with ECBN would require agreement from respective funders and would also require a dedicated resource to consider procedures and to implement them. Sharing databases is therefore unlikely to reduce costs but consideration could be given to incorporating data from Level II sites into ECBN once ECBN is fully established.

Weather station calibration equipment could be shared with the **Forest Research Meteorology Network** but this would only be feasible if sites are in close proximity. Similarly, if sites were co-located with those of the **Acid Deposition Monitoring Network** it might be possible to share fieldwork resources but there is little or no overlap with the initial sample of sites.

2.2.2 Analysis of Interest in End Uses

An analysis of the responses from monitoring schemes indicating anticipated use for a series of identified outputs of ECBN is provided in Appendix 3. Graphs showing the actual number of responses (‘yes’ ‘possibly’ ‘no’ or ‘don’t know’) for each “end-use” resulting from the consultation are provided in the Project Supporting Document.

Overall, there was a positive response from other monitoring schemes and ECBN was viewed as a potentially valuable addition. The most important potential functions of ECBN for linking to other monitoring schemes were in interpreting and explaining biodiversity trends and the provision of resources (data and field sites) that would open up new opportunities for research and co-analysis with existing monitoring data. Negative views (‘no’ or ‘don’t know’) often simply indicated that a particular issue was not directly relevant to the monitoring scheme in question. However, the point was also made by many that ECBN would be less useful for detecting large-scale trends in biodiversity, air pollution or climate change as these were already the subject of various national schemes. There were relatively few specific ideas put forward on some topics, for example models that could be tested or new data analyses or research projects. This suggests that more time needs to be spent on developing ideas and making more detailed proposals.

2.3 Synergies with Strategic Initiatives

The ECBN proposal 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 whilst a range of relevant strategic initiatives have also been under development. These initiatives will provide direction and frameworks against which the benefits of the ECBN can be ascertained 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. Synergies with strategic initiatives are presented in section 2.6 of the Business Case.

3. Implementation of ECBN

3.1 Outline Implementation Plan

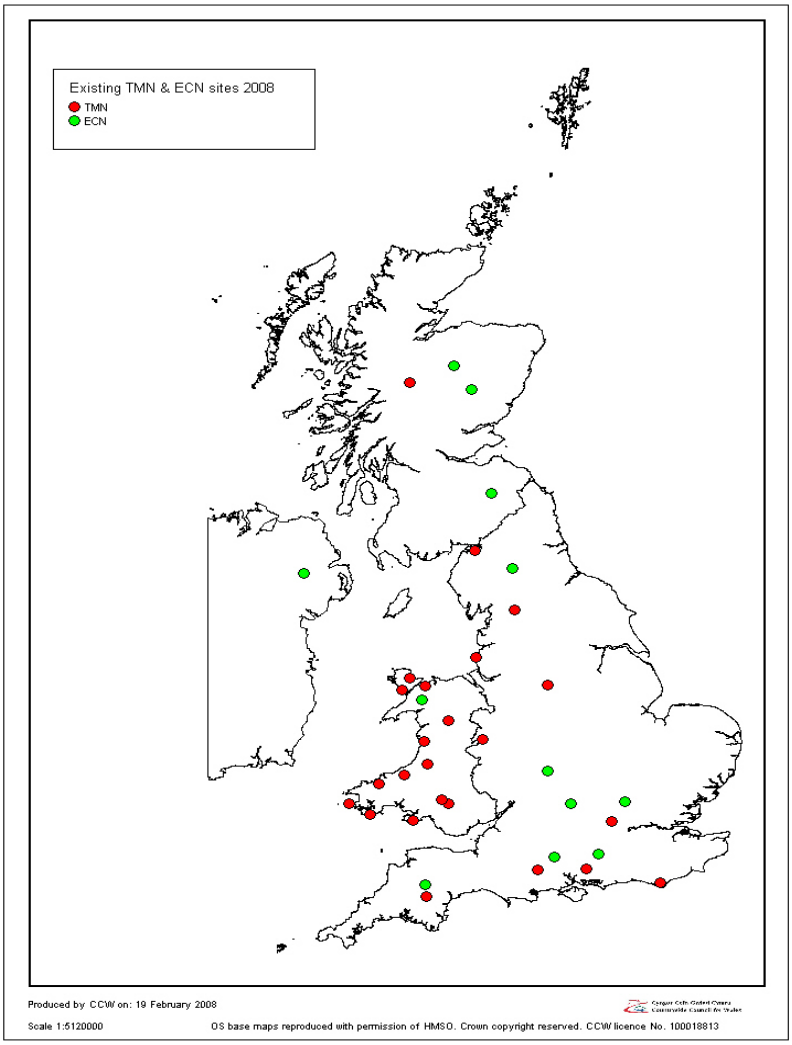
A timetable demonstrating progress with the development of the ECBN is shown in Table 1. Following approval of the Business Development Plan, it is anticipated that the process of negotiation within the ECBN partnership and putting in place contractual arrangements would take about five months during financial year 2008/09, with the result that the ECBN CCU would not be operational before September 2008/9 at the earliest. A Gantt chart outlining the timetable for key tasks in the implementation phase is presented in Appendix 6 of the Business Case.

Table 1: Outline Timetable of ECBN development

Main tasks	**Financial Year**						
	2005/06	2007/08	2008/09	2009/10	2010/11	2011/12	2013 onwards
Proposal & technical specification to develop the ECBN	Completed						
Identify and initial set up of pilot sites	Completed						
Business Development Plan, incl. Business Case		Completed					
Arrange funding, formalise partnership, establish ECBN CCU							
Implementation phase: Establishing further sites and full suite of monitoring, data management and processing.				Further sites			
				Establish full suite of monitoring			
Develop methods for coastal sites, protocols, data analysis and reporting				Data management & processing			
Establish requirements for review of the Implementation phase; carry out review, forward planning. Final contract report.					Review / forward planning.		
Continuation, extension and further development of ECBN, as appropriate							

Over the past two years, the statutory conservation agencies in Great Britain and particularly in England and Wales have been systematically assessing the short list of potential ECBN sites identified by CEH in 2006. National co-ordinators have been appointed in CCW and NE to take forward the ECBN. Through co-ordinated effort they have identified 22 pilot sites which have a range of the targeted habitats and, in most cases, the staffing available to contribute to the monitoring and appear to provide a reasonable spread of the range of environmental space identified in the initial statistical analysis. This is in addition to the two ECBN pilot sites set up through the activities of the ECN. The agencies have deployed automatic weather stations and some other equipment on these pilot sites (Map 1). Most of the pilot sites have ongoing bird and butterfly surveys, carried out by site staff or volunteers. To capitalise on the on the investment already made, particularly by CCW and NE, it is proposed to incorporate these sites in to the ECBN in the implementation phase.

Map 1: Pilot ECBN (formerly TMN) Sites proposed for inclusion at implementation (Year 1)



For the implementation phase, proposed to begin in 2008 and spanning the first four years of activity, it is intended to phase in a total of 40 ECBN sites across the UK, in addition to the 12 existing ECN sites (Table 2) which would contribute data to the

ECBN from the outset. This is the minimum number of sites recommended to provide an acceptable probability of detecting significant change in the aspects of biodiversity measured in the ECBN (as described in section 2).

