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Spatial framework for assessing evidence needs for operational ecosystem approaches

User Guide

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Introduction

The ecosystem services approach is a key element of planning for sustainable development. This user guide accompanies the report and framework from a study undertaken for the Joint Nature Conservation Committee (JNCC) to develop the use of spatially-based biodiversity data for the delivery of work on ecosystem services. It explains the framework and information and gives a worked mapped example.

The overall project aim

- To aid the practical quantification and valuation of ecosystems services for a range of decision making processes at local, landscape and country levels and in doing so inform on-going development of UK-level biodiversity data collection surveys and schemes and data access provision.

The spatial framework:

- Describes the biophysical characteristics occurring within a landscape;
- Makes links between the physical and biological characteristics of habitats and the major ecosystems services being provided;
- Identifies practical and appropriate ways in which habitat (and other biodiversity) data can be used to identify and understand ecosystem service provision;
- Identifies ways in which habitat data can be used to describe landscape characteristics and understand how this varies spatially.

The influence that a parcel of land (the basic area on which a habitat sits) exerts on the delivery of an ecosystem service depends on four main factors:

1. **What it is** – i.e. the land cover or habitat type and its condition
2. **What it is on** – i.e. the geology and soil type underlying the land
3. **Where it is** – i.e. the landscape context of the land (e.g. on a steep slope or valley bottom next to a river or proximity to an urban area)
4. **How it is managed** – i.e. the management regime, which in some cases is influenced to differing degrees by statutory or other designations imposed upon the site, or voluntary agreements that specify aspects of management (e.g. intensive or extensive or little active management or designation as a SSSI or AONB, schemes such as Woodland Grant Scheme, agri-environment schemes)

From these four factors the framework identifies **three evaluation criteria**:

a) The overall importance of the habitat in helping to deliver each ecosystem service.

b) The general state of knowledge about relationships between the habitat and each of the services.

c) The quality/availability of the data that exists to help quantify and map these services.

The three evaluation criteria described above have been used to produce a 'Tier' Table where each of the habitats studied is evaluated in terms of the importance of the ecosystem service the knowledge we have about how that service operates and the quality of data available. It is these three evaluation criteria that help place a habitat in an appropriate 'tier' so that when it comes to considering the role the habitat plays in the delivery of a particular ecosystem service, the framework approach can be used in an informed way.

The use of a tier table structure provides a logical way of highlighting existing gaps in knowledge and data, and a method of relating these to ecosystems services present in the studied habitats. This then provides a good indication of where further information would be needed for informed use. Tier scores are also a useful tool to include with spatial maps of the services, to indicate where knowledge is less certain and data may need to be used with caution or supplemented by further studies.

Table 1 Tiers of the spatial framework

Example Habitat and Ecosystem Service										
Tier Importance for the Ecosystem Service		Knowledge and scientific understanding of how the service operates								
		Good knowledge (i)			Some Knowledge (ii)			Little or no Knowledge (iii)		
1	The habitat has a High Importance/Risk for the ecosystem service	Data Good (a)	Data Some available (b)	Data Poor (c)	Data Good (a)	Data Some available (b)	Data Poor (c)	Data Good (a)	Data Some available (b)	Data Poor (c)
2	The habitat has a Moderate Importance/Risk for the ecosystem service	Data Good (a)	Data Some available (b)	Data Poor (c)	Data Good (a)	Data Some available (b)	Data Poor (c)	Data Good (a)	Data Some available (b)	Data Poor (c)
3	The habitat has a Low Importance/Risk for the ecosystem service	Data Good (a)	Data Some available (b)	Data Poor (c)	Data Good (a)	Data Some available (b)	Data Poor (c)	Data Good (a)	Data Some available (b)	Data Poor (c)

Framework structure

The framework has been developed as a large matrix, where, for each habitat, rows show the ecosystem services and columns show the attributes of importance and the knowledge and quality of the data available and the assessment made of the tier allocation. The outline of the framework is shown in Table 2.

