

**CENTRE FOR ECOLOGY AND HYDROLOGY
NATURAL ENVIRONMENT RESEARCH COUNCIL**

**Proposals for CS2000 Follow-up Research:
A Report on Issues and Funding Possibilities**

April, 2001

Roy Haines-Young
CEH Monks Wood



**Centre for
Ecology & Hydrology**

NATURAL ENVIRONMENT RESEARCH COUNCIL

Centre for Ecology and Hydrology
CEH Monks Wood
Abbots Ripton,
Huntingdon, Cambs. UK

Roy.Haines-Young@Nottingham.ac.uk

Tel: **44 (0)1487 772400
Fax: **44 (0)1487 773467

Contents

Summary		2
Part 1:	Introduction	3
Part 2:	Research Proposals	4
<i>Topic Area I:</i>	What factors are contributing to change in stock/turnover of broad habitats and vegetation, and what are the implications of these changes for biodiversity and wider BAP objectives?	5
<i>Topic Area II:</i>	What is the relationship between changes in freshwater quality and changes in habitat structure and condition in the wider landscape?	11
<i>Topic Area III:</i>	How can CS2000 data be used with other information about countryside change to derive indicators of countryside character, quality and environmental capital?	13
<i>Topic Area IV</i>	How, in the future, should changes in stock and quality of habitats be monitored and changes in the condition of the wider countryside assessed and reported?	14
<i>Topic Area V</i>	How are the socio-economic drivers of countryside change reflected in CS2000 data?	16
Appendix 1	Concept Note 1: <i>Countryside Survey 2000 – Finding Out Causes, Understanding Significance (CS2000 Focus)</i>	19
Appendix 2	Concept Note 2: <i>Evaluating the Processes Underlying Changes in Broad Habitats and Vegetation Between 1978 and 1998.</i>	22
Appendix 3	Concept Note 3: <i>Assessing the Changing Capacity of the British Landscape for Biodiversity</i>	25
Appendix 4	Concept Note 4: <i>Annual Variations in Climate and their Affect on Vegetation</i>	28
Appendix 5	Concept Note 5: <i>The Quality of Freshwater Habitats and the Management, Use and Structure of the River Corridor and Adjacent Catchment Land Cover</i>	29
Appendix 6	Concept Note 6: <i>Methods for Assessing the Nutrient Status of Small Watercourses</i>	31
Appendix 7	Concept Note 7: <i>Upland Streams and Land Management</i>	33
Appendix 8	Concept Note 8: <i>New Techniques and Methods for Collecting and Exploiting Countryside Survey Data</i>	35
Appendix 9	Concept Note 9: <i>Integration of Field Survey and Remotely Sensed Satellite Data</i>	38
Appendix 10	Concept Note 10: <i>Farmer Characteristics and Countryside Change</i>	40
Appendix 11	Concept Note 11: <i>Linking Cs2000 and Other National Agricultural Datasets to Understand Patterns of Countryside Change</i>	42
Appendix 12	Concept Note 12: <i>Structural Changes in Land Ownership and Land Management and their Impact on Countryside Quality.</i>	44
References		46

Summary

This document sets key areas for research to follow on from publication of the results of CS2000. Table 1 summarises the broad issues identified as the potential foci for this work and the concept notes that have been developed to address these needs. The concept notes are provided in the Appendix to this document. The issues surrounding them are discussed on the main body of this Report.

Table 1 also indicates those organisations that have expressed an interest in taking the development of these proposals forward. **It is recommended that further consultations are initiated to progress these ideas and develop funding arrangements, although there is some urgency to progress the ideas in Concept Note 1 more urgently.**

Table 1: Summary of Research Topic Areas, Concept Notes and Consortia

Broad Question and Concept Notes	Discussion Groups/ Consortia
<p>I What factors are contributing to change in stock/turnover of broad habitats and vegetation and what are the implications for biodiversity?</p> <p><i>Concept Note 1: Countryside Survey 2000 – Finding Out Causes, Understanding Significance (CS2000 Focus)</i> <i>Concept Note 2: Evaluating the Processes Underlying Changes in Broad Habitats and Vegetation Between 1978 and 1998</i> <i>Concept Note 3: Assessing the Changing Capacity of the British Landscape for Biodiversity</i> <i>Concept Note 4: Annual Variations in Climate and their Affect on Vegetation</i></p>	<p>DETR (Stott) SNH (Mackey) FC (Patterson) EN (Hopkins) CCW (Howe/Burrows) JNCC (Yeo)</p>
<p>II What is the relationship between changes in freshwater quality and changes in habitat structure and condition in the wider landscape?</p> <p><i>Concept Note 5: The Quality of Freshwater Habitats and the Management, Use and Structure of the River Corridor and Adjacent Catchment Land Cover</i> <i>Concept Note 6: Methods for Assessing the Nutrient Status of Small Watercourses</i> <i>Concept Note 7: Upland Streams and Land Management</i></p>	<p>EA (Ferguson/Huggins) DETR (Stott) SNH (Mackey, Boon) FC (Patterson) EN (Hopkins) CCW (Howe/Burrows) JNCC (Yeo)</p>
<p>III How can CS2000 data be used with other information about countryside change to derive indicators of countryside character, quality and environmental capital?</p>	<p>DETR (Stott) FC (Yarnell) EA (Tuckett) EN (Burney) CA (Somper?)</p>
<p>IV How, in the future, should changes in stock and quality of habitats be monitored and changes in the condition of the wider countryside assessed and reported?</p> <p><i>Concept Note 8: New Techniques and Methods for Collecting and Exploiting Countryside Survey Data</i> <i>Concept Note 9: Integration of Field Survey and Remotely Sensed Satellite Data</i></p>	<p>DETR (Stott) FC (Smith) EN (Porter) SNH (Mackey) CCW (Howe/Burrows) JNCC (Yeo)</p>
<p>V How are the socio-economic drivers of countryside change reflected in CS2000 data?</p> <p><i>Concept Note 10: Farmer Characteristics and Countryside Change</i> <i>Concept Note 11: Linking Cs2000 and Other National Agricultural Datasets to Understand Patterns of Countryside Change</i> <i>Concept Note 12: Structural Changes in Land Ownership and Land Management and their Impact on Countryside Quality.</i></p>	<p>LUPG (Lloyd) DETR (Stott) FC (Sangster) EN (Burney) EA (Kinneburgh) SNH (Mackey) JNCC (Yeo)</p>

Part I: Introduction

Background

Following the workshop on the areas of research that should follow publication of the CS2000 Field Survey results in September 2001, CEH identified a series of questions and issues raised by the 'user community'. These questions were taken forward as a framework for consultations which aimed to develop a more complete specification for the kinds of work that were required.

The process of consultation was initiated at the meeting of the Countryside Survey Advisory Group (CSAG) in January 2001 (See CSAG Minutes/8).

The CSAG was asked to:

- Confirm that the questions cover the main areas of interest, recognizing that as the results become widely known a better definition of important research areas will become available.
- Confirm proposals for working up more detailed specifications for each, setting out how the questions could be answered using CS2000 and/or other independent data.
- Suggest what priority should be attached to the projects in terms of whether the work needs to be done in the short or long term.
- Suggest how best to fund the work.

As a result of the discussions, the CSAG agreed that the framework of questions that was set out was a useful way of taking the work forward, and CEH were asked to draw up more detailed papers for the end of February 2001. CEH were also asked to identify a series of working groups involving sponsors who could then discuss matters further.

The paper tabled at the CSAG meeting was circulated within CEH, and concept notes were invited for those areas which people felt had the highest priority in terms of CEH's main interests and which, consequently, CEH could in part support from its own research funds.

This document:

- Brings together the concept notes
- Sets out some of the initial responses by potential sponsors
- Makes further proposals for how funding might be secured in each of the topic areas

Part 2: Research Proposals

In order to retain continuity with previous papers, the framework of questions and their numbering has been retained, although some modifications have been made to take account of suggestions and additional thinking. Table 2 sets out the broad issues as initially presented to the CSAG.

Because of the close linkage between questions about land cover and vegetation it proved difficult to disentangle issues relating to topics 1 and 2. Thus in the revised scheme shown in Table 1 these issues have been merged. The framework of 5 Broad Topic areas is used as the framework for this document.

Table 2: High level issues identified for follow-up work

Topic area initially suggested	Broad Question	Revised Topic Area based on consultations
1	What factors are contributing to change in stock/turnover of broad habitats and what are the implications for UK BAP objectives?	I
2	What are the causes of the vegetation changes reported by CS2000 and what are their implications of for the conservation of biodiversity?	
3	What are the relationships between changes in freshwater quality and changes in habitat structure and condition in the wider landscape?	II
4	How can CS2000 data be used with other information about countryside change to derive indicators of countryside character, quality and environmental capital?	III
5	How, in the future, should changes in stock and quality of habitats be monitored and changes in the condition of the wider countryside assessed and reported?	IV
6	How are the socio-economic drivers of countryside change reflected in CS2000 data?	V

Topic Area I

What factors are contributing to change in stock/turnover of broad habitats and vegetation, and what are the implications of these changes for biodiversity and wider BAP objectives?

Background

As noted above, this topic area now amalgamates the questions about broad habitats and vegetation into a single theme. The questions posed were (initial numbering is shown in parentheses, alongside new system):

- I.1. (1.1) *How has the turnover of area features affected ecological condition, including composition, structure and connectivity of habitats in the landscape? What are the characteristics of habitat patches being lost, gained and restored?*
- I.2. (1.2) *How has the turnover of linear features affected hedgerow condition, including composition, structure and connectivity? What are the characteristics of hedges being lost, gained and restored?*
- I.3. (1.3) *Are the opportunities for the dispersal of native and alien species becoming better or worse in relation to changes in pattern/structure of habitats in different landscapes?*
- I.4. (2.1) *What do the CS2000 Indicators of Biodiversity (IBDs) really tell us about vegetation condition and change?*
- I.5. (2.2) *To what extent is atmospheric nitrogen a cause of increasing fertility in vegetation in different areas and habitats?*
- I.6. (2.3) *To what extent is changing soil acidity a factor leading to vegetation change?*
- I.7. (2.4) *What are the implications of vegetation change recorded by CS2000 for the conservation of biodiversity in the UK?*
- I.8. (2.5) *What implications of long-term quantitative and qualitative changes in habitats and vegetation recorded by CS2000 for other species groups?*
- I.9. (2.6) *To what extent do annual variations in climate affect vegetation and what are the implications of this for (i) the interpretation of existing CS vegetation results; and (ii) forecasting the impacts of climate change scenarios on CS vegetation results?*

Results of Consultations on Topic Area and Proposals

Consultations with DETR, and feedback from EN, SNH, CCW, FC and researchers within CEH, suggests that:

- There is support for short term work to explore the **consequences or implications** of land cover and vegetation change rather than more detailed work on the **causes**. The latter should be considered in the medium to longer term. However, the issue of eutrophication and nitrogen enrichment came out as a key concern of several organisations, which suggested that they would support a short term study which looked critically into both causes *and* consequences.
- Questions should not be restricted to semi-natural Broad Habitats, but consider all Broad Habitats and should attempt to draw out implications at the Priority Habitat and Species level.
- The investigation of causes and consequences should be set in the framework of the *Pressure-State-Response* Model.
- The initial question on the consequences of changing connectivity (1.3) should be moved to topic area 2, where more general questions about biodiversity are being considered. The merger of the land cover and vegetation topic areas now achieves this.
- Questions about IBDs are more about methods and should be moved to Topic area III

Thus it is proposed that:

- **The short-term work aims at tracing the implications or consequences of the land cover and vegetation changes reported in *Accounting for Nature*.**
- **The longer-term study of underlying causes of change be made, together with a further refinement of ideas relating to implications**

In order to take these proposals forward three concept notes have been developed:

Concept Note 1: *Countryside Survey 2000 – Finding Out Causes, Understanding Significance (CS2000 Focus)*:

This proposal (Appendix 1) been designed to explore the questions arising from *Accounting for Nature* by researchers and policy customers that needed to be addressed as a matter of urgency. The work is directed towards meeting short-term requirements. The questions covered relate to the meaningfulness and the relevance of the results posted in the Report. The questions covered are shown in Table 3. The full Concept note is provided in Appendix 1.