Table 2: Cumulative Numbers of Sites during the Implementation Phase

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

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

In addition to fully implementing pilot sites, it is proposed to set up a further five sites in England in 2008/09. Discussions are beginning in Scotland for proposals to set up a further seven sites in Scotland during the implementation phase.

Discussions with potential partners in Northern Ireland are still at an early stage and time has been allowed in Year 1 to engage partners and allow time to formalise any potential participation. For planning purposes four sites in Northern Ireland are proposed to be established in 2009, resulting in all 40 proposed ECBN sites being operational by 2010 in a UK wide Network.

3.2 Informing Further Site Selection

3.2.1 Characteristics of the Pilot Sites

All pilot sites are NNRs, but also characterised by a range of other designations (Table 3) with associated national and international legislative and policy commitments and targets. These operate at a variety of spatial and temporal scales and many require monitoring of the condition of habitats and species.

Table 3: Statutory Designations of Year 1 (pilot) ECBN Sites only

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*

Many ECBN pilot sites comprise more than one habitat. The distribution (Table 4) of major habitats for the pilot sites suggests that once established, the 40 site network (plus ECN sites) is likely to have an uneven representation of habitats. Whilst some

habitats or environmental zones might be under-represented initially, the sample will serve to help define the development and expansion of ECBN in the long term.

Table 4: Estimate of occurrence of major habitats on ECBN pilot sites

	Number of sites and habitats present[1]								
	Bog	Dwarf shrub heath	Acid grassland	Calcareous grassland	Neutral grassland	Broadleaved woodland	Coniferous woodland	Fen marsh swamp	Montane
Wales	3	4	4	1	0	4	0	4	0
Eng.	3	5	1	5	5	10	1	0	0
Scot.	1	1	0	0	0	1	2	0	2
Total	**5**	**10**	**5**	**6**	**5**	**15**	**3**	**4**	**2**

[1]Data are provisional pending agreed minimum habitat area; ECN sites included

In addition to those shown, two ECBN sites have coastal habitats, two have bracken, and both improved grassland and arable/horticulture are present in ECN sites. Montane habitats and coniferous woodland are expected to increase with the introduction of more Scottish sites.

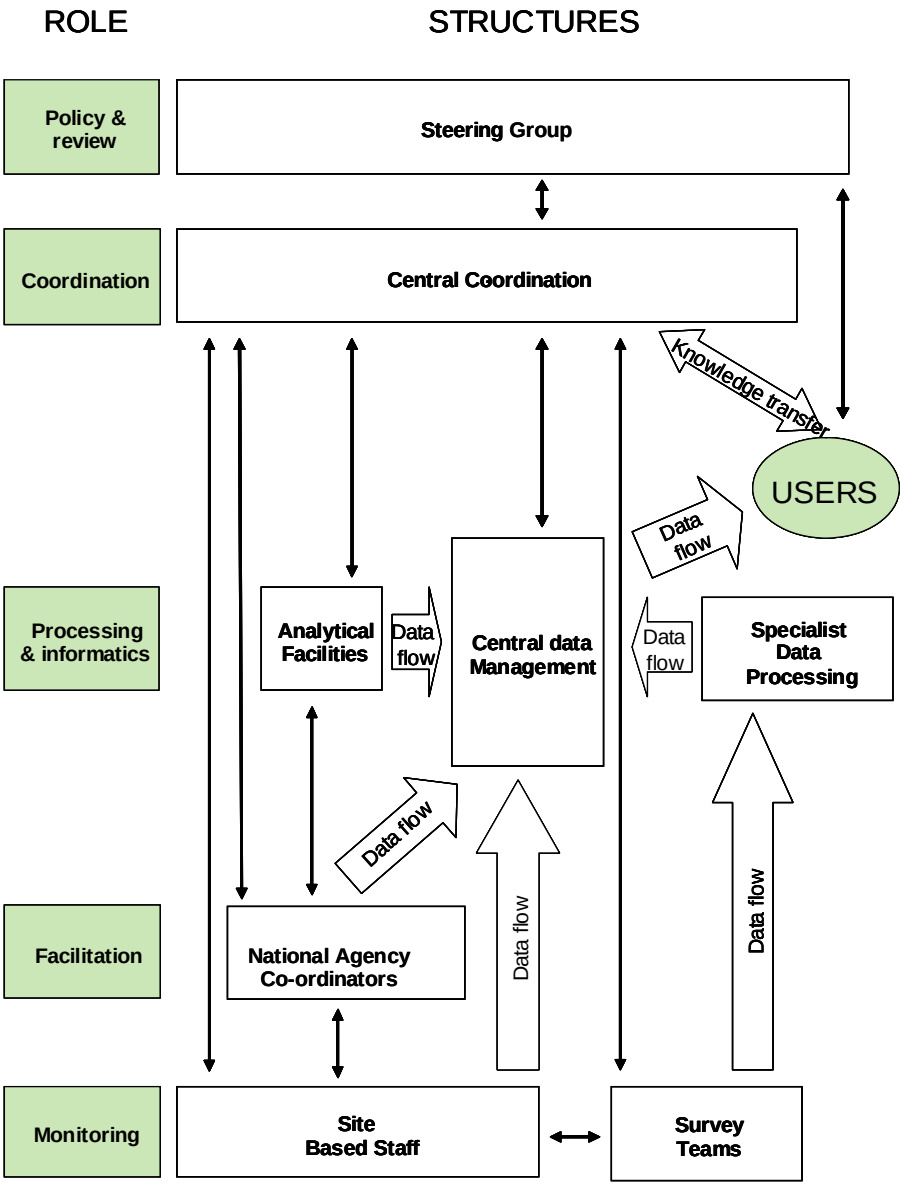
3.2.2 Additional Analysis

Further analysis is required to ensure a good representation of environmental space and habitats of interest from the pilot sites and further candidate sites identified by national agency co-ordinators in each country. This will ensure ECBN uses potential candidate sites to greatest effect (within the practical constraints of site selection) and thus delivers value for money. To progress this requirement BioSS have produced a proposal to provide a statistical analysis and interpretation of the representativeness of candidate sites, which will allow the ECBN Steering Group to make an informed decision on the sites to include in the implementation phase of ECBN. Full details of the requirements of the analysis and the BioSS proposal are provided in Project Supporting Document, Appendix 4).

3.3 Co-ordination Structure

The coordination (Figure 2) of the ECBN is as described by Morecroft (2006).

Figure 2: Co-ordination structure for implementation of the ECBN



The ECBN has been developed through a partnership approach. The Steering Group for the ECBN was set up in 2005 and will provide the organisational structure to co-ordinate the scientific development, funding and implementation and set the strategic direction of the ECBN. The Steering Group will ensure ECBN is scientifically robust, designed to meet strategic policy and scientific needs and that it provides value for money. Steering Group activities include the commissioning of scientific studies, preparatory work, periodic reviews and associated studies and projects.

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, Appendix 3.

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 NNR site staff, trained volunteers and specialist teams /contractors visiting sites on a

periodic basis. Monitoring will be supported by co-ordinators, from the statutory conservation agencies (national agency co-ordinators).

During the implementation phase, national agency co-ordinators will continue to identify sites, assess their suitability and liaise and support site-staff in arranging the set up of equipment and establishment of monitoring (Table 5). National agency co-ordinators will also organise the purchase of most goods and services required by ECBN and ensure data are submitted to the ECBN CCU in the prescribed format.

