Review of monitoring data for reporting on Natural Capital

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1. Introduction

This review of data sources was established to determine which monitoring data could be used to report on natural capital. This required the collation of potential datasets and the creation of a link between individual monitoring data and each natural capital asset. The review was focused on collating metadata and hence no data have been extracted or analysed. Some data have been examined and sourced for particular assets to support the metrics and risk register work (Eftec and Cascade, 2014) and to illustrate possible uses and issues. The review has also identified gaps in monitoring data that might inhibit natural capital reporting.

2. Methods

The data review has been informed by the Natural Capital Committee's emerging conceptual framework (Natural Capital Committee, 2014). A list of assets of interest for natural capital reporting was drawn from this framework and included: **Species, Ecological Communities, Soils, Freshwaters, Land, Atmosphere, Minerals, Sub-soil assets, Oceans and Coasts.**

The scope and definitions for each of these assets are provided in the Natural Capital Committee metrics paper (Natural Capital Committee, 2014).

For each asset potential datasets were identified and reviewed, information was captured in an Excel spreadsheet on:

- Source
- Extent
- Spatial configuration
- Monitoring frequency
- Accessibility
- Ease of use
- Quality
- Uncertainty

From this information summary tables were created for each asset that identified key sources of data. These were colour-coded red, orange, green according to the availability of appropriate data (red= no data available, orange=some data, inconsistently collected across components, time or space, green= good data at appropriate spatial or temporal scales).

Reports containing relevant data have been identified, collated and archived to enable efficient extraction of information, sources of data such as web portals and summary reports have been listed at the end of this report.

3. Results

Appendix 1 presents the outputs of this review of datasets that could potentially be used to report on each natural capital asset. The data source has been identified (web page given where possible, reports cited) and metadata has been recorded for each dataset on the categories described above. Each source has been numbered and these numbers are referred to in the summary tables (Appendix 2).

Summaries of the data identified and categorised into the three colour classes (red, orange and green) are presented in Appendix 2. In each summary assets are broken down into components for which reporting may be required; the most appropriate datasets for reporting are then identified. In addition to the two detailed appendices accompanying this report, three tables are included at the end of this report. Table 1 shows the breakdown of assets and proposed components for reporting. Table 2 provides an example of the summary analysis for the soils asset and Table 3 gives an example of how data on ecological communities can be reviewed and used to indicate status and trends for a particular asset; the source for each statistic used is referenced. In Appendix 1 datasets have been identified for the extent (stock and trend) and condition (stock and trend) of each asset component. Multiple datasets for the same asset/component have been included where necessary and there is discussion of data within the cells of the spreadsheet as well as a notes column.

A brief discussion of the main data source and particular issues for each asset follows:

3.1 Species

This asset is defined as:

> *All living organisms including plants, animals, fungi and micro-organisms. The product of ongoing evolutionary processes.*

The primary mechanism for reporting on species of conservation concern was through the UK Biodiversity Action Plan, the last report for both species and habitats was in 2008 (see below). Responsibility has now devolved to individual countries and all have produced their own biodiversity strategies (**UK post 2010 Biodiversity framework** http://jncc.defra.gov.uk/page-6189). This may result in divergence in methods and indicators and less emphasis on UK reporting.

There are a number of summary reports that describe the results from analyses of existing data to create trends in distribution and abundance of species.

- The State of Nature in the UK and its Overseas Territories RSPB report
- UK NEA Biodiversity chapter
- UK Biodiversity Indicators JNCC 2013 Indicator C4a Change in the relative abundance of priority species in the UK, 1970 to 2010, C4b status of species of European importance, C5 Birds of the wider countryside and at sea (Farmland birds, Woodland birds, Wetland birds, Seabirds, Wintering water birds), C6 Insects of the wider countryside (Butterflies), C7 Plants of the wider countryside, C8 Mammals of the wider countryside.
- The UK Biodiversity Action Plan: Highlights from the 2008 reporting round
- Common Standards Monitoring results – species on SSSIs

The Biological Records Centre is working on species models which will enable them to assess the distribution of a wider group of species (Figure 1).

