Semi-natural habitat natural capital accounts methodology, UK: 2021

How the natural capital semi-natural habitat accounts are measured and developed, including the specific methods used to value individual components of natural capital and physical and monetary data sources

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1 . Introduction

The methodology used to develop these estimates remains under development; the estimates reported in Semi-natural habitat natural capital accounts, UK: 2021 are experimental and should be interpreted in this context.

Experimental Statistics are those that are in the testing phase, are not yet fully developed and have not been submitted for assessment to the UK Statistics Authority. Experimental Statistics are published to involve customers and stakeholders in their development and as a means of building in quality at an early stage.

This article describes the methodology used to develop Natural Capital Ecosystem Service Accounts. The broad approach to valuation and the overarching assumptions made are explained in this article. This is followed by a more detailed description of the specific methodologies used to value the individual components of natural capital and physical and monetary data sources.

We have used a wide variety of sources for estimates of UK semi-natural natural capital, which have been compiled in line with the guidelines recommended by the United Nations (UN) System of Environmental-Economic Accounting Central Framework and System of Environmental-Economic Accounting Experimental Ecosystem Accounting principles, which are in turn part of the wider framework of the system of national accounts.

As the UN guidance is still under development, the Office for National Statistics (ONS) and the Department for Environment, Food and Rural Affairs (Defra) published a summary of the principles underlying the accounts.

We welcome discussion regarding any of the approaches presented.

2 . Methodology by service

This section provides an explanation of the data sources and methods used in each service.

Water abstraction

Physical data for water abstraction are sourced from Scottish Water, Defra, Natural Resources Wales, and Northern Ireland Water. No industry water data are available for Scotland so only data for public water supply are included to maintain consistency. Removing industry data also avoids double counting with the valuation of hydropower.

Monetary estimates are based on resource rents calculated for the Standard Industrial Classification (SIC) subdivision class: Water collection, treatment and supply (SIC 36). The definition of this industry subdivision states, "the collection, treatment and distribution of water for domestic and industrial needs. Collection of water from various sources, as well as distribution by various means is included". A limitation of this approach, therefore, is that the calculated resource rent is not purely related to water supply, but also includes the process of treating the water.

Further work is required to value the services relating to other uses of the water provisioning services, and to explore the roles of different ecosystem types in providing clean water.

We are exploring alternative methods used to value water provisioning services, with the aim to look at the short-term cost and certainty, and long-term sustainability of the UK's water supply. Our aim is to capture the impact of the changing demand for water, and of climate change on the UK water supply by reporting on:

- current and projected demand and water abstraction levels
- weather forecasts and costs of ecologically excessive abstraction
- water movements by truck
- restrictions on supply

Because of population growth in England, and climate change, demand for water is forecast to continue to increase (PDF, 622.88KB), according to the Environment Agency 2018. This report also states that current levels of water abstraction are already unsustainable in certain regions, creating pressure on our water resources. Climate change effects are predicted to lead to increasing winter rainfall and reducing summer rainfall resulting in floods in the winter and droughts in the summer.

Renewable generation

Energy generated by renewable sources is published by the Department for Business, Energy and Industrial Strategy (BEIS) in the Digest of UK Energy Statistics.

Monetary estimates are based on the "residual value" resource rent approach calculated from the SIC Group 35.1: Electric power generation, transmission and distribution. These data are then apportioned using turnover from our Annual Business Survey (ABS) to derive the resource rent of 35.11: Production of electricity. To estimate the renewable provisioning valuation, data were further apportioned using renewables proportion of total energy generation.

On semi-natural habitats renewable energy generation is from hydro and wind sources. To calculate the proportion of wind turbines on semi-natural land the map of semi-natural habitats was overlaid with location of UK turbines. BEIS wind farm maps do not necessarily indicate turbine positions so an alternative was required.