The site set up (incl. staff time to achieve this) and monitoring costs are relatively high in the implementation phase, requiring further capital outlay for all 40 sites and the initial monitoring of vegetation and soils surveys on these sites. To manage overall costs during implementation, the support provided by the ECBN CCU has been scaled down to a basic but adequate level. Analysis and reporting will be carried out, but concentrating mainly on an annual report (see section 3.8.1) and final contract report (including a review and forward planning). Additional analyses, such as more sophisticated statistical techniques or tailored outputs for different sponsors, would have to be funded separately.

Table 5: Assignment of responsibilities during ECBN implementation phase

Structural Unit & *Role*	Strategic & Operational responsibilities
ECBN Steering Group *Governance*	• responsibility for ECBN implementation • provide direction, set high level objectives • ensure synergy with strategic initiatives • ensure objectives achieved & relevant to science & policy users • source funding & help organise specific events to increase participation • identifying specific requirements of sponsors • monitor & control progress of implementation, manage risks • responsible for any publicity or other dissemination of information about ECBN • continuation of business case • make provision for project assurance • problem referral • evaluate & review ECBN effectiveness
ECBN Central Co-ordination Unit (CCU) *Co-ordination, Processing & Informatics*	• *Central Co-ordination* • project management of implementation phase • provide information for project assurance • co-ordination with ECN • provision & maintenance of quality standards & protocols • analysis & interpretation of data • provide or arrange specialist statistical, scientific, data analysis advice • communication planning and delivery (incl. to SG) • knowledge transfer, reporting & dissemination of results in collaboration with national co-ordinators • establish & maintain effective links with other monitoring • manage scientific development of ECBN • organise & manage survey teams for soil and vegetation & delivery of data • provide training & some QA of fieldwork • provide secretariat to Steering Group

Structural Unit & *Role*	Strategic & Operational responsibilities
	• organise specific events to increase participation, aid communication (e.g. workshop for site-based staff) & help develop techniques (e.g. coastal methods workshop). • *Central data management* • provision & maintenance of IS infrastructure • database development • data QA & input of data to database (following initial checks) • preparation of ECN data for analysis • provision of data analysis systems and procedures • provide & manage web content • provision of systems for receiving field data directly from survey teams, from country co-ordinators or from specialist data processing facilities
National Agency co-ordinators (NE, SNH, CCW, & equivalent for NI) *Facilitation & Regional coordination*	• co-ordination of ECBN implementation at the country level • assessment and proposal of sites for inclusion in ECBN • co-ordination & management of work undertaken by site staff and volunteers at sites • functional management of site staff • problem referral (from site based staff) • assist with communication between site staff & ECBN CCU • assist with data compilation and transfer, incl. historical data • co-ordination of group purchasing of equipment & other goods & services • management of contractual arrangements & central purchasing • advise on site set-up, help establish & mark up plots for survey
Site-Based Staff *Monitoring*	• manage equipment installation • collect samples (precipitation samples, diffusion tubes) and organise transfer to analytical facilities) • downloading of AWS (where no telemetry) • carry out butterfly surveys (selected sites) & initial data input • carry out bird monitoring & initial data input • collation and transfer of data to relevant co-ordinator • collect and collate site management data (to ECBN CCU) • on-site management of contractors (e.g. specialist surveyors, site visits for equipment maintenance / calibration, planners etc.)
Specialist Data Processing *Processing & Informatics*	• collation & processing of butterfly data – Butterfly Conservation (CEH Biological Records Centre) • processing of bird data (BTO) • chemical analysis for atmospheric deposition (CEH Edinburgh wet deposition & ammonia) • remote sensing data, analysis & interpretation
Analytical Facilities *Processing & Informatics*	• analyse soil samples (commercial labs - data & samples to ECBN CCU) • analyse diffusion tubes (commercial labs – processed data to ECBN CCU) • analyse precipitation samples (EA or commercial labs – processed data to ECBN CCU) • data input for above • specialist statistical advice to assist in site selection
Survey Teams *Monitoring*	• butterfly monitoring on selected sites (data to be processed by Butterfly Monitoring Scheme) • soil monitoring (samples to specialist analytical facilities) • vegetation monitoring (data to ECBN CCU) • calibration and checking of site equipment e.g. AWS • epiphytic lichen surveys for nitrogen deposition bio-monitoring

Survey Teams cover any monitoring work that will not be carried out by NNR site staff. This includes monitoring that is planned to be contracted out (e.g. soil monitoring) or may be delivered by volunteers (e.g. some butterfly monitoring). It is anticipated that the calibration and checking of site equipment, such as AWS, is most likely to be carried out by a specialist contractor.

Further consideration is required to determine how vegetation surveys should be delivered. Some national conservation agencies see benefits in monitoring vegetation using their own staff, whilst for others outsourced delivery may be a more viable option due to lack of suitable local resources. Decisions will need to be made at an early stage about resourcing vegetation surveys, possibly with co-ordination across country agencies where outsourced delivery is used.

3.4 Summary of Tasks and Deliverables in the Implementation Phase

Appendix 7 of the Business Case presents a summary of tasks proposed for each financial year of the implementation phase and Appendix 8 lists the associated deliverables.

3.5 Governance and Project Management

Proposals for Governance and Project Management are presented in Section 4.4 of the Business Case and include discussion of the proposed interface with ECN.

3.6 Risks & Issues

The main risks to the successful implementation of the ECBN are summarised in the Business Case in Section 4.5. 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 ECBN are identified in the current Risk Register provided in the Project Support Document, together with management strategies to control them.

3.7 Quality Assurance

CEH does not currently follow the quality and environmental management systems detailed in ISO9001:2000 and ISO14001:1996 but does operate a rigorous internal quality assurance programme based on PRINCE 2 standards and follows the Joint Code of Practice for Research (JCoP) as defined by Defra, FSA, BBSRC and NERC.

In 2004, the ECN work at CEH was audited by the UK Accreditation Service (UKAS) as part of a Defra baseline assessment to assess compliance with the JCoP. It looked at all aspects of research including training, project planning, management, review processes, documentation, facilities and laboratories, data management, protocols and "traceability" (i.e. audit trails) of research carried out. The UKAS report found no significant deviations from the JCoP. The report also concluded that "Data quality, management and control was of an exceptionally high standard".

The main elements of the QA procedures maintained by ECN and which are applicable and should be employed with the ECBN are:

(i) The use of standard data collection and data transfer protocols;

(ii) The operation of data and information and management procedures including data quality issues; and,

(iii) The maintenance of communication and review procedures to ensure that standards and procedures are applied and reviewed appropriately.

3.8 Communication and Dissemination of Results

A Communication Plan for ECBN was produced by CEH and partners for the technical specification (Morecroft, et al., 2006) and sets out the strategy for communication for ECBN during its implementation phase and beyond. The key aspects of the Communication Plan are described in this section and the reporting aspects updated for the implementation phase.

A communication plan is not intended as a static document and it will require updating when ECBN is implemented and should be periodically reviewed. The aims of communication are summarised by CEH as:

- Ensuring key individuals are well-informed, so that implementation and network operation activities are effective and efficient;
- Raising awareness of the existence and purpose of ECBN;
- Publicising the outputs, such as datasets, publications and interpretations of results, and to receive feedback on these;
- Building support for and commitment to ECBN, providing the information necessary to the support of existing partners and attracting further sponsors;
- Making data collected in ECBN available to external users.

