



## **COLLABORATION FOR ENVIRONMENTAL EVIDENCE**

### **SYSTEMATIC REVIEW No. 39**

#### **WORKING TITLE: COMPARISON OF METHODOLOGIES FOR THE MONITORING AND SURVEILLANCE OF UK TERRESTRIAL VEGETATION.**

#### **CONSULTATION DRAFT REVIEW PROTOCOL**

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## COVER SHEET

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## 1. BACKGROUND

Effective monitoring, observation and surveillance mechanisms are required in order to assess environmental change and measure progress towards environmental/biodiversity targets (ERFF 2006). A recent report listed over 400 monitoring and surveillance activities in operation in the UK, ranging across the spectrum of pollution, climate change, hydrology, meteorology and conservation management and costing between £88 million and £500 million per annum (Slater et al. 2006). However, many monitoring and surveillance schemes are limited in their ability to meet their objectives, which are to determine state (condition) on successive occasions, and/or to detect changes of an appropriate magnitude, as reviews by Legg and Nagy (2006) and Yoccoz et al. (2001) have concluded. Numerous factors can contribute to the failure of a monitoring programme including insufficient attention being paid to hypothesis formulation (Legg and Nagy 2006), survey design (Seavy and Reynolds 2007), data quality (Vittoz and Guisan 2007) and statistical power (Stefano 2003).

Terrestrial vegetation monitoring is an important component of monitoring and surveillance activities, but currently has a limited coverage and is poorly linked to other environmental sectors (JNCC 2008a, b). In particular, a Vegetation Sampling workshop organised by the JNCC concluded that there is a lack of understanding of suitability and effectiveness of approaches used in vegetation monitoring and recommended the development of protocols which give good measurability and consistency (JNCC 2008b). Improved vegetation monitoring approaches, and knowledge of suitability for purpose, would serve a number of functions. By providing accurate assessments of plant populations and communities (and changes in them), effective vegetation monitoring would help to increase understanding of ecosystem change, measure environmental pressures such as climate change and assess changes in habitat quality.

For practitioners, this would ensure appropriate management decisions are taken at the site level and would allow sensible use of limited resources. More widely, this would contribute to key strategies such as the Joint Nature Conservation Committee (JNCC) **Proposal for a Terrestrial Biodiversity Surveillance and Monitoring Strategy** which includes the need to ‘...*create flexible and fit for purpose surveillance and monitoring...*’ and the **England Biodiversity Strategy- Towards adaptation to climate change**, which states the importance that ‘...*monitoring is based on scientifically sound and statistically robust design, in order to maximise the chance of detecting trends and extreme events and separating them from natural variation.*’ (JNCC 2008a; Mitchell et al. 2007). Improved vegetation monitoring is also required for a number of international obligations including the **European Habitats Directive** which states that ‘*member States shall undertake surveillance of the conservation status of the natural habitats and species...with particular regard to priority natural habitat types and priority species.*’ (EEC 1992), the **Millennium Development Goals** which uses vegetation indicators to monitor progress towards the goal of ‘...*reversing the loss of environmental resources.*’ (DFID 2008), the **Global Plant Conservation Strategy** which demands a ‘*preliminary assessment of the conservation status of all known plant species, at national, regional and international levels*’ (CBD 2008) and also the **Ramsar Convention on Wetlands** which sets targets for the assessment and monitoring of wetland vegetation (Ramsar 2008).

This review is concerned with the methods, techniques and protocols for monitoring and surveillance of vegetation used in conservation and natural resource management, which may include surveys and censuses, where the methodologies are relevant (or where the terms are being used interchangeably with monitoring or surveillance). For the purposes of this review, *monitoring* is taken to be the description and quantification of the state of the environment and ‘...only requires a single observation for a comparison to be made with the required standard, norm or outcome’, whereas *surveillance* measures how the environment is changing, and thus requires observation on more than one occasion (Rowell (1996) based on definitions set out by Hellowell (1991)).

The available literature regarding the empirical evaluation of methods for monitoring and surveillance of vegetation has not been subject to uniform critical appraisal. This review will use diagnostic test systematic review methodology (Khan et al. 2001; Khan et al. 2003; Pullin and Stewart 2006), to investigate and critically appraise the comparative utility of vegetation monitoring methods in terms of their ability to reliably detect state and/or direction and rate of change. Publication bias will be limited through the use of comprehensive literature searching (including searches of grey literature). Selection bias will be addressed with the use of specific inclusion criteria, and formal assessment of the quality and reliability of the studies retrieved. Subsequent data synthesis (qualitative and/or quantitative) will summarise evidence to provide guidance regarding the relative merits of different monitoring techniques and highlight any gaps in existing practice.

## 2. OBJECTIVE OF THE REVIEW

### 2.1 Primary question

How do current terrestrial vegetation monitoring and surveillance methods compare in their ability to reliably assess state and/or direction and rate of change in state?