It is proposed that the work should extend over a period of one year, beginning in the FY starting April 2001. The resources required are about three person years at HSO level.

Table 3: Short-term issues addressed by project proposed in Concept Note 1 (Appendix 1).

1. What are the likely causes of the decline in semi-improved grassland and why is there high turnover between this and other grassland types? Is this significant for biodiversity? How abnormal is this for grazed systems?
2. What was the amount and character, in terms of broad habitat, parcel size and location, of land that was newly cultivated in 1998?
3. What are the possible causes of more overgrown streamsides? What are the implications for other species and neighbouring systems?
4. Where are the increases in fen, marsh & swamp and what are the botanical characteristics of these areas?
5. What are the possible causes of decline in acid grasslands? What are its implications for biodiversity and is the change reversible?
6. What are the environmental and management circumstances under which bracken invades acid grassland, heath and bog habitats? Is the expansion likely to continue and what are the implications for agriculture?
7. What are the possible causes for decline in dwarf shrub heath habitats? Are there variations between environmental zones and why?
8. What are the characteristics and locations of the hedges that are being gained as opposed to those that are being lost?
9. What is the relationship between plant diversity in 10m and 30m plots, hedgerow characteristics and adjacent land use?
10. What evidence is there from the bird survey of the value of different types of hedges for birds and, by comparison with previous survey, of changes in the habitat condition (for birds) of hedges?
11. What evidence is there that length of hedges declined between 1990 and 1993 and increased between 1993 and 1998?
12. What and where are the new ponds? How do the 1996 figures relate?
13. How have agri-environment schemes contributed to recent changes in the countryside?
14. Why are there differences in estimates of woodland cover obtained from FC surveys and those of CS2000 field survey estimates and land cover mapping?
15. Where and how are the changes in woodland taking place?
16. How is an improvement in the status of freshwater habitats related to management or use of river corridors?
17. Under what circumstances are habitats being created on parcels of previously developed land ?
18. Does the countryside around towns have a different character and trajectory of change than more rural areas?

Concept Note 2: Evaluating the Processes Underlying Changes in Broad Habitats and Vegetation Between 1978 and 1998.

This proposal (Appendix 2) has been developed to explore the ‘causes’ rather than ‘consequences’ of habitat and vegetation change. It will consider the following questions:

- (i) *What are the characteristics of habitat patches being lost, gained and restored over the period 1978-90?*
- (ii) *What are the characteristics of hedges being lost, gained and restored over the period 1978-90?*

The work will then go on to consider both the ecological processes of change and the factors driving change in each of these areas.

It is envisaged that the work will run in parallel with a GANE project, to examine the role of different nitrogen sources on GB wide vegetation change. Thus the eutrophication issue is excluded from this proposal.

It is proposed that the work should extend over a period of three years, beginning in the FY starting April 2002. The resources required are 1.5 HSO years per annum.

Concept Note 3: Assessing the Changing Capacity of the British Landscape for Biodiversity

Although the short-term work covered in Concept Note 1 will look at the consequences of change, it is recognised that in the longer term this understanding will be refined and broadened. **Thus it is proposed that a further project on ‘implications’ is considered.** This work is described in Concept Note 3 (Appendix 3). The work will explore in detail issues such as:

- (i) *How has the turnover of area and linear features affected the composition, structure and connectivity of the landscape?*
- (ii) *How have these changes in the landscape affected its capacity for biodiversity?*
- (iii) *What are the implications of the findings for conservation policy i.e. in terms of landscape design and land management?*

It is proposed that the work should extend over a period of three years, beginning in the FY starting April 2002. The resources required are 1.5 HSO years per annum.

Issues and Next Steps for Topic Area I

The three concept notes generally cover the questions set out in sections 1 and 2 of the original consultation paper. However, several issues emerge:

- (i) The nature of the GANE proposal on eutrophication needs to be made explicit and in particular the extent to which the work will meet the needs of the user community within the time frame envisaged. **It is recommended that a summary of the GANE Project be circulated for comment to interested parties.** Consultations with SNH emphasise the fact that the project must link up with the critical loads exceedance scenarios currently being developed by CEH, and other climate change modelling work.
- (ii) The effects and causes of changing soil acidity (and other changes in soil parameters identified by on-going soils work arising out of CS2000) need to be investigated more explicitly. Concept Note 2 mentions it as an issue, but does not consider the problem explicitly. FC suggests that the project might link to MLURI's soil plots. **It is recommended that the concept note be developed further in this area, following discussions with potential funders.** EA suggest that soils related projects should be based on analysis of the data from the MASQ project. CEH have been asked to generate a series of additional concept notes.
- (iii) In the context of woodlands, differences between stock and change estimates from CS2000 and the Forestry Commission's National Inventory of Woodlands and Trees (NIWT) will be explored in work on integration of datasets which will consider correspondence with external data. Analysis of the consequences and implications of woodland change are best explored bilaterally by CEH and FC, in the light of integration-assessments. **It is recommended that a further concept note will then be developed in order to take this project forward.**
- (iv) The links between the proposals in Concept Notes 1-3 and other data sources and initiatives need to be made clearer, and in particular these other data sources should be brought into the analysis. Specifically the role of the data held by the BRC needs to be considered. Table 3 sets out a series of research issues identified from recent analysis undertaken by BRC¹. **It is recommended that following further consultation with potential funders, CEH develop these links to other data sources more explicitly.**
- (iv) The links between CS2000 follow-up work and the ECN need to be made more explicit. **It is recommended that an additional concept note be developed to address question 2.6 (See page 5); a brief initial set of ideas is given in Concept Note 4 (Appendix 4). Since the proposal envisages fieldwork during 2001, a decision is required by April so**

¹ Chris Preston - pers comm

Table 3 Research Issues Arising from Recent Recording Projects by BRC

The following issues arise from examination by BRC of the preliminary results of recent recording projects. These issues would all be best followed up by comparing data from the individual taxonomic groups (hitherto looked at in isolation) and by using the BRC data sets in conjunction with other data sets, and ideally as collaborative research with partners within or outside CEH. The following issues all have policy implications for government.

Eutrophication Effect of eutrophication on plant species and vegetation cover, including sward height and area of bare ground. Resultant effects on terrestrial bryophyte and invertebrate species (including butterflies, carabids, molluscs). Do the effects on freshwater vascular plants relate to those on invertebrates such as molluscs and dragonflies?

Falling water tables/drainage Nature and scale of effects of falling water tables on wetland species, including vascular plants and molluscs, especially in S.E. England. (Clear relationship to topical issues of land-use in flood plains).

Success of habitat generalists and specialists Develop index of habitat specificity. Look at trends in species with different degrees of specialism (all groups). Identify species which will respond most rapidly to ecological changes and which could function as indicators.

Change in distribution and frequency of occurrence in alien species (including the occurrence of agricultural crops as casuals outside cultivated land) Are there consistent trends in the distribution and frequency of alien taxa. How do these relate to date of arrival? Can the patterns of spread be linked to urbanisation, waterways, development of the network of major roads, or other disturbance? (vascular plants, molluscs).

Changes in the agricultural environment Identify species dependant on arable environment (vascular plants, seed-eating carabids, molluscs) and look at changes in relationship to loss of arable land in north and west, and intensification in south and east.

Patterns of heterogeneity at local, regional and national scales Many species show regional differences in trends of distribution and abundance. What is the overall effect on patterns of local, regional and national diversity? Are regions becoming more homogeneous? What is the relative importance of good quality 'habitat', as evident in field survey, and local to regional context, as given by LCM?

Modelling future change If current trends continue, what habitats and species will be most vulnerable to change (other than those already known to be threatened)? What trends would be expected in different areas? How will these relate to environmental context?

that this can be organised and continuity of data collection guaranteed.

- (v) The nature of the links between this work and that proposed/initiated by CEH Banchory need to be made explicit. **It is recommended that a paper setting out the current position is circulated. A mechanism for sharing experience and expertise needs to be established.**

Consultations suggest that parties interested in developing and potentially funding work in the areas covered by the three concept notes are: DETR, SNH, FC, EN, CCW, JNCC. It is recommended that further consultations with these partners be initiated, with discussions broadened to include EA and CA.

The extent of MAFF's interest collaborative research is unclear from our consultations. It is recommended that CEH set up a bilateral meeting with MAFF to explore areas of common interest.

Topic Area II:

What are the relationships between changes in freshwater quality and changes in habitat structure and condition in the wider landscape?

Background

Internal discussions suggest that the original set of detailed questions within this topic area be replaced by the following (initial numbering of questions is indicated in parentheses):

- II.1. (3.1) *How is the improvement in the quality of freshwater habitats related to management, use and structure of the river corridor and adjacent catchment land cover?*
- II.2. (3.2) *How can the multiple sources of ecological information collected during CS2000 be best used to indicate the nutrient status of small watercourses?*
- II.3. (3.3) *How are changes in the biological condition of upland streams related to changes in land management?*

Results of Consultations on Topic Area and Proposals

Consultations with DETR, and feedback from EN, SNH, CCW, FC, EA and researchers within CEH, suggests:

- That work in this area is generally regarded as a matter of high priority. SNH observe that it ought to make explicit reference to the Water Framework Directive, and make use of EA and SEPA water quality data as a context for the CS2000 information.
- EN observe that there is a gap in the proposals, in that standing waters are not dealt with.
- Interest was expressed in the implications of changes in structure of woodlands in the riparian zone; FC would like to maintain a watching brief on this aspect of any follow-up work.