Table 2 Overview of the framework structure

<table>
<tr><td colspan="9">Framework example for Broadleaved Woodland (BLW):</td></tr>
<tr><td colspan="3">Ecosystem service:</td><td colspan="3">Assessment:</td><td colspan="3">Contextual data:</td></tr>
<tr><td colspan="3">Services are most easily mapped at the specific level. The maps can then be combined to give the Intermediate level and high level service picture using geoinformatics techniques</td><td colspan="3">Each habitat is assessed in terms of the importance of the habitat in its contribution to the service and therefore the risk to the service if the habitat is not maintained. The knowledge available about how the habitat functions is then assessed and the data sets available to map the systems are considered within the data column</td><td colspan="3">Contextual data is essential to understand how the habitat relates to its surroundings in terms of ecosystem services. The available, type and relevance of contextual data is outlined in these parts of the framework.</td></tr>
<tr><td>High Level</td><td>Intermediate Level</td><td>Specific Service</td><td>Importance</td><td>Knowledge</td><td>Data</td><td colspan="3"></td></tr>
<tr><td rowspan="4">Climate regulation</td><td rowspan="2">Carbon flux</td><td>Carbon sequestration Soil</td><td rowspan="4">Highly important for climate regulation</td><td rowspan="4">Identifies what attributes are important and can be measured.

e.g. Extent of woodland, type of woodland,</td><td rowspan="4">What existing datasets are available to quantify those attributes

e.g. Phase 1, LCM, AW, NFI</td><td rowspan="4">Scale of data availability::
National, regional, local + suitability</td><td colspan="2" rowspan="4">Where the habitat is – landscape context
What substrate the habitat is on – underlying geology
How the habitat is managed</td></tr>
<tr><td>Carbon sequestration Vegetation</td></tr>
<tr><td rowspan="2">Carbon storage</td><td>Carbon Storage Soil</td></tr>
<tr><td>Carbon Storage Vegetation</td></tr>
<tr><td colspan="3"></td><td colspan="3">Tier allocation categories for assessment.
Scored:</td><td colspan="3"></td></tr>
<tr><td colspan="3"></td><td>High/Med/Low
+ve or -ve</td><td>High/Med/Low</td><td>High/Med/Low</td><td colspan="3"></td></tr>
<tr><td colspan="3"></td><td colspan="3">Assessment for Broadleaved Woodland:</td><td colspan="3"></td></tr>
<tr><td colspan="3"></td><td>H+</td><td>M</td><td>H</td><td colspan="3"></td></tr>
</table>

It is mostly possible, with existing knowledge, to categorise the ecosystem service relevant to each data set into those of high, medium and low significance therefore within the tables classes, 'high', 'medium', and 'low' were used to split the data for each ecosystem service and data. Even with less than ideal data and a less than exact knowledge about the interactions between the habitats, its location, management and the service, it is possible to grade the importance into this simple three-step categorisation. As research progresses and new data sets are found it will be possible to become more exacting with these classifications

Throughout the process of developing a framework there was recognition that the quantification and mapping of ecosystem services is a young and developing science, where knowledge and data are likely to improve as new work is carried out and new insights developed into factors important for the delivery of those services. Figure 1 below shows an example Tier diagram for Broadleaved woodland.

Broadleaved Woodland

Services	Importance + Risk	Knowledge	Data	Tier
Regulating Water Quality	H	H	H	1ia
Regulating Water Quantity	H	H	H	1ia
Carbon Storage	H	H	H	1ia
Cultural	H	H	H	1ia
Agricultural Goods				
Forestry Goods	M	H	H	2ia
Pollination	H	M	M	1iib
Biodiversity	H	H	H	1ia

Importance + Risk of habitat on provision of service

H	Highly Important and High Risk
M	Moderately Important and Moderate Risk
L	Slighty Important and Slight Risk

Figure 1 Example of Tier of knowledge for Broadleaved Woodland

The framework sets out the data and information about the relevant habitat that will be important in helping to quantify and map its role in ecosystem service mapping. Behind the rationale of the work is the basic premise that every parcel of land contributes to delivering every ecosystem service in some way, however small (and possibly negatively). An example of the mapped output is shown in Figure 2 below. The framework shows links between the physical and biological characteristics of habitats and the major ecosystem services they provide.