Methods of communication planned or anticipated during the implementation phase include country-based **workshops**, a **town meeting** to engage the scientific community, **further workshops** (for site-based staff, to develop the requirements for monitoring coastal habitats and to set research priorities), Steering Group meetings, a **leaflet**, **web-based communication**, submission of metadata or other information to appropriate **information portals** or **initiatives** (e.g. BICCO-Net, ERFF database etc, OPAL for engaging local communities).

3.8.1 Reporting, outputs and Other Communication

Existing reports and papers support the scientific rationale and provide details of the initial scoping stages of ECBN (see section 2).

The ECN website contains a web page explaining the rationale and plans for ECBN.

Suggested outputs from or related to ECBN during the implementation phase (2008-2012) are:

- **An annual report** aimed at building understanding and wider support by demonstrating the successful operation of ECBN, promoting data availability, providing information on the data analysis procedures and policies being developed and reporting progress with data collection, collation and planned use.
- A **final contract report** (2011/12) based on a **review of progress** and findings during the implementation phase and **forward planning**. It should include the rationale and requirements for continuation and further development of ECBN and

costed recommendations for the continuation and proposed development of ECBN; reporting on spatial patterns in physical and biological data.

- Occasional additional material (e.g. on the ECN website), to aid in building support for and awareness of ECBN;
- Promotion of the availability of **summary** and **raw datasets** from ECBN, and possibly one or more presentations (e.g. in web-form) of interpreted results, such as indicators that utilise the data;
- Real-time weather data will be made available by CCW during the first year of the implementation phase. CCW are also working with the Met. Office and NE to use information from water content reflectometers attached to AWS on some ECBN sites to produce a fire severity index to indicate the likelihood of fire on NNRs, which will mean that they can be closed during times of high risk.

Country based analysis & interpretation of data including tailored outputs for country agencies can be produced but are not costed into the work of the CCU during the implementation phase and would need to be commissioned separately.

In the longer term interpretation of data for individual sites should be possible, and for NNRs, ECBN should inform and complement Common Standards Monitoring (Williams, 2006) by identifying where climate change or air pollution may be preventing the achievement of “favourable condition”.

3.8.2 Audiences

The Communication Plan lists the anticipated audiences and assigns a priority to each audience group. The primary audiences are:

- People involved in the operation of ECBN;
- Key people involved in the existing ECN network;
- Researchers in relevant disciplines;
- Government and other policy users; and,
- People responsible for other long-term ecosystem research monitoring and its co-ordination.

Different forms of communication will be appropriate for each audience. The Communication Plan indicates suitable methods of communication (e-mail, letter, web page, etc.) for each situation.

3.8.3 Dissemination & Promotion of Scientific Aspects

The collection of scientific data in ECBN will require a significant resource so it is important that equal priority is given to scientific analysis of the data and dissemination of the results to ensure the scientific value is fully exploited. Data will have some scientific value in the early years even although informative trends will not be apparent until ECBN has been running for several years. Therefore, it would be beneficial to compile a plan during the early stages of the programme for promotion of the scientific aspects.

The consultation showed that high priority was given to using ECBN data for research (see section 3.2.2). This indicates a requirement for expert workshops to identify priority questions and mechanisms for addressing them, using both ECBN data and data from other projects or monitoring schemes. A 'town meeting' (meeting for the wider community of interested researchers) has been proposed early in the implementation phase for this purpose. This would have the benefit of publicising ECBN and informing a programme of research priorities. Regular workshops at approximately three-yearly intervals would maintain the momentum and ensure action points were followed up. Each workshop could address a specific scientific topic and would also aim to identify funding sources for specific projects.

A regular assessment of the scientific information arising from ECBN could also be carried out by holding meetings of ECBN staff at set intervals, to review trends in the data and identify topics for analysis and publication. Even in the initial stages, a description of ECBN together with an analysis of spatial contrasts in the baseline data and a comparison with ECN could merit publication in a scientific paper.

Quality assurance of the data would need to be completed for all sites before general release and data analysis. The ECN database includes a list of scientific publications arising from the programme. This could be done also for ECBN but in addition, electronic archiving of publications may be possible, where copyright allows.

Country agencies will also need to report on individual ECBN sites. Annual reports showing trends at individual sites could be produced automatically and issued to the relevant agencies.

The effect of extreme events, whether anticipated or otherwise, will also be of scientific interest. The capability for flexible, selective and rapid reporting will facilitate this.

3.9 Data Management

3.9.1 Procedures

The ECN information management system, run by the ECN CCU, is well-established and will provide secure and tested mechanisms for data collation, storage, quality assurance and manipulation. The system is described in detail by Rennie (2007) and can adopt the additional ECBN sites with a modest amount of database development to accommodate the ECBN data. The ECN and ECBN data will add value to one another. Development of a new, alternative system specifically for ECBN would be complex and costly. Similarly, if data were stored in separate databases, held independently by country agencies, there would be additional and duplicated costs incurred. An integrated ECN and ECBN system will also be advantageous to users as they would not have to access more than one system.

In ECN, individual site managers send data to the CCU. In ECBN, data from individual sites will be collated initially by the country agencies. This will have the advantage of data only coming into the ECBN CCU from three or four sources and should ensure timely submission of data. In ECN, butterfly data are analysed by the BMS initially and then forwarded to the ECN CCU. Currently, no other data are handled by third parties but a similar arrangement with the BTO to collate BBS data could be advantageous (see section 3.2.1). Third party involvement would have the

advantage of data being received by ECBN CCU from a single, central point. However, adequate quality assurance procedures would be required and data from individual sites would still need to be collated initially by the country agencies.

3.9.2 Data Access

ECN summary statistics of monthly or annual data for individual sites or combinations of sites are available to all users by querying the database via the ECN website. Raw data are also available by means of individual requests via the website, but release of raw data is at the discretion of the individual sponsors linked to each site. Currently, the CCU has authority to issue licences on behalf of sponsors but some require prior sight of all requests. Therefore, each request has to be assessed separately. CEH charge an agreed commercial rate for administering the licences and extracting the data for commercial purposes but do not charge users for *bona fide* research. Data extraction is partly streamlined by routine preparation of packages for which there is greatest demand. Nevertheless, with some 60 requests per annum for raw data, a significant resource is required to administer it.

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 ECN 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 dataset(s) they had requested. Organisations would not need a licence for their own data - they would however need a licence for data from other organisations. Adoption of this system by ECBN would meet the sponsors' requirements for open access in a cost-effective manner whilst also meeting NERC's data access policy requirements.

Open access to ECBN data will be dependent on agreement of all sponsors from whom delegated authority would be needed for NERC to release data on their behalf. This might be achievable for ECBN since sponsors are unlikely to be linked to individual site ownership and are more likely to be primarily government agencies and NERC. Open access could be restricted at individual sites (including some ECN sites) if necessary. With most ECBN sites being nature reserves, confidentiality of data will be less of an issue than with some ECN sites. A record of data requests would still be required, with regular reporting to sponsors, possibly on an annual basis.