Three concept notes have been developed by CEH though consultation with the EA that can form the basis for further discussion:

Concept Note 5: *Analysis of the quality of freshwater habitats and the management, use and structure of the river corridor and adjacent catchment land cover*

This proposal (Appendix 5) been designed to explore the questions relating to the linkage between the quality of the freshwater environment and land cover change in the riparian zone and the wider catchment.

A three-year study is envisaged. Costings have to be refined, but initial estimates suggest a total resource of about £150-210k are required. **Given the priority attached to this area it is recommended that work is begun in 2001.**

Concept Note 6: *Methods assessing the nutrient status of small watercourses*

This proposal been designed to develop the methods for the assessment of the nutrient status of small streams (Appendix 6). The goal of the proposed work is to link CS2000 data with other sources of information of value in determining the general ecological status of CS2000 headwaters, their riparian corridors, and sub-catchment and catchment land uses, and to develop and test new metrics directed towards evaluating the eutrophication status of headwater streams.

A three-year project is envisaged. Initial estimates suggest total funding of between £130-195k is necessary.

Concept Note 7: *Upland streams and land management*

This project (Appendix 7) has been designed to relate changes in the biological condition of upland headwaters, to changes in upland management strategies, including the impacts of differential grazing pressures by both agricultural livestock and native deer populations, heather burning, forestry practices, the development of riparian zones and tourism. It will also allow the effects of annual and medium-term climatic variation to be assessed, and identify those macro-invertebrate taxa whose distribution, frequency of occurrence and abundance are most sensitive to changing land management practices and other environmental influences.

A three-year project is envisaged. Initial estimates suggest total funding of between £85-130k is necessary.

Issues and Next Steps for Topic Area II

The three Concept Notes presented here have been commented on by the EA and will be developed further by CEH. Given the interest expressed in the links between the freshwater environment and terrestrial habitats **it is recommended that the papers be circulating more widely to determine what additional support can be identified.** In addition to the EA, consultations suggest that parties interested in developing and potentially funding work in the areas covered by the three concept notes are: DETR, SNH, FC, EN, CCW, JNCC.

Topic Area III

How can CS2000 data be used with other information about countryside change to derive indicators of countryside character, quality and environmental capital?

Background and Results of Consultations

The areas covered by this question were identified as important by the user community, and although of interest to CEH they are not the focus of their primary science effort. Our consultations suggest that these issues are best taken forward as part of other initiatives. Specifically:

Countryside Quality: Proposals from CA are currently with DETR, and methods of co-ordinating this work are currently being considered. CEH await developments/proposals from DETR. The development of environmental and sustainability indicators from CS2000 is an important policy issue and CEH should participate actively in this topic area. Some insight into the issues will be available from the habitat accounts work based on CS2000 currently being undertaken for EN by CEH (see below). Landscape 'quality' can be mapped using LCM's Broad Habitat mapping with additional spatial-contextual analysis, internal and external, with linkage to field sample data on quality. This procedure would provide UK-wide assessments, based on environmentally meaningful criteria, objective applied, to give national mapping. The resultant products would be evaluated against other indicators of landscape quality (e.g. biodiversity) to assess the role in landscape ecological assessment, policy, planning and management.

Habitat Accounts: Since publication of *Accounting for Nature*, CEH have undertaken further pilot work for EN on the development of habitat accounts at Broad Habitat level for England. Although CS2000 is the main data source, where necessary the information will be supplemented by other data sources; these include the National Inventory of Woodlands and Trees (NIWT).

The results of the initial stage of this work, which has concentrated on feasibility and methodology, should now be circulated. In particular the views of DETR should be considered. It is presently envisaged that EN will take this work forward the construction of a full set of accounts during FY starting 2001.

The extent to which the 'habitat accounts approach' could be extended to Wales and Scotland should be considered. For example the use of CS2000 data as input into Scotland's *Natural Heritage Indicators* should be investigated.

Topic Area IV

How, in the future, should changes in stock and quality of habitats be monitored and changes in the condition of the wider countryside assessed and reported?

Background

Investment in the development and refinement of monitoring techniques has been identified an important area of further research. Such research will provide the basis for developing proposals for future countryside survey and help the policy community assess their wider needs in this area. Initial consultations identified the following questions as being of interest (original question numbers are shown in parentheses):

- IV.1. (5.1) *What features and characteristics of the countryside should we be monitoring in future countryside surveys?*
- IV.2. (5.2) *What opportunities are there for more efficient and/or more extensive survey using new surveying technologies?*
- IV.3. (5.3) *How can field survey and remote sensing techniques be most effectively combined and integrated for future countryside surveys?*
- IV.4. (5.4) *How should CS relate to other monitoring/reporting activities in the UK such as NBN?*

In response to these questions two concept notes have been developed, one dealing primarily with field survey techniques, the other with the outputs from LCM2000 and the integration of survey and census data.

Concept Note 8: *New techniques and methods for collecting and exploiting countryside survey data.*

This concept note (Appendix 8) has been designed to explore developments in methodology and to review critically what features should be monitored. It also takes in issues of monitoring vegetation change using the IBD concept (moved from topic area I).

A three-year project is envisaged, involving about 3 person years at HSO level.

Concept Note 9: *Integration of field survey and remotely sensed satellite data*

This concept note (Appendix 9) has already been passed to DETR for consideration, and is included here for completeness. The proposal envisages a two-stage project, involving:

- *A scoping study:* to assess similarities and differences in the Field and LCM products; evaluate results of calibration; develop trial output-datasets; assess independent maps and data to be used collaboratively or identify key differences between data sources. The scoping study will also

develop proposals for the second, operational phase of the project (see below).

- *An operational study:* to reconcile spectrally-derived LCM information with field data; exploit additional spectral information to extrapolate field data; generate the best parcel-based vector datasets, 1 km summary datasets and statistics.

It is anticipated that the scoping phase will take about 50 person days at a cost of approximately £17k. The work could start in spring and finish mid-summer, 2001. The operational phase could be undertaken in one year at an additional cost of £118k. It would follow the scoping study and completion of LCM production, probably starting in mid- to late summer, 2001. However, the time-table is dependent on completion of LCM2000.

Issues and Next Steps for Topic Area IV

Consultations suggest the following issues need to be considered in taking these projects forward:

- Although integration of LCM2000 and field survey data is a crucial short-term issue for publication and use of CS2000 data, investigation of methodologies is probably a medium term concern. It was argued (EN) that evaluation of new methods must wait critical evaluation of the results themselves.
- Work on the methodology and integration must be considered and taken forward in the context of the project by JNCC on 'the harmonising of reporting'. The work should also consider and link to NBN and the National Sampling Framework (SNH).

It is recommended that the two concept notes be circulated to determine the extent to which they meet current needs and to confirm the timetables proposed.

Consultations suggest that the main interest in these ideas lies with DETR, JNCC, and EA, though all users of CS2000 data will benefit from an integration of field and LCM data which provides operational data and tools for countryside analyses.

However, the issue of comparisons with woodland data (FC, and see Topic area I) needs to be considered in the short term.

Topic Area V

How are the socio-economic drivers of countryside change reflected in CS2000 data?

Background

The need for a deeper understanding of the socio-economic drivers of countryside change has been widely acknowledged as an important output from future research. Such an understanding is important for both for explaining the patterns of change observed by the Survey and for using the information to evaluate and design future countryside policy. These issues have been explored in the Report submitted to DETR by CEH on the *Drivers of Countryside Change* (Haines-Young and McNally, 2001). The study provides the backdrop for the questions identified in this topic area:

- V.1. (6.1) *What can the typology of farmers developed by Potter and Lobley tell us about the changes recorded by CS2000?*
- V.2. (6.2) *How do the changes recorded by CS2000 relate to changes in the farm economy recorded by other national datasets?*
- V.3. (6.3) *What is the relationship between the changes recorded by CS2000 Field Survey and those detected by other national datasets such as DETRs 'Land use Change Statistics', FCs 'National Inventory of Woodlands and Trees'.*
- V.4. (6.4) *How have the characteristics of land owners and land management changes in the CS2000 sample squares since 1990, and to what extent can they explain changes recorded by CS2000? [i.e. socio-economic re-survey of the sample squares]*
- V.5. (6.5) *How can we model the impacts of policy in the CS2000 sample squares in order to examine the consequences of policy changes for the wider countryside?*
- V.6. (6.6) *How can CS2000 data be used as a 'base-line' or 'context' for monitoring the effects of agri-environmental policy?*

The six questions cover short-term and long-term needs. At present three concept notes have been developed to cover the main priority areas.

Concept Note 10: *Farmer Characteristics and Countryside Change*

This concept note (see Appendix 10) envisages a limited, short-term study that examines the extent to which the farmer typology developed in the *Processes of Countryside Change* Study (Potter and Lobley, 1996) can be used to help our understanding of habitat and vegetation change recorded by CS2000.

All the data resources necessary for this work are available, since the information from the *Processes* Study is now part of the CS2000 database. The work would be undertaken by CEH in association with Potter at Imperial College, and would take about 4-6 months to complete.

It is recognised that there may have been considerable changes in farm ownership and management since the time of the 1993 study. This work would identify the changes that had taken place in the different ownership and farm types since that time, and develop a set of working hypotheses about farm characteristics that could inform the design of any future survey.

Concept Note 11: *Linking CS2000 and other National Agricultural Datasets to Understand Patterns of Countryside Change*

The extent to which CS2000 data could be linked to other national datasets was examined in the *Drivers of Countryside Change* Study (Haines-Young and McNally, 2001). The key datasets considered were the MAFF June Census and the Farm Business Survey. With regard to these datasets it is not possible to directly link CS2000 results at the field survey square level. However, as the *Drivers* Project showed, it would be informative to describe change within the farm economy on a more aggregate basis, in a way that can be related to observed change within CS2000. For example, one could examine changes in agricultural land use within the June Census and environmental change within CS2000 by Standard Statistical Region. A project outlining the nature of the project that could be undertaken is provided in Concept Note 11 (Appendix 11).

The project could be undertaken by CEH in about 4-6 months at HSO level. However, it would be valuable to also seek some collaboration with outside organisations such as the Dept. of farm Economy at the University of Cambridge.

Concept Note 12: *Structural Changes in Land Ownership and Land Management and their Impact on Countryside Quality.*

A key issue considered in the *Drivers of Countryside Change* Project was the case for a re-survey of farm businesses within the CS2000 field survey squares, to follow-up the work undertaken in 1993. It was concluded that there is considerable justification and support for a socio-economic re-survey but that the scope of the project should be extended to include a wider range of factors affecting rural areas.