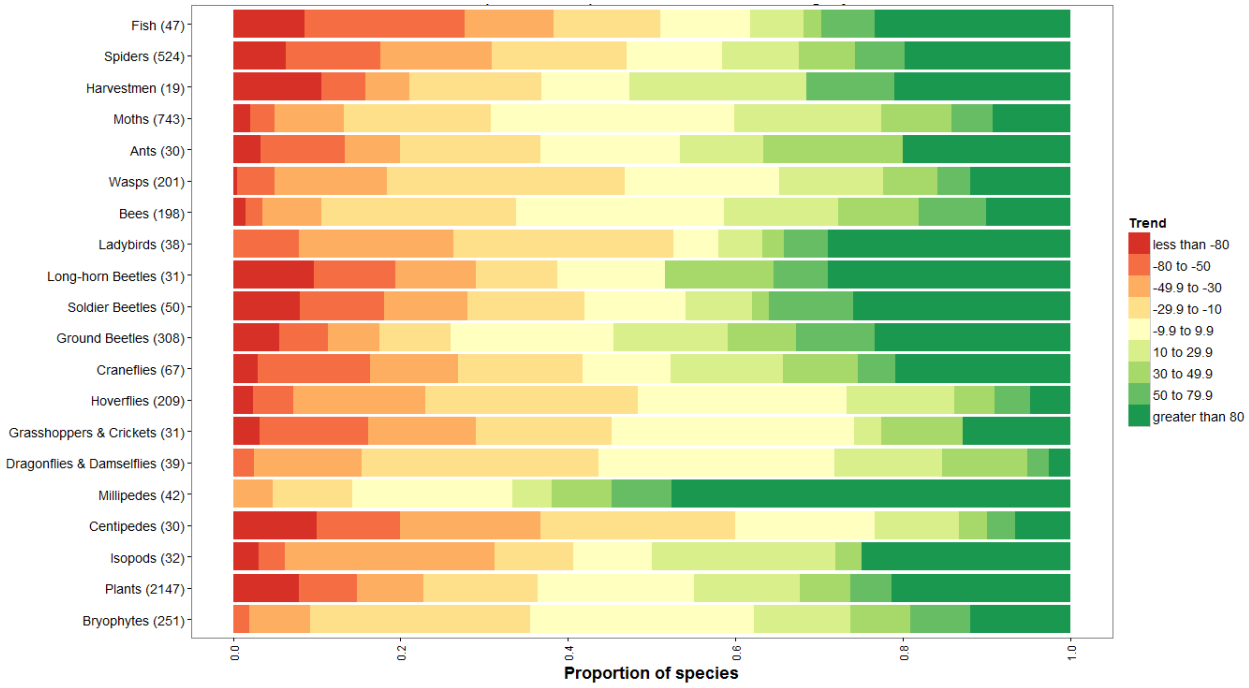

Figure 1 Bar plot showing the proportion of species that fall within each trend category based on the change in probability of observation between 1990 and 2000. The number of species for which trends were estimated is listed in brackets alongside the name of the taxonomic groups. These are provisional results and require validation with species groups representatives.

Monitoring gaps

- The State of Nature report collated trends in abundance, distribution, or both, for as many species of plants and animals as possible -3,148 in total – but this represents only 5% of the estimated 59,000-plus terrestrial and freshwater species in the UK. 58% of vertebrates were assessed compared to only 4% of invertebrates and 6% of plants and fungi. Even amongst the best known group, the vertebrates, they had information only for birds and some mammals, and for just one amphibian.
- There tend to be more data on frequency and distribution than abundance, it is very difficult to record abundance of some species. For many groups there is only frequency data not abundance available.
- There tends to be a spatial bias to recording- some areas of the country are better recorded than others, may be due to population density or presence of experts in particular groups.
- There is also a temporal bias- recording may have improved (or declined) in intensity over time. New methods for quickly capturing information have been developed.
- Microorganisms are poorly studied on a large spatial scale (soil bacteria was sampled in the last Countryside Survey).
- Data on fungi are limited although there is a recording scheme with many records.
- For many taxa there are inconsistent data e.g. mammals, amphibians, mobile terrestrial invertebrates, phytoplankton, seagrasses, macroalgae. Consequently some species or groups

may be very well recorded e.g. natterjack toads, butterflies, moths, yet for others no or little data is available.

The National Biodiversity Network (NBN) contains over 92 million species records and there are many recording schemes in existence. It is therefore, hoped that in the future reporting will be possible for a greater number of taxa.

3.2 Ecological Communities

This asset is defined as:

> *A group of actually or potentially, interacting species living in the same place. Groups of interacting species form distinctive assemblages interacting with their physical environment.*

This asset is considered to broadly correspond to 'habitats' for which there are a number of readily available data sources. There are a number of habitat classifications that are currently or have previously been used for UK habitat reporting. The Broad and Priority habitat types have been around for 13 years as reporting units for the UK Biodiversity Action Plan (UKBAP). In addition the EU Habitats and Species directive requires reporting on Annex 1 priority habitats which is based on a European level habitat classification scheme (EUNIS). Other potential classifications include the National Vegetation Classification, and Phase 1 and Phase 2 habitat classifications. To capture information on all of the habitats in GB it was decided that the Broad Habitat classification was most appropriate for natural capital reporting, priority habitats can be nested inside of this classification and it means that habitats in a range of states can be reported on rather than just those of the highest quality or conservation concern.

Countryside Survey (CS) reports on the extent and change in stock and condition of Broad Habitats in the UK, the advantage of CS is that data are recorded consistently across habitat types and over time so that comparisons between habitats are possible. The Land Cover Map also records the extent of habitats based on remote sensing but does not report on all of the Broad habitats to the same level of accuracy (Morton *et al*. 2012) nor currently record change. The National Forest Inventory (NFI) provides estimates for woodland in GB.

Reporting on Priority or EU Habitats and Species Directive Annex 1 habitats is less consistent. Historically, reporting was by individual priority habitat at the UK level and there was inconsistency in methods and approach between habitats. The UKBAP report for 2008 stated that Lead Partners felt that there was adequate monitoring data to assess the status and trends of only six priority habitats (13%). There has been a lot of work since then to compile datasets and to produce estimates of extent of priority habitats and spatial data layers, these are now available for England on the Natural England website (Alexander, 2013), Wales also has spatial priority habitat data (Blackstock *et al*., 2010). Scotland is creating the Habitat Map of Scotland (HabMoS) which is to be completed by 2019. This will have digital cover of EUNIS coded Annex 1 habitats and also at a lower broad level EUNIS code. The data used in England and Wales is from diverse sources; SSSI (Sites of Special Scientific Interest) monitoring, local records centres, remote sensing, specially commissioned surveys, NVC data, and agri-environment schemes information (Higher Level Scheme and Farm Environment Plan data). It is not clear how change can be measured accurately, reporting on BAP

habitats stated whether they were increasing or decreasing but quantifying the extent at a point in time and then repeating using consistent methods is much more difficult.

