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Calculating the economic values of the ecosystem services provided by Natura 2000 features and sites in Wales

Prepared by LUC for Natural Resources Wales as part of the LIFE Natura 2000 Programme in Wales

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Calculating the economic values of the ecosystem services provided by Natura 2000 features and sites in Wales

A concise feasibility study exploring whether a financial value may be placed on the delivery of ecosystem services by Natura 2000 features and sites in Wales, and if so how this may be calculated.

LIFE Natura 2000 Programme for Wales
LIFE N2K Wales: LIFE 11 NAT/UK/385
Action A9: Ecosystem services
LIFE Natura 2000 Programme for Wales: Ecosystem Services contract

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1 Crynodeb Gweithredol / Executive Summary

Nod Rhaglen LIFE Natura 2000 yw meintioli'r buddion a ddarperir gan nodweddion a safleoedd Natura 2000 (N2K) yng Nghymru i ddangos ei werth i'r economi a chymdeithas. Mae hyn i dynnu sylw at y manteision o gyfeirio mesurau economaidd tuag at wella a chynyddu'r buddion a ddarperir.

Mae'r papur byr yn edrych ar ymarferoldeb o roi gwasanaeth ecosystemau sydd â gwerth ariannol cyflwynwyd gan nodweddion N2K yng Nghymru, ar ffurf ffigurau safonol sy'n caniatáu cymariaethau rhwng safleoedd ac astudiaethau prisio gwasanaethau ecosystem eraill. Cyfeirir at waith tebyg a wnaed mewn manau eraill a nodir o ble mae'r wybodaeth ofynnol yn deillio neu ble gellid ei ganfod, a sut y gellid gwneud cyfrifiadau. Hefyd amcangyfrifir yr adnoddau fyddai'i angen i ymgymryd â'r gwaith hwn o ran diwrnodau staff a'r sgiliau a'r profiad gofynnol.

Nododd yr adroddiad amrywiaeth o ffyrdd y gellid deall a meintioli gwerth y nwyddau a gwasanaethau. Roedd hyn yn cynnwys ffactorau o ddefnydd uniongyrchol, defnydd anuniongyrchol, diffyg defnyddio a gwerth opsiynau, a sut y mae'r dull Gwerth Economaidd Cyfan yn rhoi modd i'r holl elfennau ddod at ei gilydd.

The LIFE Natura 2000 (N2K) Programme for Wales is interested in quantifying the benefits provided by Natura 2000 (N2K) features and sites in Wales to demonstrate their value to the economy and society. This is to highlight the benefits of directing economic measures into maintaining and enhancing N2K features.

This short paper explores the feasibility of placing a monetary value on ecosystem services provided by N2K features in Wales, in the form of standard figures that allow comparisons between sites and with other ecosystem service valuation studies. It refers to other similar work carried out elsewhere and identifies where the required information could be sourced or derived, and how calculations could be made. It also estimates the resources that would be needed to undertake this work in terms of staff days and the skills and experience required.

The report identified a variety of ways of understanding and quantifying the value of goods and services. This included values from direct use, indirect use, non-use and option values, and how the Total Economic Value (TEV) approach allows all of these values to be brought together.

2 Introduction

- 2.1 The LIFE Natura 2000 Programme for Wales is interested in obtaining information on the financial value for all benefits from Natura 2000 (N2K) features, in the form of standard figures that allow comparisons between sites and with other ecosystem service valuation studies. This would enable a better understanding of the benefits to society provided by the N2K series and the way in which economic measures might be directed to maintaining and enhancing these benefits.
- 2.2 This paper explores the feasibility of placing a monetary value on the benefits described above. The study refers to other similar work carried out elsewhere and identifies where the required information would be sourced or derived, and how calculations would be made. It estimates the resources that would be needed to undertake this work in terms of staff days and the skills and experience required.

3 Types of ecosystem services and the benefits they provide

- 3.1 Ecosystem services can be defined most succinctly as “the benefits people obtain from ecosystems” (MEA, 2005). Collectively, these benefits are fundamental to the health and well-being of all humans and maintenance and development of society on earth.
- 3.2 They include benefits that people receive as consumers of food, energy and other materials (termed **provisioning services**).
- 3.3 There are the less tangible ‘quality of life’ benefits people receive through spiritual enrichment, recreation and aesthetic experiences from the natural environment (termed **cultural services**).
- 3.4 There are also wider benefits experienced by communities and society in the form of the maintenance of natural processes such as the climate, water, air, soil, diseases and pests (**regulating services**).
- 3.5 Finally, society benefits indirectly from the fundamental way that ecosystems support life including through primary biological production (such as photosynthesis), soil formation, nutrient cycling and water cycling (**supporting services**).