It was argued that *all* types landowners and managers are interviewed. The goal should be to build up a much better understanding of the rural context of the CS sample squares, and hence the socio-economic and policy factors likely to shape change within them. Using such information, it was also argued that the work should develop a range of modelling tools that would allow different policy scenarios to be developed. An outline proposal is provided in Concept Note 12 (Appendix 12).

The project outlined in this concept note involves considerable resources. It is anticipated that the work will extend over three years and require about £350k. A consortium involving CEH, Imperial College and the University of

Nottingham is proposed, with funding sought from customers (co-ordinated by the Inter-Agency Land Use Policy Group) and ESRC.

Issues and Next Steps for Topic Area V

The three concept notes presented for this topic area do not cover all six questions outlined in the introduction to this section. In the context of linking CS2000 information to other datasets describing land cover and land use change (question V.3), this is likely to be carried forward though:

- Analysis of the differences in stock estimates between CS2000, LCM2000 and National Woodland Inventory as part of the work outlined in Topic Areas III and IV.
- Work already initiated by DETR that is linking information from their *Land Use Change Statistics* and the CS2000 field survey data.

The extent to which an understanding of the socio-economic drivers of countryside change can be used to assist policy development and appraisal (question V.5) has been linked to question V.4 in Concept note 12. However, the specific evaluation of the impacts of agri-environmental schemes probably requires a separate study that is probably best developed outside the programme of research related more directly to CS2000. **It is recommended that this topic is pursued through bilateral contacts with MAFF.**

Appendix 1:

CS2000 FOLLOW-UP WORK - CONCEPT NOTE I

COUNTRYSIDE SURVEY 2000 – FINDING OUT CAUSES, UNDERSTANDING SIGNIFICANCE (CS2000 FOCUS)

Questions

During the preparation of the report '*Accounting for Nature: assessing habitats in the UK countryside*', and immediately after its launch in November 2000, a number of questions were identified by researchers and policy customers alike which needed to be addressed as a matter of urgency. These questions related to the meaningfulness and the relevance of the results posted in the report (and elsewhere, e.g. the CS2000 Web site). Whilst some of the deeper questions will require an extended programme of scientific research to shed light on their ecological and political significance, others may be addressed, or start to be addressed, in the shorter term. The identified questions included:

1. What are the likely causes of the decline in semi-improved grassland and why is there high turnover between this and other grassland types? Is this significant for biodiversity? How abnormal is this for grazed systems?
2. What was the amount and character, in terms of broad habitat, parcel size and location, of land which was newly cultivated in 1998?
3. What are the possible causes of more overgrown streamsides? What are the implications for other species and neighbouring systems?
4. Where are the increases in fen, marsh & swamp and what are the botanical characteristics of these areas?
5. What are the possible causes of decline in acid grasslands? What are its implications for biodiversity and is the change reversible?
6. What are the environmental and management circumstances under which bracken invades acid grassland, heath and bog habitats? Is the expansion likely to continue and what are the implications for agriculture?
7. What are the possible causes for decline in dwarf shrub heath habitats? Are there variations between environmental zones and why?
8. What are the characteristics and locations of the hedges that are being gained as opposed to those that are being lost?
9. What is the relationship between plant diversity in 10m and 30m plots, hedgerow characteristics and adjacent land use?
10. What evidence is there from the bird survey of the value of different types of hedges for birds and, by comparison with previous survey, of changes in the habitat condition (for birds) of hedges?
11. What evidence is there that length of hedges declined between 1990 and 1993 and increased between 1993 and 1998?
12. What and where are the new ponds? How do the 1996 figures relate?
13. How have agri-environment schemes contributed to recent changes in the countryside?
14. Why are there differences in estimates of woodland cover obtained from FC surveys and CS2000?
15. Where and how are the changes in woodland taking place?
16. How is an improvement in the status of freshwater habitats related to management or use of river corridors?
17. Under what circumstances are habitats being created on parcels of previously developed land?
18. Does the countryside around towns have a different character and trajectory of change than more rural areas?

The following questions were also identified as important. However, it is considered that each is in itself a major piece of work that should be covered in separate projects to be defined in discussions with possible funders:

- a. What are the possible causes of eutrophication? What are its implications for biodiversity and what can be done to help mitigate negative effects?
- b. Are the opportunities for the dispersal of native species becoming better or worse (in relation to changes in the pattern / structure of habitats in the farmed landscape)?

Outcomes, Justification and Priority

Outcomes

- Initial interpretation of the significance (statistical, ecological and political) of the main results published in the CS2000 'Launch report'.
- Preliminary (but well-substantiated) hypotheses for the causes of observed and reported changes.

Justification

The publication of the CS2000 results was carried out according to a tight and regulated timetable. It was never intended that the report should carry information relating to the causes of change. However, it is inevitable that the questions listed above should have been asked immediately the results were released. While it will take major research programmes to define scientifically rigorous and unequivocal answers to many of these questions, it is possible to make a start on the understanding of the issues raised. Indeed, there is already a demand that effort be made to address the important ecological and political points raised by these results.

The proposed research programme falls clearly within the mission statements for CEH Programme 2, since understanding the causes of land use change are central to themes 2.1, 2.2 and 2.4.

Priority

High priority should attach to this work programme. Apart from its intrinsic scientific value, there are a number of political aspects that need answers as soon as possible. Anything that can be done to define and focus down on the likely significance and consequences of the observed changes should be implemented as soon as possible.

Approach

The three main approaches to addressing the questions listed will be (1) closer examination of the base-data, (2) further analyses at a greater level of detail, and (3) setting the results in a wider context (and understanding the relationships between CS2000 Field Survey and LCM2000 results and other relevant information).

1. Base-data: Some of the results that have generated most comment, or are counter-intuitive, will need to be examined in relation to the consequences of the way the base-data were analysed. Similarly, the allocation routines which have been used to aggregate, or partition, the data for analytical purposes, need to be re-assessed. We need intelligent approaches to the mapping of change from LCM.
2. Further analyses: New analyses, at a greater level of detail, both spatially and in terms of feature classification, will yield additional information which will help to locate and explain patterns in the results. Thus, a particular type of hedgerow may be expanding in one region, whereas it is in decline elsewhere.

3. Contextual information: In some cases, examination of the base data, or novel analyses of them, is unlikely to yield more information. However, examination of estimates from other surveys, or databases which relate to associated factors, may help to further explain and amplify CS2000 results and extrapolate field observations on the LCM framework.

Resources and timetable

Resources: 4 x HSO equivalent per year, for one year (FEC: £186k; cost to funders £135k)

Timetable: Because of the separate identity of the questions being addressed, it is not clear how an integrated timetable can be developed. However, it is proposed that the work will be completed within the 2001/02 Financial Year, starting on 1st April 2001 and culminating in a draft final report to be delivered by 31 March 2002.

Project leader: TBA

Staff involved: Colin Barr, Les Firbank, Mike Furse, David Howard, Lindsay Maskell, Lisa Norton, Sandrine Petit, and Simon Smart, Geoff Smith, Ross Hill.

Linkages

There will be linkages with organisations providing contextual information.

Potential funders

DETR, EN, SNH, CCW, JNCC, FC, NERC

Appendix 2:

CS2000 FOLLOW-UP WORK - CONCEPT NOTE 2

EVALUATING THE PROCESSES UNDERLYING CHANGES IN BROAD HABITATS AND VEGETATION BETWEEN 1978 AND 1998.

Questions

This concept note proposes an integrated programme of research that will specifically address the ‘causes’ rather than ‘consequences’ parts of questions 1.1 and 1.2.

1.- *‘What factors are contributing to change in stock/turnover of semi-natural Broad Habitat?’*

1.1 - *‘What are the characteristics of habitat patches being lost, gained and restored?’*

1.2 - *‘What are the characteristics of hedges being lost, gained and restored?’*

The research programme will work in parallel with an already funded GANE initiative to examine the role of different nitrogen sources on GB wide vegetation change and so will address:

2.2a - *To what extent is atmospheric nitrogen a cause of increasing fertility in vegetation in different areas and habitats?*

Landscape scale and cross-habitat changes in soil pH already reported by CS2000 must be linked to spatial and temporal variation in plant species composition within Broad Habitats. This research programme will feed into collaborative work programs concerned with the following question:

2.2b - *To what extent is changing soil acidity a factor leading to vegetation change?*

Outcomes, Justification and Priority

Outcomes

- Identification of the drivers of change which operated between 1978 and 1990, and between 1990 and 1998 with a tabulation of their locations in the landscape and expected Broad Habitat responses (via linked pressures in terms of the DPSIR model developed in ECOFACT).
- Presentation of a framework of nested models that characterise land-cover (Broad Habitat) and vegetation dynamics over the 78-90-98 period.

Justification

In order to be able to predict the consequences of future scenarios of land-use change it is necessary to understand how changes in the quality and quantity of widespread habitats recorded between 1978 and 1998 relate to land-use pressures operating during the same period. Effective prediction will help to inform policy aimed at counteracting the downward trend in biodiversity across the UK.

Moreover, predicted climate change and its consequences remain unclear. If changes due to parallel environmental impacts can be reliably characterised then we will have a greater chance of teasing out signals due to climatic forcing.

The proposed research programme falls clearly within the mission statements for CEH science and Programme 2, since small scale experimental data will be used to generate expected signatures of change to be matched with observed change in large-scale monitoring

data. These cross-scale relationships will form the basis of models relating the pressures of land-use change to Broad Habitat and vegetation responses between 1978 and 1998.

Priority

High priority should attach to this work program. Apart from its intrinsic scientific value, completion of this work in advance of the next Countryside Survey will feed into any debate concerning recording of additional features or phenomena in or outside sample squares.

Approach

We will carry out a more quantitative extension of the approach already used in an initial exploration of the causes of vegetation change in CS data between 1978 and 1990, that is: a) establish which potential pressures of change in quantity and quality of Broad Habitats have operated during the survey interval. b) select those for which location and prevalence indicate that their effect could be detected in CS squares. c) gather independent evidence from small scale experiments, model predictions or surveys in other regions to draw up hypotheses of expected impacts. d) match expected impacts with those actually observed and quantify the potential causal role of each candidate driver.

This approach will be used to address net change in vegetation attributes as well as change, turnover and relative stability in extent of Broad Habitats (including linear features). The following additional methodological developments will result in much greater precision in estimating the importance of competing causes of change:

- use of existing experimental data and model predictions to derive quantitative signatures of expected vegetation and land-cover response to individual land-use changes
- sensitivity analyses to assess the stability of the allocation of land-cover parcels to Broad Habitats under different scenarios of change
- partitioning change by a range of strata including landscape pattern or parcel geometry, soil and vegetation relationships for 1978 and 1998, historical and geographical information eg. hedgerows along parish versus non-parish boundaries in addition to existing and well tested strata such as ITE Land Class and plot type.
- incorporation of spatially referenced estimates of nitrogen, ammonia and sulphur deposition as well as changes in soil attributes between 1978 and 1998
- incorporation of information on changes in the intensity of agricultural management within squares

The research programme will focus specifically on two potential causes of land-cover and vegetation change:

- atmospheric deposition of nitrogen compounds
- changes in the management of agricultural land and associated features

Resources and timetable

Resources: 1.5 HSO equivalent per year, for three years.