Responsibility for Priority habitats (now Section 42 habitats in England under the Natural Environment and Rural Communities Act) has been devolved to individual countries. There is a danger that methods and definitions will differ between countries. There is still a requirement for integration of monitoring data within and between countries despite recent advances.

The most up to date assessments of Annex 1 habitats in the UK have just been published on the JNCC website as part of the 2013 Article 17 reporting process - see links below

- Habitats report = http://jncc.defra.gov.uk/page-6563
- Individual habitat reports = http://jncc.defra.gov.uk/page-6392

Other useful datasets/reports include:

- Countryside Survey
- SSSI condition data, available on line and summarised in: Williams, J.M., ed. 2006. Common Standards Monitoring for Designated Sites: First Six Year Report. Peterborough, JNCC
- National Forestry Inventory
- UK Biodiversity indicators
- UKBAP Habitat descriptions

Monitoring gaps

- As mentioned above it is difficult to find consistent, reliable trend data for priority habitats.
- There are some data on ecological networks e.g. hedgerows, wetlands, connectivity indicator but functional relationships between species and connectivity need more work to report nationally. For organisms in more isolated environments, landscape studies of metapopulation dynamics would be valuable.
- The urban environment- there has been recent activity to collect urban natural capital data. Scotland reports on the extent of greenspace, England and Wales are collecting data at a local authority level but there doesn't appear to be a report at the country level. Quality is also being measured by local authorities but there do not appear to be agreed methods for how to measure it so it is not possible to report nationally.
- There is limited information on the extent and condition of specific habitats within the Mountain, moor and Heath accounting unit e.g. montane, upland flushes.

3.3 Soils

This asset is defined as:

> *The combination of weathered minerals, organic materials, and living organisms and the interactions between these.*

Table 2 provides a summary of data sources for the soils asset. There are good data for reporting on soils at a national scale although some components may require additional data collection or

collection at a different resolution. There have been conflicts between results from different surveys e.g. soil carbon results from Countryside Survey and National Soil Resources Institute.

Useful sources of data include:

- Countryside Survey
- LandIS – Land Information System
- British Geological Survey
- NERC soils portal
- National Soils Archive Scotland (James Hutton Institute)

Monitoring gaps

- Data are not yet available on soil depth and soil gas content.
- There are limited data on soil biota.

3.4 Freshwaters

This asset is defined as:

> *Freshwater bodies (rivers, lakes, ponds and ground-waters) and wetlands. Includes water, sediments, living organisms and the interactions between these.*

Data are generally available for reporting on freshwater extent and condition from the reporting requirements for the EU Water Framework Directive (WFD). There may be some differences in reporting methods between different country administrations (e.g. Environment Agency and Scottish Environment Protection Agency) but in general WFD methods have been developed at the UK level and have also been inter-calibrated with other EU member states.

Useful sources of data include:

- WFD monitoring data from the relevant authority
- Data on headwater streams and ponds from Countryside Survey
- UK Lakes.net and the Lake Inventory
- Lakes Tour data (Centre for Ecology and Hydrology)
- Environmental Change Network
- Acid Waters monitoring network
- SSSI monitoring data
- National River flow archive
- Freshwater Habitats Trust (formerly Pond Conservation) – pond data

Monitoring gaps

- There is ongoing work to improve data on wetlands, wetland inventories have been commissioned by EA and SEPA and Natural England are adding to their wetland inventory data.

3.5 Land

This asset is defined as:

> *The physical surface of the Earth and space for human activity. Includes the various landforms and processes which shape these (weathering and erosion).*

Data on topography, and land height are available from various Digital Terrain models (Nextmap, Ordnance Survey). There is also information on the condition of geological SSSIs and some information about landscape (for example the Countryside Quality Counts data) but note that the later includes assessments about cultural landscapes and therefore covers both natural and built capital.

3.6 Atmosphere

This asset is defined as:

> *The layer of gases surrounding the Earth including oxygen, carbon dioxide and nitrogen used by all living organisms, and the processes which give rise to climate, weather (wind, precipitation) and temperature regulation.*

Data are available on individual atmospheric components as annual extent and trends from the National Atmospheric Emissions Inventory. In addition modelled data is available in the form of critical load exceedence maps for acid and nitrogen deposition. Globally, CO_2 levels are monitored.

3.7 Minerals

This asset is defined as:

> *Naturally occurring, non-living substances with a specific chemical composition formed by geologic processes.*

Data are available from BGS on the geological distribution of onshore mineral resources in England, Wales and the central belt of Scotland. This is mapped data available for a license fee. Reports by county are available for England. Values for the production of each mineral for the UK in world tables are also available.

3.8 Sub-Soil

This asset is defined as:

> *Other non-living substances in the Earth's crust including rocks and aggregates as well as non-mineral substances such as fossil fuels.*

Data on the potential resources for different minerals are available from the British Geological Society as maps or as reports by county. Data on geology and sub-soil components are included in condition reports for geological SSSIs.