Table 1. Definition of components of the primary research question

Subject	Comparators	Outcome
UK terrestrial vegetation	Two or more vegetation monitoring or surveillance methods  Component(s) of single vegetation monitoring or surveillance method  Scale: spatial e.g. site/regional/national/international (UK and Europe) temporal e.g. one off/annual/less frequent  Observers: how many, level of experience	Ability to assess state* and/or direction and rate (magnitude over time) of change in state*  Reliability (repeatability over space and between observers)

\*State encompasses a range of measures of quantity (extent) and quality (using measures such as dominance, maximum height or mean height of individuals).

## 2.2 Secondary question

Are similarities and differences in the ability and reliability of individual monitoring and surveillance methods to assess state and/or direction and rate of change in state consistent across type of vegetation, spatial scale, temporal scale and observers?

## 3. METHODS

### 3.1 Search strategy

The following computerised databases and catalogues will be searched:

1. ISI Web of Science, incl. ISI Web of Science and ISI Proceedings ([www.portal.isiknowledge.com/portal](http://www.portal.isiknowledge.com/portal))
2. Scopus ([www.info.scopus.com](http://www.info.scopus.com))
3. ScienceDirect ([www.sciencedirect.com](http://www.sciencedirect.com))
4. COPAC ([www.copac.ac.uk](http://www.copac.ac.uk))
5. Index of Theses Online ([www.theses.com](http://www.theses.com))
6. Science Conference Proceedings ([www.osti.gov/scienceconferences](http://www.osti.gov/scienceconferences))
7. Science.gov ([www.science.gov](http://www.science.gov))
8. Blackwell Synergy ([www.blackwell-synergy.com](http://www.blackwell-synergy.com))
9. IngentaConnect ([www.ingentaconnect.com](http://www.ingentaconnect.com))
10. Directory of Open Access Journals ([www.doaj.org](http://www.doaj.org))
11. CAB Abstracts ([www.cabi.org](http://www.cabi.org))

Other specific/ specialised databases will be searched where identified or recommended by experts within the field. The citations retrieved from each search will be recorded within an EndNote database. In addition, web searches will be performed using the search engines: Google Scholar ([scholar.google.com/](http://scholar.google.com/))/ Google ([www.google.com](http://www.google.com)) / Intute ([www.intute.ac.uk](http://www.intute.ac.uk)).

The first 50 hits (.doc, .txt, .xls and .pdf documents where this can be separated) will be fully viewed and then the next fifty will be checked for any relevant hits. No further links from the captured website will be followed unless to a document/pdf file. The following search terms will be utilised and adapted as necessary during searching (\*indicates a wildcard):

1. monitor\* AND review\* AND vegetation OR communit\* OR “plant communit\*” OR grass OR wood OR forest OR heath
2. monitor\* AND optim\* AND vegetation OR communit\* OR “plant communit\*” OR grass OR wood OR forest OR heath
3. sampl\* AND method\* AND vegetation OR communit\* OR “plant communit\*” OR grass OR wood OR forest OR heath
4. design\* OR survey\* AND method\* AND vegetation OR communit\* OR “plant communit\*” OR grass OR wood OR forest OR heath
5. monitor\* AND method\* AND plot\* AND vegetation OR communit\* OR “plant communit\*” OR grass OR wood OR forest OR heath
6. observer\* AND vegetation OR communit\* OR “plant communit\*” OR grass OR wood OR forest OR heath
7. protocol\* AND monitor\* AND vegetation OR communit\* OR “plant communit\*” OR grass OR wood OR forest OR heath
8. surve\* AND vegetation OR communit\* OR “plant communit\*” OR grass OR wood OR forest OR heath

Some search engines lack the wild card ability. In those cases, the following search terms will replace the wildcard term:

monitor OR monitors OR monitoring OR monitored  
method OR methods OR methodology OR methodologies  
optimal OR optimise OR optimize OR optimising OR optimizing OR optimised OR optimized  
sample OR samples OR sampling OR sampled  
observer OR observers OR observed  
community OR communities  
protocol OR protocols  
survey OR surveillance

Specific websites for environmental organisations will also be searched, concentrating on UK and European sites in the first instance:

Countryside Council for Wales ([www.ccw.gov.uk](http://www.ccw.gov.uk))  
Environment & Heritage Service ([www.ehsni.gov.uk](http://www.ehsni.gov.uk))  
European Forest Institute (<http://www.efi.int/portal>)  
European Plant Conservation ([www.plantlife.org.uk](http://www.plantlife.org.uk))  
Forestry Commission ([www.forestry.gov.uk](http://www.forestry.gov.uk))  
Finland's Environmental Administration ([www.environment.fi](http://www.environment.fi))  
Joint Nature Conservation Council ([www.jncc.gov.uk](http://www.jncc.gov.uk))  
METLA (Finnish Forest Research Institute) ([www.metla.fi](http://www.metla.fi))  
Natural England ([www.naturalengland.gov.uk](http://www.naturalengland.gov.uk))  
Planta Europa ([www.plantaeuropa.org](http://www.plantaeuropa.org))  
Scottish Natural Heritage ([www.snh.gov.uk](http://www.snh.gov.uk))

If focusing on the UK and Europe produces too few studies, the geographic range will be widened and the following websites also searched:

Australian Government Department of the Environment, Water, Heritage and the Arts ([www.environment.gov.au](http://www.environment.gov.au))  
Canadian Forest Service ([www.cfs.nrcan.gc.ca](http://www.cfs.nrcan.gc.ca))  
Conservation Online (<http://palimpsest.stanford.edu>)  
Environment Canada ([www.ec.gc.ca](http://www.ec.gc.ca))  
IUCN ([www.iucn.org](http://www.iucn.org))  
New Zealand conservation department ([www.doc.govt.nz](http://www.doc.govt.nz))  
The Nature Conservancy ([www.nature.org](http://www.nature.org))  
United States Department for Agriculture Forest Service ([www.usda.gov](http://www.usda.gov))  
WWF International ([www.panda.org](http://www.panda.org))

The four top ranked journals (determined numerically from a trial search of ISI Web of Science) for monitoring related papers: Conservation Biology, Environmental Management and Assessment, Journal of Applied Ecology and Journal of Environmental Planning and Management will also be searched separately for the term 'monitoring' in Web of Science. Bibliographies of articles accepted at full text will be searched for relevant articles missed by previous searches.

It is envisaged that a large amount of work assessing monitoring and surveillance methods will not be published formally, thus recognized experts, practitioners and authors (mainly from the UK) will be contacted for further recommendations and for provision of relevant unpublished material or missing data. Initial points of contact will be relevant staff from the statutory agencies, NGOs and research organisations (Natural England, Countryside Council for Wales, Scottish Natural Heritage and Northern Ireland Environment Agency, Environment Agency, Woodland Trust, National Trust, Botanical Society for the British Isles, Royal Society for the Protection of Birds, Macaulay Institute, Centre for Ecology and Hydrology, Forest Research and ADAS). If necessary, meetings will be arranged with key contacts.

### **3.2 Study inclusion criteria**

The inclusion and exclusion criteria will be applied by one reviewer to all potential studies at the title or title and abstract stages. Where there is insufficient information to make a decision regarding study inclusion, then relevance to the next stage of the review process (full text assessment) will be assumed. A second reviewer will examine a random subset of at least 25% of the reference list (up to a maximum of 300 references) to assess repeatability of the selection criteria. Kappa analysis will be performed, with a rating of substantial (0.6 or above) being required to pass the assessment. Disagreement regarding inclusion or exclusion of studies will be resolved by consensus, or following assessment by a third reviewer. If the Kappa value is low, the reference list will be reassessed against adjusted inclusion and exclusion criteria. The same subset of references will be re-assessed by a second reviewer with Kappa analysis. Reviewers will then consider articles viewed at full text for relevance, either excluding them from, or admitting them to, the review.

#### **Relevant subject(s):**

Terrestrial vegetation. The scope will be UK and Europe, although care will be taken to ensure that methods from countries outside the UK are carefully filtered for their applicability to the UK environment.

#### **Comparators:**

Studies comparing methods used for monitoring and surveillance of terrestrial vegetation (either one method with another or the same method repeated over space by single or multiple observers) will be considered valid for inclusion initially.

#### **Types of outcome:**

Ability to assess state

Ability to detect direction and rate of change in state

Reliability (repeatability over space and between observers)

#### **Types of study:**

Any comparative primary studies which directly (i.e. setting out to test or compare methods) assess the effectiveness of methods (or aspects of) for monitoring or surveillance of vegetation will be included initially. If this is producing few or biased results then studies which indirectly (i.e. setting out to research or to monitor but with comments on the efficacy of methods) assess the effectiveness of methods (or aspects of) for monitoring and surveillance of vegetation will also be included.

### **Potential reasons for heterogeneity in outcomes:**

Type of vegetation; spatial scale; temporal scale; observers.

### **3.3 Study quality assessment**

To determine the level of confidence that may be placed in selected data sets, each one must be critically appraised to assess the extent to which its research methodology is likely to minimize systematic errors or bias (Khan et al. 1996). Data quality assessment will be undertaken using a simple but discriminatory list of desirable characteristics that control for biases such as baseline confounding, parameter estimation inaccuracy, inappropriate comparison of spatio-temporal scales. Sensitivity analyses will then be undertaken to assess the extent to which results are consistent for studies which do and do not employ methodologies that control for these biases.

### **3.4 Data extraction strategy and synthesis**

The quantity, quality and type of information available to address the subcomponents of this review are currently unknown. Methods for extraction and synthesis are therefore imprecise and will be the subject of protocol amendment prior to commencing this phase of the work. Where limited information is available, or data types too diverse for quantitative synthesis, studies will be categorised according to subject, comparator and outcome to facilitate qualitative summary. Meta-analysis of diagnostic test comparisons will be undertaken on any pools of data where effect sizes can be derived. Other methods of quantitative analysis will be used where effect sizes cannot be calculated but comparative data is available.

## **4. POTENTIAL CONFLICTS OF INTEREST AND SOURCES OF SUPPORT**

There are no conflicts of interest.

## **5. REFERENCES**

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