Timetable:

Yr 1 (1.5 HSO yrs)

- a) Review existing database of Countryside Survey change data for land-cover and vegetation from 1978 to 1998.
- b) Derive new spatial strata defined by landscape pattern which best classify observed dynamics in Broad Habitat quantity and vegetation quality including linear features.
- c) Begin review of operation and location of potential drivers of change for 78-98.

Yr 2 (1.5 HSO yrs)

- a) Finish review of operation and location of drivers.
- b) Hypothesise links between spatial correlates of land-cover and habitat change and land-use drivers.
- c) Assemble experimental and model based signatures of expected change in Broad Habitats and vegetation condition.

Yr 3 (1.5 HSO yrs)

- a) Compare expected and observed changes in quantity and quality of Broad Habitats and vegetation between 1978, 1990 and 1998.
- b) Set up model descriptions of the independent and interacting role of potential drivers to observed changes in quantity and quality of Broad Habitats and vegetation.
- c) Reporting and paper writing.

Project leader: TBA

Staff involved: Simon Smart, Lindsay Maskell, Dr David Howard, Dr Sandrine Petit, Dr Les Firbank, Colin Barr, Dr Lisa Norton, staff (TBA) from the Soil Ecology Section at Merlewood, CEH Banchory and CEH Monks Wood.

Linkages

Parallel initiatives and research groups include:

- GANE project on the causes of eutrophication on large-scale vegetation change
- SERAD project on road verge biodiversity
- DETR umbrella contracts on pollution impacts on terrestrial ecosystems
- Monks Wood Socio-economics Group
- Bangor and Bush atmospheric pollutants groups.

Potential funders

DETR, MAFF, SOAEFD, JNCC, EN, NERC non-thematic

Appendix 3

CS2000 FOLLOW-UP WORK - CONCEPT NOTE 3

ASSESSING THE CHANGING CAPACITY OF THE BRITISH LANDSCAPE FOR BIODIVERSITY

Questions

This research addresses parts of the following questions in the paper “Post-CS2000 Research”:

- 1.1 - *‘What are the characteristics of habitat patches being lost, gained and restored?’*
- 1.2 - *‘What are the characteristics of hedges being lost, gained and restored?’*
- 2.3 - *‘What are the implications of vegetation change recorded by CS2000 for the conservation of biodiversity in the UK?’*
- 2.4 - *‘What are the implications of long-term quantitative and qualitative changes in habitats and vegetation recorded by CS2000 for other species groups?’*
- 6.5 - *‘How can we model the impacts of policy in the CS2000 sample squares in order to examine the consequences of policy changes for the wider countryside?’*

In particular, the following questions are addressed: How has the turnover of area and linear features affected the composition, structure and connectivity of the landscape? In turn, how have these changes in the landscape affected its capacity for biodiversity? What are the implications of the findings for conservation policy i.e. in terms of landscape design and land management?

Outcomes, Justification and Priority

Outcomes

- An assessment of change (‘78-’98) using relevant indicators in the British landscape
- A suite of spatially-explicit tools describing the relationships between landscape structure, habitat quality, derived ‘landscape quality’ and the occurrence of functional groups.
- An evaluation of policy-related scenarios of land-use change on the capacity of landscapes for biodiversity.

Justification

Fragmentation and a reduction in the quality of habitats are major concerns for the future of biodiversity in the UK. Within landscapes, the area and spatial coherence of the various habitat types have a direct effect on the distribution of species both directly and indirectly through the distribution of associated species. However, currently, the scientific basis for deciding how to measure landscape patterns and how to interpret their ecological significance remains underdeveloped. In addition, the implications of change in the quality of habitats (e.g. the impacts of change in vegetation for other taxa) has not been well documented. LCM in particular, supported by the detailed evaluations of field survey and underpinning concepts of landscape ecology, offers the potential to generate national mapping of indices of landscape quality based upon Broad Habitat, field-surveyed estimates of quality and landscape contexts, both internal (i.e. neighbourhood) and external (e.g. ITE Land Class, soils, designation-status).

Priority

This work is of high priority in maximising the use of information obtained as part of CS2000. Studying the consequences of observed changes is a logical step in the interpretation and application of CS2000 results.

Approach

The approach uses landscape assessments combined with the concept of functional groups of species, reflecting different

- scales of perception (fine grain versus coarse grain species)
- dispersal capacities
- spatial uses of the landscape: network of linear elements e.g. woodland plant species and forest ground beetles, set of individual habitat patches, e.g. sedentary specialist butterflies, whole landscape mosaic e.g. farmland birds

Year 1

- *Assessing change ('78-'98) using landscape indicators relevant to biodiversity.* A set of landscape pattern measures relevant for each of a selected set of functional groups and their rate of change between 1984 and 1998 will be estimated. This exercise is a prerequisite for the following steps of the project but will also give an overview of the recent trends for biodiversity-related landscape indicators and how trajectories vary within and between British regions.
- *Evaluating the effect of habitat fragmentation on the British vegetation.* Analysis of the data recorded in the vegetation plots between 1978 and 1998 will provide a robust basis to the development of spatially explicit regression models of the consequences of landscape change for plants. A screen for plant species sensitive to habitat fragmentation (where species response not only relates to habitat loss but also includes a “true” fragmentation effect) will be carried out in the various British regions.

Year 2

- *An analysis of the effect of vegetation change on other taxa.* The impacts of changes in cover and frequency of food plants (and/or larvae host plants) and vegetation structure on the occurrence of some butterfly and bird species will be investigated. The rate of turnover of individual plant species and its impact on populations will also be explored. These analysis will be restricted to CS squares where sufficient spatial coincidence between vegetation and other taxa can be achieved.
- *Development of a suite of spatially explicit models for functional groups.* This exercise will require development and where possible improvement of existing spatially explicit models previously developed by CEH staff. Those models will be; i) diffusion models along hedgerow networks for ground beetles ii) regression models for birds and iii) metapopulation models of butterflies. The validation of models will be carried out using CS2000 data (plants, birds), the Biological Record Centre data (butterflies) data from previous studies (ground beetles). This set of tools will be used to assess landscape capacity for biodiversity in CS sample squares.

Year 3

- *Scenario-testing of policy changes.* The set of tools developed in years 1 and 2 will allow a range of policy scenarios to be assessed in terms of their impact on the potential for biodiversity of a given landscape. Scenarios could include changes in the area of land under various schemes (e.g. ESA), changes in the CAP (e.g. set-aside). The impacts on biodiversity of the drivers of land use change identified in the parallel project ‘Causes of change’ will be explored (does this relate to the title? Should it be somewhere else?).
- *Recommendations for landscape design.* This exercise aims at identifying sets of guidelines that are likely to enhance biodiversity at the landscape level. Applications range from the optimisation of functional networks when establishing hedgerows to the suggestion of habitat restoration pattern at a larger scale.

Resources and timetable

Resources: 1.5 HSO equivalent per year, for three years.

Timetable: as above

Project leader: TBA

Staff involved: Dr Sandrine Petit, Dr Les Firbank, Simon Smart, Colin Barr, Dr David Howard, Dr Lisa Norton, staff (TBA) from the Soil Ecology Section at Merlewood, CEH Banchory and CEH Monks Wood (Nigel Brown, France Gerard, Ross Hill, Jane Sanderson, Geoff Smith, Andy Thomson).

Linkages

The programme of work links with other development proposals from CEH Monks Wood such as dispersal of alien species (question 2.4). The range of policy scenarios to be assessed is linked with proposals from CEH Monks Wood on socio-economics models (question 6.5) and proposals from CEH Merlewood related to the identification of causes of change. There could be linkages with the Biological Record Centre, the Centre for Agricultural Strategy, Lancaster University and the British Trust for Ornithology.

Potential funders

DETR, EA, EN, JNCC, SNH

Appendix 4

CS2000 FOLLOW-UP WORK - CONCEPT NOTE 4

ANNUAL VARIATIONS IN CLIMATE AND THEIR AFFECT ON VEGETATION

This brief concept note was designed to explore the following question:

To what extent do annual variations in climate affect vegetation and what are the implications of this for (i) the interpretation of existing CS vegetation results; and (ii) forecasting the impacts of climate change scenarios on CS vegetation results?

Background

Module 10 of the Countryside Survey 2000 research programme addressed the issue of year to year variability in vegetation resulting from weather patterns and how this might influence the interpretation Countryside Survey results.

Data are now available from vegetation of plots at Environmental Change Network (ECN) sites throughout the UK from 1996-2000 (and in some cases 1994). These show that year to year variability can be large enough to obscure or distort long-term changes from other causes and should be accounted for in the interpretation of CS2000 and future surveys. Furthermore, as Countryside Surveys extend into the 21st century, climate change is likely to have an increasingly large effect on UK vegetation and this may begin to confound or exacerbate the effects of changes in land management. A consolidated dataset from sites in which management is constant (or known) will form a baseline against which the relative impacts of climate and land management can be deduced.

Approach

We recommend that the fieldwork done under Module 10 is continued annually to provide a continuous data link between the 1998 survey and the next CS survey. Objectives of the work would be to:

- 1) quantify annual variation in main CS vegetation types due to climate factors;
- 2) use this information to quantify the likely contribution of climate factors to differences in vegetation composition recorded in 1998 and the next CS;
- 3) develop simple models of vegetation response to climate to help interpret Countryside Survey results and to provide the basis for forecasting the impacts of climate change scenarios on vegetation in the wider countryside.

A decision is required by April 2001 so that fieldwork can be organised for a 2001 season and continuity of data collection can be guaranteed.

Mike Morecroft and Terry Parr (CEH Merlewood)
25 January 2001

Appendix 5

CS2000 FOLLOW-UP WORK - CONCEPT NOTE 5

THE QUALITY OF FRESHWATER HABITATS AND THE MANAGEMENT, USE AND STRUCTURE OF THE RIVER CORRIDOR AND ADJACENT CATCHMENT LAND COVER

This proposal has been developed to explore the following issue:

How is the improvement in the quality of freshwater habitats related to management, use and structure of the river corridor and adjacent catchment land cover?

Objectives:

- To determine the relationship between the land cover and landscape pattern (and changes in those characteristics) and the structure and modification of river corridors and the biological condition of the watercourse
- To determine the impact of spatial scale on these relationships
- To determine the risks of loss of habitat quality and biological condition associated with particular catchment land cover characteristics.
- To identify the characteristics of the river corridor habitats that are most directly related to the biological condition of watercourses
- To determine the spatial relationships between river habitat structure and biological condition of rivers. How long do vegetated riparian strips need to be to benefit the biological condition of streams and how persistent are improvements when habitat condition becomes degraded.
- To examine the relationship between the structure and condition of the river corridor habitats and the botanical composition of the riverbanks.
- To propose appropriate management regimes to minimise the loss of desirable botanical diversity whilst maintaining the benefits of vegetated riparian zones for the biological condition of rivers.