3.9 Marine (or Oceans)

This asset is defined as:

> *Saline bodies of water that occupy the majority of the Earth's surface. Includes water, sediments, living organisms and the interactions between these.*

The nature of the marine environment makes data collection both difficult and expensive. In relative terms far less is known about this asset than the others although knowledge of some components such as commericial fish stocks, aspects of phytoplankton and chemistry are relatively well known. Only a small area of the sea bed around the UK has been sampled and mapped with modelled data filling many of the gaps. Modelled data that exist such as UKSeaMap are limited in accuracy and is currently inadequate for assessing the state of the asset. Nevertheless, given the difficulties associated with sampling and mapping the sea floor modelling can play an important role and well founded models (e.g. models based on full coverage, high resolution, acoustic data supplemented with a good coverage of ground truthing) can be the most realistic way of capturing information about the nature and condition of the seafloor.

Useful sources of Habitat and Species Data

- Marine Nature Conservation Review (MNCR) Surveys – Intertidal communities and species data

The MNCR surveys were carried out between 1987-1998 by JNCC (and formerly the Nature Conservancy Council) on behalf of the country conservation agencies (at the time: Countryside Council for Wales, Environment and Heritage Service Northern Ireland, Scottish Natural Heritage, English Nature). These reviews provide good baseline information about marine habitats and species from this time but the assessments are essentially restricted to the intertidal / coastal zone.
More details of the areas covered can be found here: http://jncc.defra.gov.uk/page-1596. The data are held in Marine Recorder and it is possible to download and access an annually released snapshot of this database from here: http://jncc.defra.gov.uk/page-1599. The database is very large and not that easy to navigate unless you have had training or some prior experience.

- UKSeaMap / EUSeaMap: Modelled habitat maps
- Mapping European Seabed Habitats (MESH)
- Regional Environmental Characterisation (REC) projects
- National Biodiversity Network (NBN)

Other types of data:

- Marine Developments
  The use of marine development datasets may not be entirely obvious but they are likely to be useful in assessing extent trends where time-series data don't exist.

- Oil and Gas
  Spatial data on the oil and gas industry can be obtained in GIS format from the UK Digital Energy & Atlas Library (UK DEAL) website. Available maps include oil and gas fields, the

location of wells, pipelines and surface structures. UK DEAL is regularly updated and linked to the Department of Trade and Industry oil and gas website.

- Aggregate Extraction **:** The Crown Estate
- Offshore Renewable Energy Developments**:** The Crown Estate, 4C Offshore http://www.4coffshore.com/index.html

Monitoring gaps

Some data are available on stock and trends in the extent of marine components although there is inconsistency in data collection. Data gaps include:

- Trend data in condition of intertidal sediments (substrate, vegetation, wildlife) is missing due to the frequency of monitoring and lack of repetition of surveys.
- There are no data on condition of sub-tidal rock minerals.
- There is limited information on the deep sea bed.
- There is limited information on saline lagoons.

3.10 Coasts

This asset is defined as:

> *The transitional zone between land and oceans. Includes water, sediments, living organisms and the interactions between these.*

Data are available on coastal habitats from similar sources as the Ecological communities asset i.e. UKBAP reporting, SSSI data, EU Habitats and Species Directive Annex 1. Some aspects of the coast are included with the EU Water Framework Directive (transitional and coastal waters). However, Countryside Survey does not report on coastal habitats.

Useful data sources:

- Sand Dune survey of Great Britain
- SSSI monitoring data
- EU Habitats and Species Directive: Annex 1 Habitat reporting
- Centre for Ecology and Hydrology datasets
- UKNEA Coastal chapter
- James Hutton Institute survey of machair and sand dune sites
- Environment Agency and Scottish Environment Protection Agency extent and condition data for saltmarshes and transitional waters.

Monitoring gaps

- There are data available on the extent of coastal sand dunes and sandy shores but it is from the sand dune survey of Great Britain in 1995 and so not up to date. This means that there are no trend data available on the extent of sand dunes.
- There are inconsistencies in the data collected for different components of coastal habitats either spatially or temporally.

- Data on the extent of saltmarsh is currently being collated so may not yet be available; there is a need for more data on trends in saltmarsh condition.

4. Conclusions

It was fairly straightforward to identify multiple datasets that could be listed under an asset and that might provide useful information (Appendix 1). However, the next step, extracting the most appropriate dataset to report on an asset and understanding the components of an asset that should be reported on was much more difficult. For some e.g. soils the choice of datasets and how to break down the asset into components has been proposed in peer reviewed publications (Robinson *et al*., 2013), for others it is more speculative and may require further consultation and iteration. Even with soils it may be more useful to move towards a single indicator of 'soil quality' that combines individual measurements and there has been discussion of this concept.
Datasets have been differentiated into those that report on condition and those that report on extent and most of the detailed components identified refer to reporting on condition.

Ecological communities have been identified as an individual asset, although if considered as analogous to habitats they are an assemblage of other assets within a community type i.e. Soils, Water, Atmosphere, Species etc. They could be reported on by the underlying assets in each community type as has been done for Freshwater and Coastal assets. However, there are many communities and this would result in a larger more complex table. There are measures designed for reporting on the condition of habitats (common standards monitoring for SSSIs) that incorporate these measures into one condition measure that does consider different components/assets within a habitat and this is what has been proposed.

This review began as a review of the data itself that could be used to report on natural capital but it became apparent that given the short time span to extract data that it was also necessary to identify reports and summaries where the data had already been analysed. This was particularly the case for the Species asset. Initially for this asset data records were extracted from the National Biodiversity Network Gateway and listed in Appendix 1 to indicate the extent and status of species records, however it became apparent that it would be more useful to cite reports that had analysed species data and an additional tab was included.