To better apportion the capacity, a new method was developed using a combination of BEIS wind farm points and Ordinance Survey (OS) wind turbine points:

- Voronoi polygons, representing an area closer to their parent point than any other point, are created around the wind farm points (wind farms with less than 1MW capacity are filtered out)
- this is then intersected with wind turbine points, thus assigning them to a given windfarm
- the wind turbine points are intersected with the land cover polygons
- for each Voronoi polygon, the proportion of assigned wind turbines on the land cover types is calculated
- this proportion is multiplied by the parent wind farm's capacity, giving the capacity on the land cover for that farm
- this is then summed to obtain the total capacity of wind turbines on the land cover

Carbon sequestration

Estimates relate to the removal of carbon dioxide equivalent (CO_2e) from the atmosphere by habitats in the UK. However, because of a lack of data we are unable to include the marine habitat, including those intertidal areas such as saltmarsh. Furthermore, peatlands are only partially covered. The Centre for Ecology and Hydrology estimates that degraded peatland emits 23 million tonnes of CO_2e. This is more than the natural environment removes.

The carbon sequestration data come from the UK National Atmospheric Emission Inventory (NAEI), which reports current and future projections of carbon removal for the land use, land use change and forestry (LULUCF) sector.

LULUCF sector breakdown identifies net carbon sequestration activities in the following subcategories:

- forest land remaining forest land
- land converted to forest land
- grassland remaining grassland
- land converted to grassland
- cropland remaining cropland
- land converted to cropland
- wetlands remaining wetlands
- land converted to wetlands

For the years 1990 to 2018, estimates of carbon sequestration are sourced from the Greenhouse gas inventory. In the asset valuation, projections of carbon sequestration are provided for the years 2017 to 2050 using the central values. This is produced by the National Atmospheric Emission Inventory (NAEI) in the LULUCF emission projections. For years used in the projections beyond 2050, the carbon sequestration rate is assumed to be constant as at 2050 levels.

To work out the annual value, we multiply the physical flow by the carbon price. The carbon price used in calculations is based on the projected non-traded price of carbon schedule. This is contained within the Data Table 3 of the Green Book supplementary guidance. Carbon prices are available from 2010 to 2100. Prices beyond 2100 are constant at 2100 levels.

The non-traded carbon prices are used in appraising policies influencing emissions in sectors not covered by the EU Emissions Trading System (ETS) (the non-traded sector). This is based on estimates of the marginal abatement cost (MAC) required to meet a specific emission reduction target. Beyond 2030, with the (expected) development of a more comprehensive global carbon market, the traded and non-traded prices of carbon are assumed to converge into a single traded price of carbon.

To apportion from total UK to semi-natural habitats data on land area was obtained. Broadleaved woodland was calculated using data from the National Forest Inventory, with 55% of total woodland being broadleaved. Proportion of semi-natural grasslands was calculated from the Land Cover Map 2015 data, of which 24% of the total grasslands is semi-natural.

Air pollution removal by vegetation

Air quality regulation estimates have been supplied in consultation with the Centre for Ecology and Hydrology (CEH). A very brief overview of the methodology will be explained here. A more detailed explanation can be found in the full methodology report published in July 2017.

Air pollution levels are produced by the European Monitoring and Evaluation Program Unified Model for the UK (EMEP4UK) atmospheric chemistry and transport model. EMEP4UK uses emissions data and models to calculate pollutant transport and deposition, considering meteorology and pollutant interactions.

Air pollution data removal by UK vegetation has been modelled for the years 2007, 2011, 2015 and then scaled to create values in 2030. Between these years a linear interpolation has been used and adjusted for real pollution levels as an estimation of air pollution removal.

The health benefits were calculated from the change in pollutant exposure from the EMEP4UK scenario comparisons, that is, the change in pollutant concentration to which people are exposed. Damage costs per unit exposure were then applied to the benefiting population at the local authority level for a range of avoided health outcomes:

- respiratory hospital admissions
- cardiovascular hospital admissions
- loss of life years (long-term exposure effects from PM2.5 and nitrogen dioxide (NO2))
- deaths (short-term exposure effects from ozone (O3))

The damage costs were updated in February 2019. The report by Defra includes the method of damage cost calculation (PDF, 0.9MB).