Work programme

Year 1 (desk studies)

- Quantification of the land cover characteristics (composition and pattern) of CS2000 stream site catchments, and temporal change in those characteristics, using both survey data and satellite imagery.
- Analysis of the relationships between landscape characteristics, at various spatial scales, and the habitat condition and extent of modification of river corridors
- Disaggregation of the component information contained in River Habitat Surveys into discrete variables or variable combinations and identification of those variables most directly related to the composition and biological condition of macro-invertebrate assemblages and changes in these assemblages.
- Extension these analyses, where relevant, to include the results of national river quality surveys and river habitat surveys
- Elucidation those macro-invertebrate taxa which benefit most from the presence of vegetated buffer strips
- Analysis of the botanical composition of streamside plots and the relationship between individual species, species types and measures of vegetation condition and the habitat quality and extent of modification of river corridors
- Production of an interim report on the results of the desk study.

Year 2 (field and laboratory studies)

- River Habitat Survey, macroinvertebrate sampling and botanical surveying of extended lengths of small headwater streams to examine the spatial relationships between changes in each sampled component and changes in each of the other component. Studies to include upland and lowland streams, streams with continuous, discontinuous and no well developed vegetated riparian zones.
- Laboratory processing of macroinvertebrate samples
- Data-logging of all field data

Year 3 (laboratory and desk studies)

Completion of laboratory processing of macroinvertebrate samples. Statistical analysis and interpretation of field studies data

- Recommendations for the best management practices for riparian zones for the promotion of appropriate botanical diversity and maintenance and enhancement of in-stream botanical condition.
- Recommendations for trial headwater restoration schemes based on the findings of this study and agreed desirable ecological objectives
- Production of an R&D Technical report R&D Project Record.

Approximate yearly costs (to be refined)

Year 1 £50-70K
Year 2 £60-80K
Year3 £40-60K

Benefits to sponsors

- An understanding of the factors and risks linking land cover and landscape patterns and changes to the quality of the river corridor and the botanical condition of the banksides and biological condition of the watercourse
- Recommendations for the best management practice for river corridors in order to promote desirable ecological objectives.

Appendix 6

CS2000 FOLLOW-UP WORK - CONCEPT NOTE 6

METHODS FOR ASSESSING THE NUTRIENT STATUS OF SMALL WATERCOURSES

How can the multiple sources of ecological information collected during CS2000 be best used to indicate the nutrient status of small watercourses?

Objectives

- To obtain multi-source ecological information of value in determining the general ecological status of CS2000 headwaters and their riparian corridors
- To use CS2000 data to integrate and cross-calibrate metrics derived from assessment procedures and taxonomic groups of value in determining the eutrophication of streams and their banksides (e.g. Mean Trophic Ranking – MTR - macrophyte data; Trophic Diatom Index - TDI – diatom data; and streamside botanical plots – fertility scores and competitor scores) with the information content of samples of other common taxonomic groups (e.g. RIVPACS and Chironomid Pupal Exuviae Technique – CPET- macro-invertebrate samples; and River Habitat Survey – RHS – habitat quality and modification index).
- To develop a suite of metrics specifically directed towards evaluating the eutrophication status of headwater streams.
- To test the proposed metrics by experimental sampling of a range of streams of known nutrient status
- To develop the recommendations as a standard procedure for evaluating the nutrient status of headwaters.

Available data

Countryside Survey 2000:	RIVPACS macro-invertebrate samples – fully processed Chironomid Pupal Exuviae samples – in store and available for processing Mean Trophic Ranking in-stream macrophyte samples – available for analysis Trophic Diatom Index – in store and available for processing Streamside “S” & “W” plots – available for analysis Bankside “S” & “W” plots – analysed River Habitat Surveys – analysed Indicative chemical samples analysed from Nitrate and Phosphate concentrations
Environment Agency (NRA)	1990, 1995 and 2000 national invertebrate survey data and complementary chemical data
CEH Dorset & EA (NRA)	National Invertebrate Database (2000 sites) Mean Trophic Ranking Database (5,000 sites) River Habitat Survey Database (15,000 sites)

Examples of questions to be addressed

- Which taxonomic group(s) is/are best suited to indicate the nutrient status of headwaters – or should all sources of information be integrated into a common metric.
- Can knowledge of the eutrophication index value of one taxonomic group be used to develop new indicator metrics based on other taxonomic groups, such as invertebrates

that may be more easy to sample or may provide extensive historical data? For example, so far we have made inadequate use of the in-stream S and W plot data. How can the results of these survey be used to help develop macro-invertebrate metrics that indicate the impact of eutrophication rather than other forms of organic enrichment?

- Do the signals emanating from MTR (Mean Trophic Ranking) echo the signals emanating from the Indicators of Botanical Diversity (IBD's) of fertility and competitive species derived from the adjacent streamside plots?
- Can the streamside botanical data (particularly from the instream sub-quadrat) provide a history of change at the CS2000 sites and which of the four survey years (1978, 1984, 1990 and 1998) are amenable to this analysis?

Work programme

Year 1 (desk studies)

- **Data logging of CS2000 MTR data**
- Processing and data-logging of CS2000 diatom samples
- Processing of CS2000 CPET data
- Data logging of CS2000 instream "S" and "W" plot botanical data
- Analysis and inter-calibration of data and assessment metrics
- Development of test metrics using macro-invertebrate data to indicate eutrophication.
- Development of an integrated suite of eutrophication metrics for operational testing.
- Production of an interim report on metric development

Year 2 (field and laboratory studies)

- Collection of field data of the taxonomic groups identified as relevant to the assessment of the impacts of eutrophication on headwater streams. Sampling to be undertaken in contrasting stream types subject to different intensities of nutrient enrichment in catchments of differing land cover characteristics.
- Processing and data-logging of field data
- Acquisition of appropriate test data from other sources.
- Production of an interim report on the field survey

Year 3 (desk studies)

- Metric testing using field and other acquired data
- Metric refinement and re-testing
- Development of a supplementary, rapid assessment protocol based on the developed metrics
- Production of standard protocol manual for the biological detection of eutrophication in small streams
- Production of an R&D Technical Report and R&D Project Record

Approximate yearly costs (to be refined)

- Year 1 £50-70K
- Year 2 £50-70K
- Year3 £30-55K

Benefit to sponsors

A practical protocol providing practical operational protocols for the biological detection of eutrophication in headwaters.

Appendix 7

CS2000 FOLLOW-UP WORK - CONCEPT NOTE 7

UPLAND STREAMS AND LAND MANAGEMENT

This project has been designed to explore the following question:

How are changes in the biological condition of upland streams related to changes in land management?

Objectives

- To relate changes in the biological condition of upland headwaters, to changes in upland management strategies, including the impacts of differential grazing pressures by both agricultural livestock and native deer populations, heather burning, forestry practices the development of riparian zones and tourism.
- To consider the inter-related or over-arching impacts of annual and medium-term climatic variation.
- To identify those macro-invertebrate taxa whose distribution, frequency of occurrence and abundance have shown the strongest recent beneficial and detrimental changes in relation to changing land management practices and other environmental influences, with special reference to taxa of special national or international conservation value.
- To document the findings of the study and recommend best practices for upland land management in order to minimise the impact on small upland streams

General approach

Changes in upland land management practices have been the subject of detailed recent review, for example by MLURI and detailed land cover maps are available or are becoming available for the last decade. Over the same period the Scottish River Purification Boards and the National Rivers Authority and their successor bodies the Scottish Environment Protection Agency (SEPA) and the Environment Agency have been carrying out extensive surveys of the macro-invertebrate fauna of upland watercourses. Countryside Surveys of 1990 and 1998 represent additional, specific surveys that incorporate both land cover and stream quality elements.

The current proposal would collate, review and interpret all existing data on the fauna of upland streams and upland land management and other potential sources of environmental impact. Apparently beneficial and detrimental influences would be identified and conclusions drawn would be tested by a series of experimental field surveys in matched upland streams subjected to different forms and intensity of land management.

Brief outline work programme

Year 1

- Review and development of testable hypotheses
- Development of a project database and webpage
- Production of an interim report on the review process.

Year 2

- Experimental field studies
- Laboratory analyses of field studies

Year 3

- **Production of a report on the analysis, conclusions, recommendations of the experimental study.**
- **Production of a project record**

Approximate yearly costs (to be refined)

- Year 1 £20-30K
- Year 2 £40-60K
- Year3 £25-40K

Benefit to sponsors

- A comprehensive review of trends of change in the macro-invertebrate assemblages of upland streams and an evaluation of the probable drivers and processes of change.
- Recommendations for the best management practices of upland catchments to promote and enhance the biological condition and biodiversity of upland streams.

APPENDIX 8

CS2000 FOLLOW-UP WORK - CONCEPT NOTE 8

NEW TECHNIQUES AND METHODS FOR COLLECTING AND EXPLOITING COUNTRYSIDE SURVEY DATA

Questions

This research addresses parts of the following questions in the paper "Post-CS2000 Research":

- 2.1 - *What do the CS2000 Indicators of Biodiversity (IBDs) really tell us about vegetation condition and change?*
- 5.2 - *What opportunities are there for more efficient and/or more extensive survey using new surveying technologies?*
- 5.1 - *What features and characteristics of the countryside require new methods to be better monitored in countryside surveys?*

In addition, the proposal suggests an innovative piece of work that would address the question: *What analytical methods are needed for deriving and presenting information from existing survey data?*

Outcomes, Justification and Priority

Outcomes

- Evaluation of the benefit of extending the field sample and/or records of local context, using remote high resolution sensing.
- Refinement of remote sensing census techniques to increase the resolution and enhance data structures used for national coverage.
- Calibration of the dynamics of the CS2000 Indicators of Botanical Diversity (IBDs) and their relationship to patterns of vegetation change.
- Visualisation of landscape characteristics and change through computer-based virtual reality techniques.
- New techniques for the collection and utilisation of survey data from unenclosed land. A pilot study to evaluate how these techniques maybe incorporated into a future surveys.

Justification

CEH has developed many survey and analysis techniques that have underpinned the successful collection and use of the Countryside Survey data. Experience has shown that review of data coverage and methods employed is vital to guide future survey work. Analysis of data coverage and piloting of new methods must be completed in time to inform future survey planning hence improving the efficiency and potential application of the Countryside Survey.

Priority:

CEH must continue to evaluate and develop Countryside Survey methodology, in order to ensure continued good scientific underpinning of the work, and to increase efficiency through the use of appropriate technology. Although some of this work package might need to be completed nearer the time of the next survey, other components cannot be left that long and need to be addressed immediately.