There are other issues to resolve in the choice of dataset e.g. the spatial or temporal resolution available, or more than one dataset being available for the same asset with different figures e.g., soil carbon from Countryside Survey and National Soil Resources Institute. The proposal in Table 3 is to list more than one value where appropriate to demonstrate that there may be some variation when measuring complex environmental variables.

This work has been carried out independently to a large extent to the work on metrics and risks so the link between the components of the asset and the benefits provided has not been included, it may be necessary in future work to return to Appendix 1 to select further datasets to measure different components.

There are other initiatives within the Living with Environmental Change programme and organisations such as Centre for Ecology and Hydrology, to relate monitoring datasets to reporting on natural capital assets but these may be at a range of scales and not just UK. It would be good to

build on the work here to develop a process that could be used by data providers to identify the relationships in their datasets to aspects of natural capital reporting and create a tool or search engine so they can be identified by others. This would need to be combined with research validating the relationship between each dataset and the provision of benefits and should include outputs from the metrics work package.

Table 1: Breakdown of assets into components that could be reported

Asset	Proposed components for reporting	Type of reporting
Ecological communities	Blanket Bog	Extent and condition (Stock and Trend)
	Mountains, Moorlands and Upland Heath	Extent and condition (Stock and Trend)
	Semi-natural grasslands	Extent and condition (Stock and Trend)
	Enclosed farmland	Extent and condition (Stock and Trend)
	Lowland Heath	Extent and condition (Stock and Trend)
	Woodlands	Extent and condition (Stock and Trend)
	Urban	Extent and condition (Stock and Trend)
Soils	Soil type	Extent (Stock and Trend)
	Soil texture	Extent(Stock and Trend)
	Soil depth	Extent (Stock and Trend)
	Soil mineralogy	Extent (Stock and Trend)
	Nutrient stock (N, P, K, Ca, Mg, Al)	Condition (Stock and Trend)
	Organic carbon	Condition (Stock and Trend)
	Soil water content	Condition (Stock and Trend)
	pH	Condition (Stock and Trend)
	Soil gas content	Condition (Stock and Trend)
	Thermal energy	Condition (Stock and Trend)
	Physicochemical structure	Condition (Stock and Trend)
	Biotic structure (Biological diversity, food web structure, community organisation)	Condition (Stock and Trend)
		Condition (Stock and Trend)
Species	Microorganisms	Abundance, distribution (presence/absence), Trend
	Fungi	Abundance, distribution (presence/absence), Trend
	Lichens	Abundance, distribution (presence/absence), Trend
	Bryophytes	Abundance, distribution (presence/absence), Trend
	Land Plants	Abundance, distribution (presence/absence), Trend
	Freshwater invertebrates	Abundance, distribution (presence/absence), Trend
	Terrestrial Invertebrates	Abundance, distribution (presence/absence),
	Freshwater Fish	
	Amphibians	

	Reptiles	Trend
	Birds	Abundance, distribution (presence/absence), Trend
	Mammals	Abundance, distribution (presence/absence), Trend
	Marine Phytoplankton	Abundance, distribution (presence/absence), Trend
	Seagrasses	Abundance, distribution (presence/absence), Trend
	Marine Macroalgae	Abundance, distribution (presence/absence), Trend
	Marine invertebrates	Abundance, distribution (presence/absence), Trend
	Marine fish	Abundance, distribution (presence/absence), Trend
	Marine mammals	Abundance, distribution (presence/absence), Trend
	Zooplankton	Abundance, distribution (presence/absence), Trend
		Abundance, distribution (presence/absence), Trend
		Abundance, distribution (presence/absence), Trend
		Abundance, distribution (presence/absence), Trend
		Abundance, distribution (presence/absence), Trend
		Abundance, distribution (presence/absence), Trend
		Abundance, distribution (presence/absence), Trend
		Abundance, distribution (presence/absence), Trend
Freshwater	Standing Open water: General	Extent (Stock and Trend)
	Standing open water: water chemistry	Condition (Stock and Trend)
	Standing Open water: Freshwater Inverts	Condition (Stock and Trend)
	Standing open water: Plants	Condition (Stock and Trend)
	Standing open water: Fish	Condition (Stock and Trend)
	Rivers and streams; General	Condition (Stock and Trend)
	Rivers and streams: water chemistry	Condition (Stock and Trend)
	Rivers and streams: Freshwater Invertebrates	Condition (Stock and Trend)
	Rivers and streams: Plants	Condition (Stock and Trend)

	Rivers and streams: Fish	Condition (Stock and Trend)
	Rivers and streams: Diatoms	Condition (Stock and Trend)
	Groundwaters: General	Extent (Stock and Trend)
	Groundwaters: Water Chemistry	Condition (Stock and Trend)
	Wetlands: General	Extent and condition (Stock and Trend)
	Wetlands: birds	Abundance, distribution (presence/absence), Trend
Coasts	Coastal Dunes and Sandy Shores: general	Extent (Stock and Trend)
	Dunes: Carbon	Condition (Stock and Trend)
	Dunes: Water	Condition (Stock and Trend)
	Dunes: vegetation	Condition (Stock and Trend)
	Transitional and coastal waters	Extent and condition (Stock and Trend)
	Saltmarsh: General	Extent (Stock and Trend)
	Saltmarsh: Carbon	Condition (Stock and Trend)
	Saltmarsh: Vegetation	Condition (Stock and Trend)
	Saltmarsh: Water quality	Condition (Stock and Trend)
	Saltmarsh: Birds	Condition (Stock and Trend)
	Saltmarsh: Invertebrates	Condition (Stock and Trend)
Atmosphere	Air concentration of heavy metals	Condition (Stock and Trend)
	Sulphur dioxide	Condition (Stock and Trend)
	Ammonia	Condition (Stock and Trend)
	Nitrogen oxides	Condition (Stock and Trend)
	Fine particles	Condition (Stock and Trend)
	Non Methane Volatile organic compounds	Condition (Stock and Trend)
	Carbon monoxide	Condition (Stock and Trend)
	Ozone	Condition (Stock and Trend)
	Area of natural and semi-natural habitat where deposition of acid exceeds critical loads	Condition (Stock and Trend)
	Area of natural and semi-natural habitat where deposition of nitrogen compounds exceeds critical loads	Condition (Stock and Trend)