All users should be required to report significant applications of the data, including publications. When released, data should be accompanied by a standard set of guidance describing intellectual property rights and the context and limitations of the data. Agreement on conditions for access to raw data should be sought from sponsors at an early stage.

3.9.3 Historical Data

The majority of pilot sites have had some data collected previously using ECBN methodologies (Table 6). Similarly, the provisional lists of sites under consideration by the country agencies for inclusion in ECBN indicate that historical data are available. Most sites already have BMS or BBS data. A substantial amount of other data collected using different methods are also available from many sites. Vegetation data have been collected from many sites but not using ECBN methodology. Site management data will also be available but the nature of data and level of detail is expected to be variable. Soil data of any type have rarely been collected.

Historical data collected using the standard methodologies and in the ECN format can be handled by the ECBN CCU in the same way as the remainder of the data, so extending the time series backwards. Data collected for other methods could be used contextually for specific projects but would not be handled routinely by the ECBN CCU.

Table 6: Number of year 1 sites with historical data comparable to ECBN methodologies.

(Total numbers of pilot sites in parentheses; data exclude ECN sites)

	Climate	Air pollution	Soil	BMS	BBS	Vegetation
Wales (13)	1	1	0	7	4	0
England (10)	6	2	0	10	9	0
Scotland (1)	0	0	0	1	1	0
Total (24)	7	3	0	18	14	0

Part 2: Development of the ECBN

Part 2 of the Business Development Plan deals with aspects of the ECBN that require further consideration and development within the implementation phase and in some cases in the longer-term. The case for monitoring of coastal habitats is made using a previous technical assessment (Garbutt, et al. 2006) and the various measurements proposed are described. Costs of coastal monitoring are set out having been recalculated based on the same categories of costs used for other aspects of monitoring in the ECBN. The role of ECN protocols to the ECBN is demonstrated and those of relevance identified. Additional measurements with potential for inclusion in the ECBN are presented and discussed.

1. Coastal Habitats

In the consultation exercise there was wide support for including coastal habitats from organisations that had an interest in them. Sand dune and saltmarsh were recognised as being of high biodiversity value and vulnerable to loss from climate change and potentially sensitive to air pollution. Coastal habitats are not well covered in existing monitoring schemes and, if included in ECBN, could provide key information on processes and causes of change. This is needed to facilitate prediction of change and adaptive management. Issues specifically identified that could be addressed in ECBN were evidence of links to climate change, C turnover rates in sand dunes and marine versus terrestrial N inputs in driving change in saltmarsh. Data from ECBN could provide important links with existing work on remote sensing of physical changes and with the Marine Climate Change Impacts Partnership and the Water Framework Directive.

Initial recommendations for including coastal sites in ECBN were made by Garbutt et al. (2006), from which the following information is summarised. Coastal sand dunes and coastal saltmarsh were the habitats recommended for inclusion. Both are Priority Habitats under the UK Biodiversity Action Plan (BAP) and protected under the EU Habitats Directive and support numerous BAP Priority Species. They also provide a range of ecosystem services, particularly in the important role of sea defences and, in the case of saltmarsh, trapping of carbon and nutrients. Many coastal dune and saltmarsh sites also have the advantage of being relatively natural with many sites only marginally affected by direct anthropogenic influences such as agriculture or recreation. The hydrological, ecological and physical processes of these habitats are relatively well-studied, so they provide a good opportunity for interpreting the causes of any temporal changes in biodiversity.

Climate change has a direct effect on coastal dunes and saltmarsh, with predicted sea level rises resulting in coastal squeeze and consequent habitat loss. Sea level rise will also change the community composition of saltmarsh, which is controlled largely by the relation between topography and inundation by sea water. In addition, increased storm strength and frequency enhances sand mobility and dune instability and increases erosion of saltmarsh. Many dune species have specialised niches in relation to seasonal variation in the water tables, or timing of life-cycles to avoid summer drought, so that any changes in these factors could impact on them. Climate change could also affect species composition of dunes via altered soil process such as nutrient cycling.

Atmospheric pollution, especially nitrogen deposition, has affected the plant species composition of sand dunes and could reduce the extent of early successional habitats and their associated specialist species. The effects of nitrogen deposition on saltmarsh are less certain, tidal water being the principle source of nutrients. Sulphur deposition is less likely to affect either habitat as both are subjected to high levels of sulphate from sea-salt. However, coastal species might be more sensitive to ozone.

A sample of sites for inclusion in ECBN would need to encompass the variation in these habitats seen across the UK. Variation in sand dunes is primarily attributable to rainfall (west to east), temperature (north to south) and sand carbonate content, which affects soil acidification. Acid sand dunes occur in Norfolk, the Hebrides, eastern Scotland and southern England. Saltmarsh variation is primarily related to temperature (north to south) and sediment particle size (west to east). There are three main types of saltmarsh, being (i) floristically rich saltmarsh on silt/clay in the south and east, (ii) grazed saltmarsh on sandy sediments in western England and Wales and (iii) smaller sites at the heads of sea lochs north of the Solway. Garbutt et al. have identified 24 potential coastal sites, being four each of 'core', 'additional main' and 'secondary' sand dune sites and nine 'core' and three 'additional' saltmarsh sites. These take into account the habitat variation and the need for a high degree of naturalness and knowledge of the site history.

Garbutt et al. made recommendations of measurements at coastal sites. Measurements made in ECN were given a priority rating for their importance to dunes and saltmarsh; the ratings for the subset of measurements to be included in the new network are shown in Table 7. Most are given high priority.

Table 7: Priority rating in coastal dunes and saltmarsh of proposed measurements for ECBN sites (from Garbutt et al. 2006). 3 = highest priority.

Proposed ECBN measurements	Dunes	Saltmarsh
Climate	3	3
Air pollution	3	1
Soil	3	3
Butterflies	2	1
Birds	2	3
Vegetation	3	3
Remote sensing for phenology	3	3
Site management	3	3

Air pollution was considered less important in saltmarsh because of the open nutrient cycle and the strong influence of tidal water, although the authors did recommend that further consultation was needed. Omission of this would, however, reduce substantially the links of coastal sites with the remainder of ECBN. Saltmarshes are relatively unimportant for butterflies, apart from transition communities at the landward margins. ECN measurements given a high priority but not proposed for inclusion in the ECBN were moths in saltmarsh and Carabids in both dunes and saltmarsh.

Recommendations were also made (Table 8) for additional measurements (see Garbutt et al. 2006 for full details). These recommendations are provisional, however, and further consultation and development is required.

Table 8: Proposed additional coastal measurements

Proposed additional coastal measurements	Description
Sand Dunes	Water Levels. Piezometers (dipwells) could be installed to monitor water levels to make the link with vegetation and climate change. Continuous monitoring with a datalogger could be the ideal setup. This could be restricted to one out of three piezometers per site
	Sand Transport. Sand traps to quantify aerial sand transport were also recommended.
Sand Dunes and Saltmarsh	Topography could be measured at the outset using Differential Global Positioning Systems (DGPS). In sand dunes, the focus is on characterising dune slack topography and elevations with respect to water tables. In saltmarsh only, topography could be surveyed at 3-yearly intervals to coincide with the vegetation surveys.
Saltmarsh	Water levels could be monitored using a single tide gauge at each site to assess tidal submergence
	Wave climate could also be monitored using bottom-mounted pressure transmitters to assess the effects of erosion.
	Sediment supply is important in determining the accretion of sediment in saltmarsh, which can moderate the impact of sea level rise. Measurements of sedimentation could be made either using SEBs; sediment erosion bars which measure the depth of sediment over a marker horizon or SETs; sediment erosion tables which take into account subsurface consolidation. Measurements should be made annually.
	Biodiversity monitoring of spiders (which are sensitive indicators of change in their environment) and beach hoppers (Orchestia gammarellus, a major component of saltmarsh invertebrate biomass and important prey items for fish and birds).
	Ozone was also considered to be of high priority but suitable monitoring methods were not identified or costed.