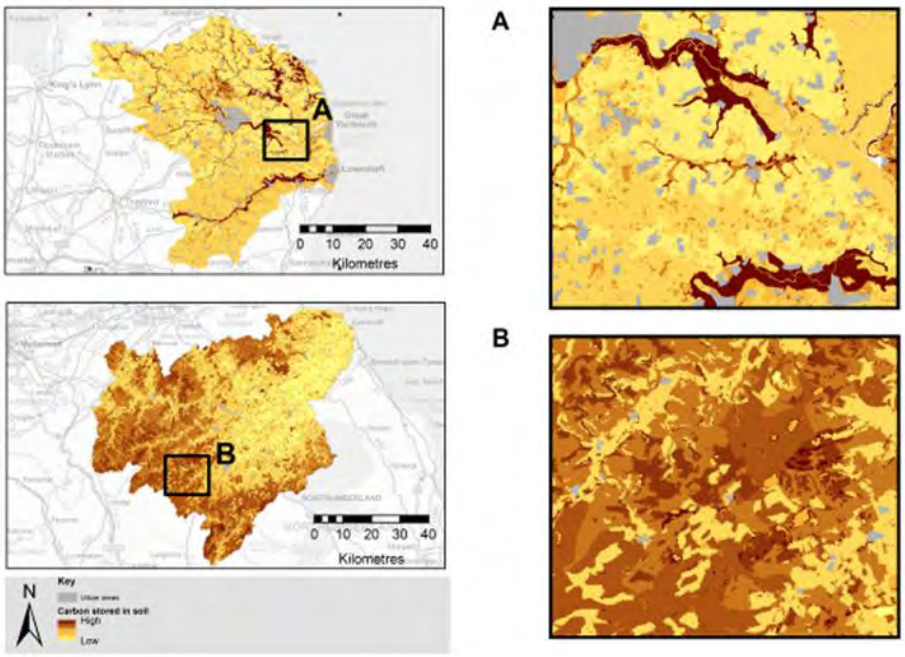

Figure 2 Example showing soil carbon storage in Norfolk (A) and Scottish Borders (B)

Using the framework

The framework has been designed to facilitate ecosystem service mapping using existing data. The spread sheets summarise:

- The important features of the habitat and the ecosystem services which relate to it;
- For each ecosystem service, the important ecosystem attributes underpinning service provision;
- The significance of geodiversity, landscape context and management on the service for the habitat;
- Existing data sets which can be used to indirectly or directly model these;
- The coverage and accessibility of these data sets;
- Limitations of the datasets.

The framework documents will therefore allow users to understand the range of data available, the use and its limitations and help facilitate mapping of ecosystem services for policy and community use. This framework contains existing knowledge and data available to this project. It is not intended to be comprehensive in its coverage but rather to provide a mechanism for going forward pointing out where data gaps are limiting. The advantage of this approach is with new data and knowledge the framework will become a more useful and powerful tool.

Conclusions

The framework provides a logical and transparent process for evaluating the role of habitats in delivering ecosystem services which can be extended to other habitats and other ecosystem services. Understanding the relationships between terrestrial habitats and ecosystem services is generally good for most regulating, provisioning and supporting services, although less so for cultural services. Understanding for marine habitats is generally under developed.

The project has shown the wide range of terrestrial datasets available for evaluating regulating, provisioning and supporting services and the differences in quality, resolution and scale. Moving forward there is a need for more consistent and compatible data across wider areas of the terrestrial landscape. Data availability is less advanced for cultural services. The case study maps have shown the effects of data quality and resolution. Fitness-for-purpose is important; high quality data is not always required, especially for strategic purposes, but for more local practical planning purposes, high quality high resolution data provides a more effective tool.

This user guide is accompanied by a report and the framework spreadsheets for ecosystem services modelling.