Marine	Intertidal sediment: Substrate/matter/minerals	Extent and condition (Stock and Trend)
	Intertidal sediment: vegetation	
	Intertidal sediment: other wildlife	Extent and condition (Stock and Trend)
	Sub-tidal rock: Substrate/matter/minerals	Extent and condition (Stock and Trend)
	Sub-tidal rock: vegetation	Extent and condition (Stock and Trend)
	Sub-tidal rock: other wildlife	Extent and condition (Stock and Trend)
	Shallow sub-tidal sediments: Substrate/matter/minerals	Extent and condition (Stock and Trend)
	Shallow sub-tidal sediments: vegetation	Extent and condition (Stock and Trend)
	Shallow sub-tidal sediments: other wildlife	Extent and condition (Stock and Trend)
	Deep sea bed: Substrate/matter/minerals	Extent and condition (Stock and Trend)
	Deep sea bed: vegetation	Extent and condition (Stock and Trend)
	Deep sea bed: other wildlife	Extent and condition (Stock and Trend)
	Pelagic water column: Water quality	Extent and condition (Stock and Trend)
	Pelagic water column: vegetation	Extent and condition (Stock and Trend)
	Pelagic water column: other wildlife (Zooplankton, Marine fish, marine mammals)	Extent and condition (Stock and Trend)
	Saline lagoons: Water quality	Extent and condition (Stock and Trend)
	Saline lagoons: vegetation	Extent and condition (Stock and Trend)
	Saline lagoons: other wildlife (Zooplankton, Marine fish, marine inverts)	Extent and condition (Stock and Trend)
		Extent and condition (Stock and Trend)
		Extent and condition (Stock and Trend)
Sub-Soil	<u>CSM categories:</u>	
	Rock sequences	Extent and condition (Stock and Trend)
	Fossils	Extent and condition (Stock and Trend)
	Ice age landforms and sediments	Extent and condition (Stock and Trend)
	Volcanic rocks, folds, faults and rock movements	Extent and condition (Stock and Trend)
	Active landforms	
	<u>BGS themes:</u>	Extent and condition (Stock and Trend)
	Bedrock geology	

	Superficial deposits	Extent (stock)
	Mass movement	Extent (stock)
	Artificial ground	Extent (stock)
	Faults and other linear features	Extent (stock)
		Extent (stock)
Land	Topography	Extent (stock)
	Height	Extent (stock)
Minerals	Sand and Gravels	Extent (stock)
	Clay	Extent (stock)
	Chalk	Extent (stock)
	Fullers earth	Extent (stock)
	Limestone	Extent (stock)
	Hydrocarbons	Extent (stock)
	Coal	Extent (stock)
	Metals and related minerals	Extent (stock)

Table 2: Summary of data sources for reporting on the Soil natural capital asset

Soil	Extent		Condition		
	Stock	trend	Stock	Trend	Notes
Soil texture:	LANDIS, BGS high resolution PSD for E Midland using Gbase	likely to be reasonably static or very slowly changing,	N/A	N/A	soil texture could be more spatially variable than LandIS resolution
Soil depth:	No systematic map of total soil/regolith depth available for UK, LandIs stops at 1.2m, ECN soil horizon depth only 12 sites. BIOSOIL examines horizons or organic and mineral soils to a depth of 80cm.	ECN re-surveys soil horizon depth only 12 sites	N/A	N/A	
Soil mineralogy	BGS has basic mineralogy data held in Soil Parent Material map database		N/A	N/A	Little information on rates of mineral weathering and natural fertility replacement for England and Wales. Skolkloster classes designed to assess mineral soils short term acid buffering capacity have been used to identify and map soils sensitive to acidification.
Nutrient stock	N/A	N/A	LandIS contains K and P, extractable K measured through RSSS scheme for agricultural land. CS monitors soil P and mineral N. Biosoil monitors N as well as Ca, Mg, K, H and Al	LandIS, CS, Biosoil	
Organic carbon	N/A	N/A	LandIS and CS monitor soil C, CS data is used as C stock indicator in State of Env Wales report.	LandIS and CS monitor soil C, Biosoil monitors forest soil C	NSRI indicated that soil carbon stocks were decreasing, CS did not find this result. Other studies have also not found a significant change in soil carbon