Approach

The Indicators of Botanical Diversity (IBDs) have been crucial to the analysis of the extensive vegetation data in CS2000. The interpretation of these indicators requires an analysis of their fundamental structure, their range of variation and their sensitivity to particular changes in the vegetation data. Initially, this work will take a statistical approach to characterizing changes in IBDs, assigning significance to IBD scores using ideas of Type I and Type II errors and similarity measures to qualify the magnitude of change. This will lead to more empirical work on calibrating changes in IBD to particular vegetation changes indicative of environmental signals such as changes in pH or nitrogen. A clearer understanding of the IBDs dynamics and development of statistical analyses to aid the interpretation will underpin the empirical calibration work. This will be closely link to research on causes of change. This work is important in the underpinning of research on identifying causes of change.

The ability to assess, visualise and analyse landscape characteristics and scenarios of change will aid the presentation and interpretation of consequences of land use change. Maps of landscape quality from spatial and contextual analyses of LCM data will form a basic framework for depicting 'quality'. To supplement this 'snapshot' of quality, computer-based techniques will be assessed for use in the visualisation of landscape change from the extensive land cover and attribute data held in the CS2000. Initially, this will involve the construction of static 'universes' using virtual reality techniques to model generic landscapes from attributes data in the CS2000 data. The temporal aspects of these landscapes will then be introduced to facilitate the assessment of change scenarios. Use of virtual reality techniques should allow the researchers to interact with these landscape models. These facilities could be developed further through existing links with software companies. Development of these facilities will be valuable in research on consequences of land use change. It will also link will research of use of remotely sensed data.

The current database of vegetation plots and spatial information from unenclosed landscapes will be subjected to integrated analysis using novel geospatial statistical techniques. This work will include assessing use of ground-based photos, remote sensed data and additional information sources to improve the quality of data analysis. The strengths and weaknesses in the information coverage identified from these analyses will indicate areas for improving or extending survey methods. The work will build on the field trails of GPS and computer-aided mapping started before CS2000 and will assess latest equipment and techniques with particular interest in efficient survey of features in unenclosed areas. This work should not only develop better methods for surveying currently monitored features, but also assess the feasibility of changing or extending what is monitored.

This work will link with developments remote sensing techniques / analysis and is vital in the development of any repeat survey work. The work will consider:

- Remote sensing segmentation to inform field survey;
- Very high resolution, 1-5 m, satellite remote sensing to extend sample sites;
- Stereo-matching of 1-5 m data for landscape and feature structure;
- Resolution enhancement of 30 m Landsat multi-spectral data with high resolution (5-15 m) panchromatic data to improve spatial detail;
- Radar data to replace and/or supplement optical data, especially in cloudy conditions;
- Integration of OS digital national framework (DNF) data with:
 - casi-LiDAR data of sample-squares,
 - conventional optical and radar satellite data,
 - resolution-enhanced satellite data;
- 'Real-time' field reconnaissance for training classification, using GPS linked to an integrated GIS.
- Developing a relational, hierarchical GIS for analysis of remote sensing and to build a intelligent landscape structure.

Resources and Timetable

Resources: 3 HSO years, over three years.

Timetable:

Year 1

Calibration of the dynamics and sensitivity of the CS2000 IBDs. Development of statistical analysis techniques for use in interpretation of change in IBD scores. 100 days Band 6. This will then be available to Year 2 of research of causes of change. Development of maps of landscape quality derived from spatial-contextual analyses of LCM. Development of outline approach to hierarchical landscape analysis. 60 days Bands 5/6/7.

Year 2

Integration of field survey data into landscape quality maps. Testing of hierarchical data structures. 100 days Bands 5/6/7. Development of computer-based visualisation and virtual reality techniques for the assessment of land use change scenarios. 100 days Band 6. This will then be available to Year 3 of research on consequences of change. Experimental evaluation of benefits of extending sample areas and/or number of squares through sampling of LCM. Desk study of sensing options for extension. 70 days HSO.

Year 3

Development of analysis techniques for survey data from unenclosed landscapes, including assessment of remote sensing. Evaluation of high resolution sensor options. Testing of resolution enhancement and consequent improvements for segmentation and classification. Assessment of use of OS DNF. 200 days HSO. Piloting of new survey methods for data collection in unenclosed landscapes for use in Countryside Survey. 150 days Band 6. This will then be available for subsequent proposals for repeat surveys.

Project leader: John Watkins

Staff involved: Simon Smart, Colin Barr, David Howard, Rick Stuart, Geoff Smith, Ross Hill, Nigel Brown, Jane Sanderson.

Linkages

This programme links with other development proposals for survey methods such as development of remote sensing techniques / analysis. The work will underpin research on identifying causes of change of land use change and assessing the consequences of land use change.

Potential funders

Development of computer-based visualisation may attract DTI funding for IT initiatives. Further development of these facilities may be possible through a NERC industrial link grant. Development of analytical methods and survey techniques may be seen as CEH core science though specific applications may be relevant for formulating policy for the Countryside (e.g. DETR, EN).

APPENDIX 9

CS2000 FOLLOW-UP WORK - CONCEPT NOTE 9

INTEGRATION OF FIELD SURVEY AND REMOTELY SENSED SATELLITE DATA

This concept note addresses the following questions:

*How can Field Survey and LCM2000 data be integrated with other data?
How can Field Survey and LCM2000 data be integrated?*

Outcomes, Justification and Priority

Deliverables:

- Revisions of the full resolution LCM attribute database, as far as possible, to correct errors;
- Generalised 1 km maps and datasets; incorporation of integrated data into the CIS;
- Published data, using integrated datasets to generate revised statistics for areal cover and, if possible, for point and linear features;
- and potentially:**
- An analytical system tailored to the generation of integrated outputs; or
- A decision support system operating the tailor-made analyses.

Integration of detailed field and laboratory data with the synoptic overview provided by remote sensing is fundamental to the extrapolation of sample-based and experimental observations. This study will be a World-leading example of research and development into methods and demonstration their in use. Applications of the results will underpin much of CEH's science. Furthermore, the ability to extrapolate is fundamental to the other CS2000 follow-up work, where: i. land cover stock must be available at local and regional scales; ii. scales of pattern and structure of habitats to be analysed are larger than the 1 km squares; iii. ecological principles are to be investigated at the landscape scale. LCM2000 is the only way to generate spatially explicit countryside indicators for the entire surface of the UK.

As the research underpins core CEH science and is applicable to all CS2000 follow-up work, the development of methods and the derivation of operational products is of the highest priority. However, production of an analytical system or a decision support system for third-party use would be in response specifically to customer needs and would not represent CEH core science.

Approach

A **scoping study** will: assess similarities and differences in field and LCM products; evaluate results of calibration; develop trial output-datasets; assess independent maps and data to be used corroboratively or identify key differences; propose an operational programme.

The **operations phase** will investigate: field survey errors and their distribution; correspondence in light of this; the means of attaching confidence limits to the LCM2000 vector data. It will aim to: reconcile spectrally-derived LCM information with field data; exploit additional spectral information to extrapolate field data; generate the best parcel-based vector datasets, 1 km summary datasets and statistics. Derived data will be checked against

corroborative information. Technical recommendations on the use of the data will be provided, including recommendations for habitat assessment and the future role of CS2000.

Resources and Timetable

The scoping study will draw upon CEH technical and support staff with LCM, field survey and GIS backgrounds, underpinned with statistical advice. It will hold workshops and technical meetings to assess needs and identify methods. CEH staff-input will total *c.* 50 days costing *c.* £17k. The work could start in spring and finish mid-summer.

The operational phase will demand similar types of staff for *c.* 360 days at a cost of *c.* £118k (provisional figures dependent on scoping study recommendations). The work would follow the scoping study and completion of LCM production, probably starting in mid- to late summer.

Linkages

Integration will combine the detail of the field survey with the full coverage of LCM2000 to provide best possible maps and statistics available from CS2000 (or anywhere). It will offer scope and coverage from the local to the national. It will provide detail which only the field survey can offer but framed within the LCM2000 context to give spatially explicit and estimates of stock and possibly change for land cover, land use, linear and point features, and species. As the best dataset with full and detailed national coverage, its products will link into every other piece of work which draws upon CS2000 maps and/or data.

Partnerships would involve user-organisations who will help determine form and use of outputs. The scoping study will investigate the need to collaborate with other specialists including especially spatial statisticians.

Potential funders

DETR and CEH would be likely funders of the scoping study. Other LCM2000 Consortium members would all be potential contributors to the operational phase. There may be other organisations who have not contributed to field or LCM2000 surveys but who envisage using the strengths of the integrated datasets; they may contribute funds, especially where they help develop specific data or generic products (including analytical / decision support systems).

APPENDIX 10

CS2000 FOLLOW-UP WORK - CONCEPT NOTE 10

FARMER CHARACTERISTICS AND COUNTRYSIDE CHANGE

This concept note has been designed to address the following question:

What can the typology of farmers developed by Potter and Lobley tell us about the changes recorded by CS2000?

Outcomes, Justification and Priority

Based on their study of farmer characteristics in the survey squares, Potter and Lobley (1996) classified farmers into various types (e.g. arable intensifiers; livestock intensifiers; extensifiers).² Past changes and future intentions were analysed by farm cluster.

Although it is likely that there will have been some change in land ownership since this survey was conducted, it would be of considerable interest to ascertain whether there are strong patterns of environmental change (as recorded in CS2000) that vary between these clusters. This would be a first step to understanding the agricultural and socio-economic context in which environmental change took place between 1990 and 2000. It may also be helpful in identifying particular issues that should be raised in any re-survey of farmers in the sample squares. Thus this project should be given a high priority in terms of the start date.

Approach

The approach would involve a descriptive analysis of environmental change recorded in the CS2000 data by farm cluster (as identified by Potter and Lobley).

The steps involved would be as follows:

- 1) A brief review of how each farm cluster was defined.
- 2) Identification of relevant environmental attributes that should be described by farm cluster; Derivation of variables that indicate different types of environmental change between the 1990 and 2000 survey.
- 3) Simple regression analyses relating environmental change to characteristics of farmers recorded in the survey – including farm typology.
- 4) Report on whether or not environmental change has taken place in situations that might be anticipated based on the analysis by Potter and Lobley (1996).
- 5) Summarise what can be learned from this information about the agricultural and socio-economic context of environmental change; Identification of relevant questions arising that should be asked in a repeat survey of farmers.

Resources and timetable

The Project leader would be Roy Haines-Young/Sandra McNally.
We would need a student to work on the data for 4-6 months.

² Potter, C., and Lobley, M., (1996), *Processes of Countryside Change in Britain*, Countryside Survey 1990 Series, Department of the Environment, London.