The economic value is attributed to the UK National Ecosystem Assessment (UKNEA) broad habitats at a UK level, by allocating the total economic value of pollutant removal at the UK level by the proportion of pollutant removed by each vegetation type. This physical estimate was calculated for the UKNEA broad habitats at the grid square level by first disaggregating the quantity of pollutant removed by each CEH Landcover class and then re-aggregating these estimates up to the UKNEA broad habitats.

Future flow projections used for asset valuation incorporate an average population growth rate and an assumed 2% increase in income per year (declining to 1.5% increase after 30 years and 1% after 75 years). Income elasticity is assumed to be one, meaning that if income rises by 1% then demand for healthcare also increases by 1%. Annual forecasts are discounted to 2018 present values using a 3.5% discount rate, reducing appropriately as per the Green Book methodology. More work is being conducted in this area.

To apportion from total UK to semi-natural habitats data on land area was obtained. Broadleaved woodland was calculated using data from the National Forest Inventory, with 55% of total woodland being broadleaved. In addition to the apportioned woodland, data was used from the inventory on semi-natural grassland, mountain, moorland and heath and open water, wetland and floodplain to calculate semi-natural benefits.

Recreation

The recreation estimates are adapted from the "simple travel cost" method developed by Ricardo-AEA in the methodological report Reviewing cultural services valuation methodology for inclusion in aggregate UK natural capital estimate. This method was originally created for use on the Monitor of Engagement with the Natural Environment (MENE) Survey, which covers recreational visits by respondents in England.

The method looks at the expenditure incurred to travel to the natural environment and some expenditure incurred during the visit. This expenditure method considers the market goods consumed as part of making the recreational visit (that is, fuel, public transport costs, admission charges and parking fees). This expenditure is currently assumed as a proxy for a marginal price for accessing the site.

Estimates for the cultural service of outdoor recreation in this publication use survey data across four surveys covering England, Wales, and Scotland. Combined Great Britain outputs are scaled up to UK level using population estimates for people aged 16 years and over.

The questions used from these surveys can be broadly summarised as:

- How many visits to the outdoors for leisure and recreation have you made in the last four weeks?
- On the last visit to the outdoors, what type of habitat did you go to?
- What was the main means of transport used on this last visit?
- How far did you travel to get to and from the main destination of this visit?
- How long was the visit, in terms of time (including travel time)?
- How much did you spend on [spending category]?

For estimates of outdoor recreation in England, the Monitor of Engagement with the Natural Environment (MENE) Survey is used. The survey collects detailed information on people's use and enjoyment of the natural environment during visits. This report relates to the full ten years of surveying from March 2009 to February 2019. MENE samples around 47,000 respondents, containing around 20,000 visit takers, annually.

In Scotland, data from two surveys are used to produce estimates of outdoor recreation. From 2003 to 2012, data from the Scottish Recreation Survey (ScRS) was used. The ScRS was undertaken through the inclusion of a series of questions in every monthly wave of the TNS Omnibus survey, the Scottish Opinion Survey (SOS). In every month of the Scottish Opinion Survey around 1,000 face-to-face interviews are undertaken with adults in Scotland aged 16 years and over.

Replacing the ScRS, Scottish Natural Heritage commissioned the Scotland's People and Nature Survey (SPANS) for the first time in 2013 to 2014, then again in 2017 to 2018. Unlike ScRS, SPANS excludes questions relating to respondent expenditure during their last outdoor recreation visit. To produce estimates of Scottish outdoor recreation expenditure beyond 2012 we created a statistical model. Using comparable MENE and ScRS data, this model examined the relationship between English and Scottish per visit expenditure on a habitat basis. Linear interpolation was used to produce estimates of Scottish recreation from 2014 to 2016.