Indicative costings presented by Garbutt et al. have been recalculated based on the same categories of costs used for other aspects of monitoring in the ECBN. These are summarised in Table 9. Annual inflation has not been added to facilitate comparison of costs between years and costs exclude central costs for data analysis.

If remote coastal sites without site-based staff were included in the ECBN there would be additional costs for travelling time, which would be site specific. However, savings could be made if data collection coincided with other routine site visits.

For measuring sedimentation, costings have been calculated assuming the SET method (Table 9). The initial high cost in Year 1 includes the one-off purchase of equipment costing £10,000 shared amongst all twelve saltmarsh sites (and includes

one ‘aluminium head’ per country @ £1,500 each). If the SEB method were used instead, the cost of equipment would be slightly less (at £1,000 per site).

If butterfly monitoring were omitted from saltmarsh sites, the savings would help to offset the annual costs of the additional measurements recommended. However, omission of key biodiversity measures would reduce the integrity of ECBN and is probably not a preferred option.

Table 9: Cost estimates (£) per site of priority additional measurements for coastal dunes and saltmarsh

	Measurement	Year 1	Year 2	Year 3	Year 4
Dunes	Piezometer	3312	656	656	656
	DGPS topography	2656	0	0	0
	Sand movement	5093	3937	3937	3937
Saltmarsh	Tide gauge	3312	656	656	656
	DGPS topography	2656	0	0	238
	Wave climate	4468	656	656	656
	Sediment supply (SET method)*	1818	328	328	328
	Spiders & beach hoppers	1812	656	656	656

**assumes capital costs shared between 12 saltmarsh sites*

Some sites being set up for the main ECBN include coastal habitats. As ECBN develops, coastal habitats could be introduced as an additional priority for targeting, especially if sites also contain other habitats being targeted. Methods and research questions for coastal habitats could be further developed during the implementation phase. It is also recommended that an expert workshop be held to consider monitoring priorities for coastal sites in general, within which the potential role of ECBN would also be considered.

2. Protocols and Protocol Development

ECN uses a system of published, standard protocols (Sykes & Lane, 1996; www.ecn.ac.uk/protocols/index.asp). This ensures comparability of the data across sites and forms part of the quality assurance. This is essential, standard practice for large monitoring and research projects and would be adopted in ECBN. Once established, protocols would be only be amended if there were a significant advantage in taking account of scientific or technological advances whilst also ensuring continuity with existing data. This approach is also being taken by the Marine Monitoring Protocols Co-ordination Group (Marine Assessment Policy Committee, 2007). The adoption of standard protocols developed for other monitoring schemes, for example BBS and BMS, also enables more formal links to be made among schemes, with respect to data handling, analysis and interpretation.

ECN protocols were recently evaluated by ECN site managers as part of the initial development of ECBN (Morecroft et al., 2006). ECN protocols that are relevant to ECBN are shown in Table 10. Some protocols will require modification to take

account of altered sampling designs or monitoring frequency, and differences in the range of variables compared to ECN. A common set of protocols could be established, each clearly stating which methods apply to ECN and ECBN. Alternatively, separate ECN and ECBN manuals could be kept, containing the relevant versions of each protocol.

Table 10: ECN Protocols Relevant to ECBN

	ECN Protocol	Principle Modification Required
LU	Locating And Marking The Sites	-
LU	Land Use And Site Management	-
MA	Meteorology: Automatic Weather Station	Guidance is required on the positioning of AWS equipment within NNRs, particularly when there are several habitat types within the NNR. This is of particular importance for large upland sites.
PC	Precipitation Chemistry	Reduced frequency; reduced number of chemical analyses
S	Soils	Modified sampling design; reduced chemical analyses plus some additions
V	Vegetation	ECN coarse grain only; increased frequency; increased species-level recording with cover estimates
IB	Butterflies	-
BB	Breeding Birds Survey	-

New protocols will also be required for additional measurements not included in ECN. A new protocol has been produced for ground-based phenological records using the UK Phenology ECBN methods (remote sensing of phenology will be done centrally). If coastal habitats are included, it is likely that protocols will be required for the proposed new measurements (see Table 7).

If new measurements are added in the future, for example ozone, for which no suitable monitoring method has yet been identified (Morecroft et al., 2006), then additional protocols will be needed.

3. Additional Measurements

There was support and justification for additional measurements to be made in ECBN. These are presented in their approximate order of priority, taking into account the number of positive responses from the consultation and the specific comments received.

(i) *Ozone* is a potential inhibitor of plant growth and therefore could impact on species composition and productivity. As well as recording ozone directly, consideration could be given to recording ozone damage to plants, although this would require specialist training.

(ii) *Foliar N* measurement would complement measurements of atmospheric N deposition. This would contribute to assessments of the nitrogen status of forestry and if measured in mosses would link with the ICP Vegetation programme on nitrogen accumulation in mosses from atmospheric deposition. Foliar N measurements would also help to interpret eutrophication signals detected in Countryside Survey.

(iii) *Atmospheric sulphur dioxide and total S* measurements in ECBN would be used in applying models of recovery from acidification. Sulphur dioxide measurements would also have some value for making the link between air pollution and for quantifying air pollution risks to forests and from large combustion plants. However, it has also been noted that sulphur dioxide levels are now low and difficult to detect.

(iv) *Carabids* were seen as a valuable general indicator, being important in the food chain and as indicators of vegetation structure and diversity, and being potentially sensitive to regional variation in the environment such as that attributable to climate change. Measurements in ECBN would also provide a useful comparison for schemes already sampling carabids (e.g. some agri-environment schemes) or other invertebrates.

(v) *Vertebrate herbivores* have a major impact on many ecosystems, and deer in particular cause significant damage in forests. The species of herbivore and effect of grazing is largely habitat-dependent however, and habitat-specific protocols might be appropriate. However, assessments of population levels of some species and grazing impacts on some habitats are difficult to make.

(vi) *Other invertebrates* could be measured in ECBN to assess overall biomass. Sampling groups recorded in other schemes, such as butterflies or carabids, could indicate how representative they are of invertebrate biodiversity more generally. Incidence of pest species are also of specific interest to relate to trends forest health.

(vii) *Soil mineralisation and nitrification* measurements would assist with assessing the nitrogen status of forestry. Increasing the time series rather than the spatial extent of sampling would be more beneficial to, for example, Countryside Survey.

(viii) *Bats* were suggested as a useful addition to make the link via invertebrates.