Organisms	N/A	N/A	Countryside Survey records change in invertebrate taxa e.g. Mites, springtails, collembolan and bacteria	Countryside Survey records change in invertebrate taxa e.g. Mites, springtails, collembolan and bacteria	
Soil water content	N/A	N/A	LandIS and CS	LandIS and CS	
pH	N/A	N/A	CS	CS	
Soil gas content	N/A	N/A	No survey of soil gas composition, CS has information on bulk density from which porosity is determined, NSRI have bulk density for soil series and horizons in LandIS		assessment of individual gases such as O2, Co2, CH4 and Mox is difficult but new sensor technologies may help
Thermal energy	N/A	N/A	MetOffice monitors soil temperature		
Physicochemical structure	N/A	N/A	LandIS	LandIS	
Biotic structure (Biological diversity, food web structure, community organization)	N/A	N/A	CS monitors soil invertebrates and makes measures of biodiversity- capacity to develop food web structures	CS monitors soil invertebrates and makes measures of biodiversity- capacity to develop food web structures	

Table 3: Example table showing data report for the ecological communities natural capital asset

Asset: Ecological Communities			**UK Extent ha**		**Condition**		
		Accounting unit	**Stock**	**Trend**	**Stock**	**Trend**	**Data sources**
Woodland	**Broad Habitat**	**Broadleaved woodland**	**1488 000ha[1] (1300 000ha[2] GB)**	**↑ by 6.9%[1]**	**43% broadleaved woodland favourable condition[3]**	**↓ species richness ground flora, ↑ competitive species, ↑ soil pH (GB)[1] BIYP C5b ↓ woodland birds[7]. ↓woodland butterflies[7]**	**[1]Countryside Survey, [2]National Forest Inventory (no UK figure) [3]CSM reporting 2006 [7]UKBIYP indicators 2013**
	Priority Habitat	Upland Birch woodlands	31 000 ha[1]	No trend data			[1]Countryside Survey
		Traditional orchards	27 850 ha[4]				[4]UKBAP descriptions
		Wood pasture and parkland	No current estimate				
		Upland oakwood	70-100 000ha[4], 61 000 ha[1]	↔ No change[1]			[4]UKBAP descriptions [1]Countryside Survey
		Lowland beech and yew woodland	30 000ha?[4]				[4]UKBAP descriptions
		Upland mixed ashwoods	30 000ha[1], 67500[4]				[1]Countryside Survey, [4]UK BAP descriptions
		Wet woodland	50-70000 ha[4], 75 000ha[1]	↑[1]			[4]UK BAP descriptions, [1]Countryside Survey
		Lowland mixed deciduous woodland	60 000ha[1]	↔ No change[1]			[1]Countryside Survey
	Broad Habitat	**Coniferous woodland**	**1380 000ha[1] (1682 000ha[2] GB)**	**↔ No change**		**↓ species richness, bird and butterfly food plants in Scotland. ↓ carbon concentration in soils[1]**	**[1]Countryside Survey [2]National Forest Inventory (no UK figure)**
	Priority Habitat	Native pine	16 000 ha[4]		assessments		[4]UK BAP descriptions

		woodland			reported are split 50:50 in favourable and unfavourable condition[3]		[3]CSM reporting 2006
Enclosed farmland	**Broad Habitat**	**Arable land**	**4657 000ha[1]**	**↓ 9.1%[1]**		**↑plant species richness (BIYPC7a), ↑bird and butterfly food plants[1]↑land under agri-envt schemes BIYP B1a[7]↓ farmland bird index C5a[7]** Of 1,064 farmland species for which have trends, 60% have decreased and 34% have decreased strongly[8]	[1]Countryside Survey **[7]UKBIYP indicators 2013 [8]State of Nature report**
		Hedgerows	**477 000 km's[1] (GB)**	↓ length of 'managed' hedgerows by 6.2% in Great Britain between 1998 and 2007		**↓plant species richness over longer time period (1984-2007)[1,7], ↑competitive species[1]**	[1]Countryside Survey **[7]UKBIYP indicators 2013**
		Improved grassland	**5067 000ha[1]**	**↑5.4%[1]**		**↓plant species richness in small habitat patches[1]**	[1]Countryside Survey
Mountains, Moors and Heaths	**Broad habitat/Habitat complex**	**Peatlands: Blanket Bog, raised bog and fens**	**2300 000ha[5]**		**<20% in favourable condition, 16% severely eroded, 10% afforested, 11% affected by past peat cutting 40% modified/ destroyed by**	**↓ condition**	**[5]IUCN UK commission on peatlands (broader definition than CS)**

					conversion to agriculture[5]		
	Broad Habitat	**Bog (includes Blanket bog and other bog types)**	**2393 000ha[1]**	**↔ No change**		**↓ in condition, increase in competitive species, ↓ species richness and nectar plants**	**[1]Countryside Survey**
	Priority Habitat	Blanket Bog	1485 000ha[4],	↔ No change[1]	more than 25% of	↓ more of the habitat in	[4]UKBAP descriptions
			2196 736 ha[6] 1234 000ha[1]		the habitat is in unfavourable condition[6]	unfavourable condition is declining than recovering[6] ↓ in condition, increase in competitive species, ↓ species richness and nectar plants[1]	[6]Article 17 reporting 2013 (includes CS figures for Scotland) [1]Countryside Survey
	Broad habitat	**Dwarf Shrub heath**	**1360 000ha[1] 2-3 million ha[4] 1362 254[6]**	**↔ No change[1]**	**>25% of wet heath habitat in unfavourable condition[6,] dry heaths in favourable condition**	**↓ in condition, increase in competitive species, ↓ species richness[1]**	**[1]Countryside Survey [4]UKBAP descriptions [6]Article 17 reporting 2013 added all annex 1 heaths except alpine (H4010, 4020, 4030, 4040)**
Mountains, Moors and Heaths	Priority Habitat	Upland Dwarf Shrub Heath	1196 000 ha[1]	↔ No change[1]			[1]Countryside Survey
	Priority Habitat	Lowland dwarf Shrub heath	93 000 ha[1]	↑ in England		habitat specialist butterflies show a significant overall decline of 40% between 1990 and 2011[8]	[1]Countryside Survey [8]State of Nature report
	Broad Habitat	**Montane**	**42 370[6]**				**[6]Article 17 reporting**