4 The different ways in which ecosystem services are delivered

- 4.1 Understanding how these benefits are derived and delivered is obviously important in order to safeguard their continued delivery. For policy interventions to be effective, it is important to know how the services that provide these benefits operate, where they come from and what forms of protection and management are necessary to maintain or enhance them.
- 4.2 Each of the individual benefits can be seen as the product of a supply chain or ‘cascade’ that starts with the environmental attributes or ‘natural capital’ from which ecosystems services are derived by human managed and/or natural processes. **Figure 1** illustrates this supply chain which, when it is working efficiently, operates in a reinforcing cycle in which the way we attach importance to the services protects and enhances the attributes and processes that deliver them.

Figure 1. The cascade from environmental attributes to human benefits implicit in the concept of ecosystem services

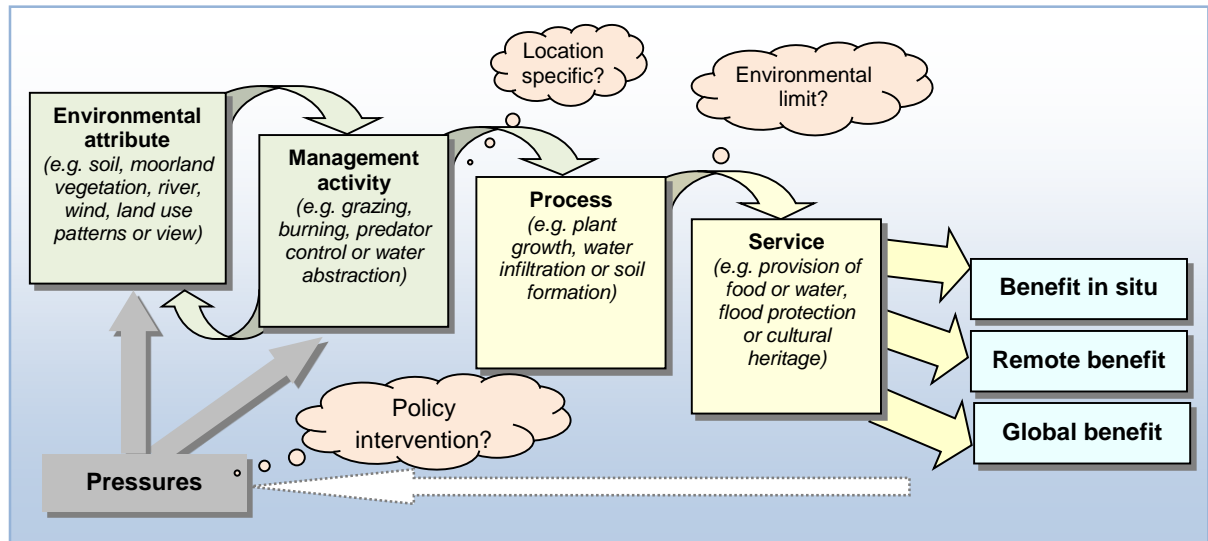


Figure adapted from Haines-Young and Potschin (2008).

4.3 **Figure 1** also shows that the scale at which benefits are received varies.

- Firstly, some benefits are derived 'in situ' at the location where the service itself is generated. An example of this is the economic activity generated by tourism in the natural environment such as from organised walking holidays, dolphin watching or wildlife parks.
- Secondly, many benefits are received more remotely, but still with a direct connection back to originating environmental attributes. An example of this is the supply of clean drinking water to communities from reservoirs and aquifers that can be a considerable distance from where the water is used.
- Thirdly, some benefits are received at a larger scale still, where the connections between the originating environmental attributes and the benefits received by people may be diffuse. An example of this is the way marine and terrestrial ecosystems, at a global scale, regulate carbon-dioxide and oxygen in the atmosphere¹.