Previously, we used the Welsh Outdoor Recreation Survey (WORS 2014) in combination with England's MENE survey to produce outdoor recreation estimates for Wales. However, since obtaining 2016 and 2018 data from the National Survey for Wales (NSW), all Welsh estimates are calculated using NSW only, as NSW provides improved quality of the sampling approach and comparability between WORS and NSW is not advisable.

For the asset valuation of outdoor recreation, projected population growth calculated from Office for National Statistics (ONS) population statistics and an income uplift assumption, were implemented into the estimation. The income uplift assumptions are 1%, declining to 0.75% after 30 years and 0.5% after a further 45 years. These assumptions project the annual value to increase over the 100 years.

It is acknowledged that the expenditure-based method provides an underestimation of the value provided by visits to the natural environment. Primarily, this is because there are several benefits that are not accounted for, including scientific and educational interactions, health benefits and aesthetic interactions. Currently, there is no method in use that incorporates these considerations. Additionally, the time spent by people in the natural environment is not itself directly valued because of the accounting and methodological challenges involved.

A significant number of outdoor recreation visits have no expenditure as people take local visits, such as walking to a local park. The value of local recreation and the aesthetic benefit from living near green and blue spaces is estimated through house prices.

To apportion from total UK to semi-natural habitats data on land area was obtained. Broadleaved woodland was calculated using data from the National Forest Inventory, with 55% of total woodland being broadleaved. In addition to the apportioned woodland, data was used from the surveys from mountain, moorland and hill and freshwater to calculate semi-natural benefits.

3 . Asset Valuation

The net present value (NPV) approach is recommended by the System of Environmental-Economic Accounts (SEEA) and is applied for all ecosystem services to estimate the asset value. The NPV approach estimates the stream of services that are expected to be generated over the life of the asset. These values are then discounted back to the present accounting period. This provides an estimate of the capital value of the asset relating to that service at a given point in time. There are three main aspects of the NPV method:

- pattern of expected future flows of values
- asset life – time period over which the flows of values are expected to be generated
- choice of discount rate

An important factor in the valuation of natural capital is determining the expected pattern of future flows of services. These paths are not observed and hence assumptions concerning the flows must be made, generally as a projection of the latest trends.

A more basic way to estimate the expected flows is to assume that the current flow (averaged over recent years) is constant over the asset life, but this might not be the case. In some cases, more information is available on future expected levels of services in non-monetary terms or future unit prices. Where there are readily available official projections these have been considered but otherwise the default assumption in these estimates is that the value of the services is constant over time.

This article assumes constant service values throughout the asset life, except for the estimates for carbon sequestration and air pollutant removal by vegetation, where further projections are used. Where the pattern of expected service values is assumed to be constant, it is based on averages over the latest five years of data, up to and including the reference year in question.

The asset life is the expected time over which the services from a natural resource are expected to be provided. An estimate of the asset life is an important component in the NPV model because it determines the expected term over which the service flows from an asset should be discounted. Following the Office for National Statistics (ONS) and Department for Environment, Food and Rural Affairs (Defra) principles of natural capital accounting paper, this article takes the renewable asset approach. For renewable natural capital assets, a 100-year asset life is applied to all assets that fall within this category of natural capital. In addition, a discount rate is required to convert the expected stream of service flows into a current period estimate of the overall value. A discount rate expresses a time preference -- the preference for the owner of an asset to receive income now rather than in the future. It also reflects the owner's attitude to risk. The use of discount rates in NPV calculations can be interpreted as an expected rate of return on the environmental assets.

Based on an extensive review (PDF, 453KB)by external consultants, the ONS and Defra use the social discount rate set out in the HM Treasury Green Book (2003, page 100). In line with guidance set out in the document, estimates presented in this article assume a 3.5% discount rate for flows projected out to 30 years, declining to 3.0% thereafter and 2.5% after 75 years. The rationale for this approach is discussed further in the principles of natural capital accounting paper.