			42 000[1]				**2013 (H4060+H4080)** **[1]Countryside Survey**
Semi-natural grasslands	**Broad Habitat**	**Neutral grassland**	**2407 000 ha[1]**	**↔ No change[1] (although ↑ 6% in GB)**	**42% of neutral grassland features reported are in favourable condition[3]**	**↓ condition. Plant species richness ↓ in small plots targeted for botanical interest. Soil pH ↑**	**[1]Countryside Survey** **[3]CSM reporting 2006**
	Priority Habitat	Upland Hay meadow	1050 ha[6] approx 1000 ha[4]		>25% unfavourable condition[6]	Declining	[6]Article 17 reporting 2013 [4]UKBAP descriptions
	Priority Habitat	Lowland Hay meadow	1510 ha[6] <15 000 ha[4]		>25% unfavourable condition[6]	Improving[6]	[6]Article 17 reporting 2013 [4]UKBAP descriptions
Semi-natural grasslands	**Broad Habitat**	**Acid grassland**	**1599 000 ha[1]**	**↔ No change[1] (although ↑ 5.5% in GB)**	**>25% unfavourable condition[6]**	**↓ plant species richness, ↓ soil Carbon[1] declining[6]**	**[6]Article 17 reporting 2013** **[1]Countryside Survey**
	Priority Habitat	Lowland Acid grassland	<30 000ha[4]		38% SSSI features in favourable condition[3]		[4]UKBAP descriptions [3]CSM reporting 2006
	Broad Habitat	**Calcareous grassland**	**59 000 ha[1]**	**↔ No change[1]**		**↑ in plant species richness (1990 to 2007) and numbers of butterfly food plants**	[1]Countryside Survey
	Priority Habitat	Upland Calcareous grassland	18.9 000ha[1](GB) 22-25 000[4]	↓	23% of upland calcareous grassland features reported are in favourable condition		[1]Countryside Survey [4]UKBAP descriptions
	Priority Habitat	Lowland Calcareous grassland	44.5 000 ha[1] (GB)				[1]Countryside Survey

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CEH Information gateway: The EIDC has created the INSPIRE-compliant **CEH Information Gateway** (http://www.ceh.ac.uk/cehinformationgateway.html) portal to provide easier access to terrestrial and freshwater datasets. Includes

- **Biological Records Centre**
- **National River Flow Archive**
- **Land Cover Map 2007**
- **NERC Environmental Bioinformatics Centre (NEBC)**
- **Environmental Change Network datasets**

Countryside Survey: http://www.countrysidesurvey.org.uk/

Defra: data.gov.uk

Environment Agency (EA) data: Environment Agency DataShare has a wide range of data products available. http://www.environment-agency.gov.uk/research/library/data/145758.aspx

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MAGIC: The MAGIC website provides authoritative geographic information about the natural environment from across government. http://magic.defra.gov.uk/Dataset_Download_Summary.htm

Natural England data: GIS data available from Natural England website, includes spatial layers for priority habitats, http://www.gis.naturalengland.org.uk/pubs/gis/GIS_register.asp

National Biodiversity Network (NBN): The NBN Gateway (3) is a portal to 67 million species occurrence records from 600 datasets whose access is individually controlled by the data providers. http://www.nbn.org.uk/

National Forestry Inventory: http://www.forestry.gov.uk/inventory

NFI Preliminary estimates of Broadleaved species in British Woodlands http://www.forestry.gov.uk/pdf/NFI_Prelim_BL_Ash_Estimates.pdf/$FILE/NFI_Prelim_BL_Ash_Estimates.pdf

National Soils archive Scotland : http://www.hutton.ac.uk/about/facilities/national-soils-archive

National Water Archive: http://www.ceh.ac.uk/data/nwa.htm**:** The NWA includes extensive time series of river flow and groundwater level data held by the **NRFA** and **NGLA** respectively.
NERC soil portal: http://www.bgs.ac.uk/nercsoilportal/home.html: NERC soil portal, access to datasets from CEH, BGS

RoTap Acidification, Eutrophication, Ground level Ozone and Heavy metals in the UK http://www.rotap.ceh.ac.uk/about

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Wales Biodiversity Partnership: The Wales Biodiversity Partnership contributes to the delivery of Global, European and national targets for biodiversity and ecosystems. Their website has links to reports and a spreadsheet capturing gaps in monitoring and scientific research. **http://www.biodiversitywales.org.uk/** and http://www.biodiversitywales.org.uk/en-GB/WBP-Evidence-Gaps-Project

UK Environmental Observation: partnership of public sector organisations with an interest in using and providing evidence from environmental observations. Terrestrial Surveillance Monitoring Database (http://www.jncc.gov.uk/) and the UK Directory of Marine Observing Systems (UKDMOS contribute data, http://www.ukdmos.org/) http://www.ukeof.org.uk/catalogue/default.aspx

UKLakes.net http://www.uklakes.net/