(ix) *Other* measurements suggested for inclusion were soil and surface water chemistry (one reason being to parameterise soil biogeographic models), and soil macrofauna. At woodland sites, measurements as made in the Forestry Commission's forest condition survey could be added, including tree and shrub species composition and cover, and diameter breast height (DBH) measured annually rather than 3-yearly.

4. Long-term Development of 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 estimated at approximately 100 sites (including the 12 existing ECN sites) and the long term objective is to extend ECBN to an optimal size through a phased implementation, depending on the growth of the partnership and availability of funding. It will become easier to assess the added value that further sites will bring, once a few years data are available.

There is likely to be a good case for the development of a service for the automatic, centralised downloading of AWS. This could be developed by the ECBN CCU or subcontractors in the implementation phase but would need to be costed separately. CEH have also indicated their intention to further develop the use of rugged laptops or hand-held computers for electronic data capture in the field.

Archiving of soil samples has been requested by national agency co-ordinators. Only a limited set of analyses is proposed for ECBN and archiving will make it possible to check samples retrospectively to carry out quality control tests. It would also provide the opportunity to carry out any additional laboratory analyses if funding became available. Ideally, biological samples would also be archived, which requires specialist facilities not available at many sites or institutions.

During the implementation phase, the adoption of a relatively small number of sites means that the capability to detect change and relate biodiversity trends to environmental variables will be reduced, although the power analysis suggests there is sufficient probability of detecting change with 40 sites (plus the 12 ECN sites). This analysis was based on historical data, and there may be differences as new data is collected, which could indicate accelerating rate and severity of change. The power analysis will need to be repeated to test this.

Whilst ECBN is intended to be representative of the range of UK climates and pollution regimes, representation of countries or regions within the UK is a possibility depending on the requirements and level of engagement of others but may require a step change in the number of sites per country.

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 ECBN and enhance the level of engagement. Such sites would need to be funded with a long-term commitment and their potential contribution to ECBN assessed in the same way as the main sample.

Part 3: Business Case for the ECBN

(see separate document)

Conclusions

The Business Development Plan provides the framework for taking the ECBN forward. It will assist sponsoring and collaborating organisations in making decisions about their support for the ECBN and will provide partners with the information they need to progress discussions and help them reach agreements towards implementing the ECBN.

The Business Development Plan sets out plans for all aspects of implementation, and considers how the ECBN could be further developed in the longer term. Some elements will require further consideration and negotiation, but it provides sufficient information to proceed to a technical specification for implementation and takes account of both immediate and longer-term needs.

There is a clear scientific and policy rationale for implementing the ECBN and consultation has identified the benefits that ECBN can bring to a wide range of users, representing policy and scientific interests, conservation management, industry and the general public.

Developing the ECBN on the ECN model would deliver an economical approach, being at a much lower cost per site than ECN. The costs of ECBN are comparable with other monitoring of a similar intensity and 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.

The Business Case sets out compelling reasons why the ECBN should be implemented now. ECBN is the only idea for monitoring 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.

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Appendix 1: Description, rationale and summary of monitoring methods

Category	Measurements	Rationale/ Reason for recording	Methodology	Frequency of monitoring			
				Daily/ continuous	weekly	monthly	other
Climate	Total solar radiation; air temperature; relative humidity; wind speed and direction; rainfall; soil water content and temperature.	To detect relationship between biological variables and climate; and to compare contrasting trends at different sites.	Measurements using automatic weather stations (AWS). Data should then be made available over internet. Existing sites should be used where possible (to exploit historic datasets and keep costs down).	X			
Air pollution	Wet deposition of pH nitrate, ammonium & sulphate	Contributes to total N deposition estimate (see below), Acidification drives changes in vegetation, soil processes etc. Sulphate provides background measurements to support regulation of large industrial plant. Ratio of nitrate to ammonium important for some plant species.	Collected using standard precipitation collector and analysed for NO2-, NH4+, SO4- and pH.			X	
	Ammonia concentration	Contributes to total N deposition estimate (see below), Dry deposition of ammonia directly impacts some species.	Ammonia concentrations measured using Alpha samplers or diffusion tubes i.e. passive sampling techniques.			X	
	Total nitrogen deposition	Major cause of change in semi-natural vegetation and threat to conservation of species adapted to low nutrient conditions	Derived from wet deposition of NO2- and NH4+ and estimated dry deposition of NH3, based on concentration measurements and site characteristics, together with interpolated national data for NO2 and nitric acid (NO2 concentration unlikely to be affected by local factors; nitric acid concentration difficult to measure and needs mains power)			X	
Soil	pH, soil organic carbon, total N, base saturation, exchangeable NH4+ and NO3-, PLFA, bulk density, microarthropods, profile description	Necessary in order to understand mechanisms of change and attributing effects to causes, esp. for changes in ecological communities caused by climate change and air pollution.	Follows ECN sampling methodology. 6 blocks with permanent grid set of 16 cells. Rather than 6 permanent blocks in a 1ha block, they should be spread across the site in representative vegetation types and adjacent to vegetation monitoring plots.				Rolling survey 6 yearly
Butterflies	Counts of butterfly species on transect	Mobile organisms with short generation times so good indicators of change. Butterfly Monitoring Scheme (BMS) methodology detects long-term trends, year-to-year variations and effects of extreme events.	Many existing BMS transects are on NNRs and these reserves will be preferentially included within the new network. BMS method is recommended - transect count carried out between April and September in suitable weather conditions.		X		

Category	Measurements	Rationale/ Reason for recording	Methodology	Frequency of monitoring			
				Daily/ continuous	weekly	monthly	other
Birds	Breeding Bird Surveys	Valuable for monitoring ecosystem health; birds make good biomonitors.	Breeding Bird Survey (BBS) line transect census method				2 visits each breeding season
Vegetation composition	Species composition, cover, vegetation height, and where possible, bryophytes and lichens	Species composition is an important aspect of biodiversity and may also determine habitat condition and value to other species. Using Ellenberg numbers allows assessment of composition of plant communities in terms of the prevailing environment such as species nutrient requirements - an effective bioindicator of N deposition.	ECN Coarse grain method (roughly 50 permanently marked 2x2m quadrats on a grid system). Presence/ absence of each species recorded. Species cover and vegetation height (ideally bryophytes, lichens etc to be included). Ellenberg numbers to assess composition in terms of prevailing environment.				Rolling survey 3-yearly
	Tree height and diameter (at woodland sites only)	Indicator of tree health, timber production and carbon sequestration	Where vegetation plots fall in woodland, a 10x10m plot to record tree species, height and DBH of up to 10 trees per plot.				
	Epiphytic lichens (at woodland sites/ sites with trees only)		Inclusion is recommended but technique currently being refined (to be confirmed).				
	Ground-based phenological measurements (subset of sites)	Provides mechanistic link between meteorological variables and biological processes, which have the potential to drive change in communities. Minimal time commitment if staff are site based/ visit regularly.	Noting down first occurrences of certain species.		X		
Satellite remote sensing of phenology	Vegetation phenology	Provides mechanistic link between meteorological variables and biological processes, which have the potential to drive change in communities. Can detect many aspects of vegetation phenology, and enables these aspects to be monitored objectively across the whole network.	Once CEH National Vegetation Phenology Observatory (NVPO) is operational, a GIS based system could be set up to extract cloud-cleared NDVI values. Summary statistics extracted. Can include processing of archive of data.	X			
Site/ land management	Location, timing and intensity of site management activities	Management can obscure climate change and air pollution impacts so need to check that management of sites in network is stable/ consistent.	Using new ECN protocol, record management operations for defined management units and store in database format.				Annual, more freq for intensive agric