There would also be a need for some time input from someone familiar with CS2000 data to help identify what environmental attributes should be analysed and to explain relevant information to the student.

Sandra McNally would help the student work on regression analysis and interpretation of results.

Linkages

The work only depends on other aspects of the CS2000 follow-up programme in so far as this involves identifying what variables are of most relevance to describing environmental change.

The project would facilitate other projects within this module since it would be a first step to identifying the agricultural and socio-economic context of environmental change. It may also be of relevance in identifying questions of interest for the socio-economic re-survey of sample squares.

APPENDIX 11

CS2000 FOLLOW-UP WORK - CONCEPT NOTE 11

LINKING CS2000 AND OTHER NATIONAL AGRICULTURAL DATASETS TO UNDERSTAND PATTERNS OF COUNTRYSIDE CHANGE

This concept note has been designed to address the following question:

How do the changes recorded by CS2000 relate to changes in the farm economy recorded by other national data-sets?

Outcomes, Justification and Priority

There is much information available on changes within the farm economy. MAFF, for example, provides some historical data-sets on their Web-site, in addition to several annual reports. It is possible to obtain several of these data-sets at a more detailed level, for example from MAFF or from the Data Archive. The most comprehensive data on agricultural land use is contained within the June Census, which is conducted annually.

Another major data source is the Farm Business Survey for England and Wales. This provides detailed information on farm accounts from an annual sample of about 2,800 farms (above a size threshold). This data-set contains the most obvious link to CS2000 because in certain years, the ITE Land Class of the farms has been recorded. Thus if certain environmental changes can be described by Land Class, it would be possible to analyse the behaviour of farmers within Land Classes where particular environmental changes are considered likely to have taken place. For example, one could examine the changes in income, subsidies, investment and resource use on such farms. Analysis of the data in this way would give insight into the link between government policy, agricultural change and environmental change.

With regard to other agricultural data-sets, it is unlikely to be possible to directly link CS2000 results with the unit of observation. However, it would still be informative to describe change within the farm economy on a more aggregate basis, in a way that can be related to observed change within CS2000. For example, one could examine changes in agricultural land use within the June Census and environmental change within CS2000 by Standard Statistical Region.

This work would contribute to an understanding of the drivers of countryside change. It would be helpful to have more analysis of CS2000 prior to starting this work since this would give a better idea about what aspects of the farm economy might be most relevant to specific environmental changes. In particular, analysis of Farm Business Survey data with reference to Land Classes would be more useful if the probability of particular environmental changes could be described by Land Class.

Approach

The approach would involve the following steps:

- 1) Summary of environmental changes that are of most relevance and interest to explain with reference to the farm economy.
- 2) Review of available data-sets and establishing the level at which it is most useful to analyse the data (e.g. farm; regional; national), subject to availability, permission

- from data holders (e.g. MAFF) and potential cost (in terms of time required to process data and any access fee).
- 3) Identification of research questions that it is possible to investigate with available data; Derivation of appropriate empirical models.
 - 4) Data processing.
 - 5) Descriptive analysis of available data-sets with regard to the issues of interest.
 - 6) Statistical techniques, such as regression analysis, either to associate variables or to test a model of farmer behaviour.

Resources and Timetable

This project could be undertaken within CEH subject to available staff time, particularly for reviewing data-sets and processing data which are not already available to CEH. The project could be undertaken by CEH in about 4-6 months at HSO level. It may be useful to seek collaboration with outside organisations if we intend to analyse data where others have more expertise (e.g. Dept. of Land Economy for June Census data).

Roy Haines-Young/Sandra McNally could lead the project.

Sandra McNally would do the work relevant to analysis of FBS data.

The time frame of the project should be about 6 months, though this depends on how easily data can be accessed and what data processing might be involved.

If there is significant extra data processing, there may be a need for some research assistance from someone outside ESPRG.

Linkages

This work would be linked to other parts of the CS2000 follow-up programme because it is essential to have some summary and prior analysis of important environmental changes (and more specific information, by Land Class) before we examine the potential relationship between such changes and changes within the farm economy. Otherwise, an analysis of the farm economy may be too wide-ranging and not focus in on the most relevant issues. This work is complementary to other parts of this module. In particular, it helps put the CS2000 results in a broader economic context.

APPENDIX 12

CS2000 FOLLOW-UP WORK - CONCEPT NOTE 12

STRUCTURAL CHANGES IN LAND OWNERSHIP AND LAND MANAGEMENT AND THEIR IMPACT ON COUNTRYSIDE QUALITY.

This concept note has been designed to address the following questions:

- *How have the characteristics of land owners and land management changed in the CS2000 sample squares since 1990, and to what extent can they explain changes recorded by CS2000?*
- *How can we model the impacts of policy in the CS2000 sample squares in order to examine the consequences of policy changes for the wider countryside?*

Aim

The last decade has been a period of rapid change in the British countryside. It is evident, for example that there is greater diversity in patterns of land ownership and management. Moreover, patterns of rural economic activity in rural areas are both more varied and more closely linked to pressures of distant markets. As a result we face greater uncertainty in predicting the behaviour of landowners and land managers to policy initiatives which aim to sustain and enhance the qualities of the environment in our rural areas.

The aim of this research is therefore to:

- Understand the structural changes that have taken place in patterns of land ownership and land management in rural areas since the early 1990s;
- Document the relationship between these changes in ownership and management and patterns of land cover and habitat change over the same period;
- Report on the significance of these changes in ownership, management and land cover in relation to the goal of sustainable rural development;
- Provide a set of novel modelling tools, based on 'Baysian Belief Networks' and 'Evidence-Based Reasoning' Techniques, that would allow policy customers to explore alternative future scenarios.

Justification

The research builds on investment in research already made by DETR. The framework for the study is that of *Countryside Survey 2000* (CS2000), which has recently reported on the stock and change in the UK's Biodiversity Action Plan 'Broad Habitats' (Haines-Young et al. 2000).

CS2000 is unique in that it not only allows us to understand patterns of ecological change over the last 25 years, but it also allows us to look at these changes in relation to some of the key socio-economic drivers that shape our rural environment. In 1993, for example, a survey of farm businesses was undertaken in the same areas sampled by the last Countryside Survey, and these data allowed a typology of farmers to be constructed that could be used to understand land cover change (see Potter and Loblely, 1996).

This work on the socio-economic processes underlying the changes recorded by Countryside Survey has recently been evaluated by DETR, as part of their *Drivers of Countryside Change Project* (Haines-Young, 2001). The study confirmed the value of these data to the policy

community. These are a valuable asset in that they are the only data set available in the UK which allows us to link socio-economic characteristics of land managers to land cover change at national scales. The work went on to recommend that these data should be maintained and updated to take account of the changes that have and are taking place in the British countryside since the last survey. In particular it was recommended that:

- The survey of land owners and land managers should be extended beyond the agricultural sector, to take account of new patterns of woodland ownership and management;
- The survey should be extended to include a larger number of owners and managers, so that the data could be used more effectively to understand the regional patterns of countryside change identified by CS2000;
- That the outputs from the study should be used to understand the linkage between patterns of ownership and land management on the various indicators now being developed to monitor both countryside quality and rural sustainability.

The current proposal seeks to implement these recommendations.

Approach

The approach proposed for the study builds on an existing, robust survey methodology. However, it also extends our understanding of rural processes by including a wider range of land owners and managers in the survey, and operationalises this knowledge by the development of novel modelling tools.

The study will involve the following key steps:

1. Update the ownership database of CS2000 sample squares in England, Scotland and Wales. CS2000 is based on a stratified random survey of 1km x 1km Ordnance Survey grid squares. Quantitative and qualitative ecological change has been mapped in these squares and this first stage of the study would allow these changes to be allocated to different land ownership and land management units. This was done first in 1993, for the earlier socio-economic study. The updating process is both essential to understanding recent ecological change, and will also allow us to document the structural changes that have taken place in the farming sector in the survey squares since 1993.
2. Using the ownership database constructed in 1, a questionnaire survey of all landowners and managers will be undertaken across the survey squares. The priority will be to repeat the questionnaires in the 169 sample squares used in the 1993 study. However, the importance of extending the information to all survey squares in England Scotland and Wales is emphasised. These additional data will provide a base line against which future change in the countryside can be understood.
3. A subset of occupiers in sample squares will then be selected, for more detailed interview survey, to understand more deeply their attitudes towards rural sustainability issues. The interview survey will be structured in England to coincide with the Character Areas framework used by English Nature and the Countryside Agency, and in Scotland the Natural Heritage Areas. Advice will be taken on the structure of the interview survey in Wales. In this way the outputs from the work can be used to reflect on decision making in a wider landscape context. It will also allow us to determine attitudes towards the various advisory mechanisms that have been put in place to implement policy at the landscape scale.
4. The final stage of the research will involve both report on the empirical results of the study and the development of novel modelling tools that can be of use in the policy development process. The models will be based on the techniques of Bayesian Belief Networks and Evidence Based Reasoning, that are currently being discussed in the

environmental management literature, and will apply them, for the first time to this important area of countryside Policy. The work will build on expertise within CEH and University of Nottingham. The techniques allow the beliefs and goals of different stakeholders to be represented as a set of probabilistic variables, so that their behavioural response can be modelled as conditions impacting on the actors change or their beliefs about the properties of the system being managing are modified. The value of these tools is that the consequences of different assumptions can be explored. The work will seek to understand how the behaviours of the different land owner and manager groups will respond to different policy incentives, and what consequences (if any) these changes in behaviour will have for policy goals. As a result policy customers will be better placed to understand how policy initiatives will affect the various indicators of countryside quality and rural sustainability now being used by Central Government and its agencies.

Timetable and resources

A three-year study is envisaged. The work will involve a partnership between the University of Nottingham, Imperial College and CEH.

The key stages are:

Year 1:

- Update ownership/management database
- Pilot questionnaire survey
- Implement questionnaire survey
- Capture all questionnaire survey data in the CS2000 database

Year 2:

- Analysis of questionnaire survey results
- Identify locations for detailed interview survey
- Implement interview survey
- Scoping and specification for modelling tools

Year 3:

- Report on empirical results of study and organise review workshop for dissemination of results
- Complete modelling study
- Implement and test modelling tools
- Organise a workshop to review and disseminate results of modelling study.

It is anticipated that the resources required for the study are £470k over three years. The resources required include 2 Post-doc RAs and the funds to undertake the socio-economic questionnaire surveys.

References

Haines-Young, R.H. and McNally, S (2001) *Drivers of Countryside Change: Final Report*. CEH, Monks Wood. PROJECT No: CO1444

Haines-Young, R.H. *et al* (2000) *Accounting for nature: assessing habitats in the UK countryside*, DETR, London ISBN 1 85112 460 8

Potter, C. and Loble, M. (1996) *Processes of Countryside Change*. Countryside Survey 1990 Series, 7. Department of the Environment, London.