Appendix 2: Monitoring Schemes with Potential Links to ECBN

Scheme	Organisation
ALTER-Net	CEH
BAP reporting framework/Biodiversity Action Reporting System (BARS)	JNCC
Biosoil	Forest Research
BRC voluntary recording schemes	CEH
Breeding Bird Survey (BBS) (incorporating Common Birds Census)*	BTO
BTO Integrated Population Monitoring (IPM)	BTO
Butterfly Monitoring Scheme (BMS)*	CEH
Climate Data Support Initiative	Met Office
CLIMOOR/VULCAN climate change experiment	CEH
Common Plants Survey	Plantlife
Common Standards Monitoring	JNCC
Countryside Quality Counts (CQC)	NE
Countryside Survey (CS)	CEH
International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests Level II (ICP Forests)*	FR
International Co-operative Programme Vegetation (ICP Vegetation)	CEH
Inventory of long-term studies on terrestrial habitats (metadata)	JNCC
Long-term agri-environment monitoring England	NE
Long-term agri-environment monitoring Northern Ireland	AFBI
Long-term agri-environment monitoring Scotland	SG
Long-term ecological change in British woodlands	NE
Meteorology Network (Forest Research)*	FR
National Biodiversity Network (NBN)	NBN
National Expert Group on Transboundary Air Pollution (NEGTAP)	CEH
National Inventory of Woodland & Trees (NIWT)	FC
Northern Ireland Countryside Survey (NICS)	NIEHS
Recovery Roof Project – Peaknaze Moor, Peak District	CEH
Rothamsted long-term experiments	Rothamsted Research
Terrestrial Umbrella	CEH
Tir Gofal monitoring Wales	WAG
UK Acid Deposition Monitoring Network (ADMN)*	AEA Technology
UK Climate Impacts Programme (UKCIP)	Oxford University
UK Environmental Change Network (ECN)*	CEH
UK National Ammonia Monitoring Network (NAMN)*	CEH
UK Phenology Network	CEH
UK Surface Observations Networks*	Met Office

**Key schemes*
The Scottish Native Woodland Survey was also subsequently identified as an additional scheme with potential links.

Appendix 3: Analysis of interest in specified End Uses by Monitoring schemes

End Use	Interest shown in End-Use
Explaining Biodiversity Trends in the Context of Climate Change and Air Pollution	This is the principle aim of ECBN and all but one response indicated that this was a likely benefit to other schemes. Information on the separate and interactive effects of climate change and air pollution were considered to be especially important. ECBN was not necessarily seen as providing information in isolation, but as complementing the information arising from other schemes and other research. It could potentially also provide an extension to existing monitoring, where data subsets were similar to those already being collected. However, the utility of ECBN is strongly dependent on a representative sample of sites and there was clear support for further extension of the existing pilot sites, for Scotland and Northern Ireland in particular.
Understanding Ecosystem Processes on Designated Sites	This was seen as a key, important output from ECBN in relation to the majority of schemes. However, some schemes were more concerned with trends and processes at a higher level, and for these ECBN was too finely focussed on a sample of designated sites. For others not specifically concerned with designated sites, this was not considered to be a relevant output.
Reporting on Biodiversity Trends for Particular Habitats	There was a clear need for biodiversity monitoring at the habitat level and ECBN was considered to be important in this for the majority of schemes. However, its main function was seen as providing information on processes and helping to interpret the causes of change. ECBN was considered to be less important for detecting biodiversity trends within habitats because of the limited sample sizes at this level. There are other, more representative schemes in place to do this but results from ECBN would complement these. ECBN would also fill existing gaps in a spatial context (e.g. ECN) and temporal context (e.g. Countryside Survey). Broadleaved, mixed and yew woodland was the habitat relevant to most other schemes (78% of schemes that considered ECBN was likely to contribute to biodiversity reporting). Dwarf shrub heath, bogs, neutral grassland, calcareous grassland, montane habitats and acid grassland were of interest to 57-74% of these schemes. Coastal habitats were only of interest to 39% of the schemes but this reflected the relatively small amount of monitoring activity currently allocated to coastal habitats, and does not necessarily imply they are of low priority per se.
Accessing Source Data for Further Analysis with Other Data from Other Initiatives or for Further Research	This was clearly seen as a potentially important function of ECBN, although there were relatively few specific suggestions as to how the source data might be used. CEH staff use data for the MAGIC-GBMOVE linked model chain. ECBN data could be used to determine population responses, for validation of existing data, for putting more limited datasets in a wider UK context and for addressing specific research questions of interest to particular schemes. Data from other sources (e.g. general climate data) were considered to be adequate for some schemes.
Helping to Interpret Changes Detected in Other Monitoring Schemes	This was seen as one of the most important end use of ECBN for other monitoring schemes, as all responses received to this question were positive. The value of ECBN would be in explaining trends seen in the other schemes, including population and geographical changes. ECN already does this to some extent but its value would be increased by ECBN. This could also apply to schemes outside the UK.
Detecting the Recovery of Soil and Plant Communities (since the decline of acid deposition)	There was less certainty about the capability or need for ECBN to address this more specific issue but the majority of responses were still positive. Recovery of vegetation could be linked to changes in other taxa and put in context with other drivers such as acidification from fertilisers. The sample of sites would, however, need to encompass the range of environmental variation. The inclusion of sulphur deposition measurements would also be necessary for input to some models. The urgency for detecting recovery was questioned as recovery of rapid responders such as epiphytes has already occurred.
Providing Biodiversity Trends of Particular Species (e.g. birds, butterflies)	Opinion was somewhat divided on this issue. There was a fairly widespread view that other, more extensive schemes would provide better, adequate data on overall trends at the species level. There might be some benefit in expanding the number of sites at which certain taxa are monitored under other schemes, for example for butterflies if sufficient upland sites were included. This function was seen as less important than identifying the reasons for species population trends.

End Use	Interest shown in End-Use
Relating Changes in Soil (incl. carbon content) with Changes in Above Ground Biodiversity	This was seen as being potentially important for schemes focussed primarily on vegetation and there might be potential to make additional links with air pollution. Limited above-ground biodiversity monitoring was seen by some as a drawback of ECBN in this context.
Other Uses Identified by Monitoring Schemes	Other specific uses of ECBN to other monitoring schemes were identified by scheme co-ordinators. Some of these repeated the issues outlined above but can be summarised as: Use of ECBN sites or data for new and existing research projects linked to other schemes. This was identified repeatedly as a potential role for ECBN. Some specific examples were given, which included linking remotely sensed phenology with the GB Land Cover Map, validating and extending models of ecosystem change derived from ECN and development of the European Environment Agency's indicators and UK biodiversity indicators. Interpreting the causes of change identified in other schemes and placing their context within a wider network. Sharing resources and information to increase the efficiency of other monitoring, such as that required for designated sites. Other specific issues. Examples were assessing changes in site management in response to climate change, impact of invasive non-native plant species, quality assurance of less frequent monitoring (Countryside Survey), potential for producing UK maps by interpolation, provision of a model for a European monitoring network.