4.4 Some ecosystem services are delivered primarily by natural processes that require little involvement from people, but where human activity can disrupt or degrade the processes (an example being the regulating of flooding where soils and vegetation intercept and slow the run-off of rainfall, and where land use and management activity can affect the capacity of soils and vegetation to do this). Many ecosystem services involve more active management by people (such as the provision of food by farming and timber by forestry) or are the result of the way that people interact with the environment (for example the appreciation of cultural heritage and landscapes as part of the way we perceive places).

4.5 In each of these cases, an understanding of how human activity shapes ecosystem service delivery is essential if we are to adopt policies to safeguard and enhance their provision. This involves developing a detailed understanding of how different forms of land use and management contribute to or damage different ecosystem services and how the recipients of services appreciate and react to the benefits they receive.

¹ For more on the different pathways involved in ecosystem service delivery, see Fisher et al. (2008)

The purpose of economically valuing ecosystem services

4.6 Developing the kinds of detailed understanding of how ecosystem services are delivered does not necessarily require a formal process of valuation. Furthermore, any valuation does not necessarily need to be in monetary terms (using a currency value to define the quantum of service produced). However, undertaking such a process of economic valuation has several distinct advantages, as follows:

- **Firstly**, economic valuation provides an objective way of comparing the benefits derived from one service, or one policy affecting ecosystem services, against another. This ensures that trade-offs between ecosystem services where a course of action increases one service but diminishes another can be properly evaluated (such as the decision on whether to plant forestry for timber on a wetland valued highly for its biodiversity). It also provides a way of comparing the costs and benefits of delivering an ecosystem service in one location compared to another (for instance the sequestration of atmospheric carbon dioxide for climate regulation in peat soil in the uplands compared to peat soils in the lowlands).

Using a currency value as the metric for making this comparison is not essential (other metrics such as the effect on human lifespans could be used). However, since we make many of our decisions, as individuals and society, on the basis of financial costs and benefits, the use of currency values tends to be easily understood.

- **Secondly**, economic valuation provides a way of comparing the benefits of public investment in the regulation or delivery of ecosystem services with the benefits of other policy programmes such as in the health service or defence. For instance, there has been much interest in recent years in the benefits to human health and well-being from living close to high quality natural green spaces. Economic valuation provides a useful policy tool for comparing the effect of these spaces on people's physical and mental health outcomes with the cost of treating illness and conditions caused by the absence of these spaces (South et al, 2012).
- **Thirdly**, economic valuation provides a way of understanding how the operation of markets and commercial activity by businesses can be used to enhance service provision. Some services are reliant on the efficient operation and regulation of private markets, such as food production, while others, such as energy production from wind or biomass, involve government interventions in markets to stimulate the service. There is growing international interest in the concept of Payments for Ecosystem Services (PES), in which policy is used to stimulate market demand for service delivery (Defra, 2003)².

Different types of value

4.7 Economists have developed a variety of different ways of understanding and quantifying the value of goods and services and these can be applied to ecosystem services. The Millennium Ecosystems Assessment (MEA, 2005, also quoted in RSPB, 2009) identified four causes of value that reveal the broad range of ways we benefit from nature.

- **Direct use values.** These include the benefits we get from eating food, fish, using timber or enjoying outdoor recreational activities. These values can often be obtained from examining the operation of existing markets (although externalised costs of production that may not be properly reflected in market values – such as the cost of treating water pollution caused by farming – need to be taken into account).
- **Indirect use values.** These include the processes that contribute to the production of goods and services like soil formation, water purification and pollination. These are frequently not reflected in market values (i.e. they are externalised) but can be established by understanding the market costs incurred in providing them.
- **Non-use values.** Many people derive pleasure from simply knowing a resource exists or because they wish to bequeath it to future generations. These are more difficult to attach a monetary value to because they are usually not traded commodities. However, people are

² See also <http://www.iied.org/markets-payments-for-environmental-services> for international examples of PES.

usually able to state how important they consider these things to be in comparison with other goods or services which are traded and can be valued – this is covered further below.

- **Option values.** Despite the fact that people may not currently be gaining any benefits from them, many ecosystem services still hold value for preserving the option to use such services in the future either by the individual (option value) or by others (bequest value). Again, these are frequently not traded and they may be difficult for people to assign relative importance to because doing so requires an understanding of future uncertainty.

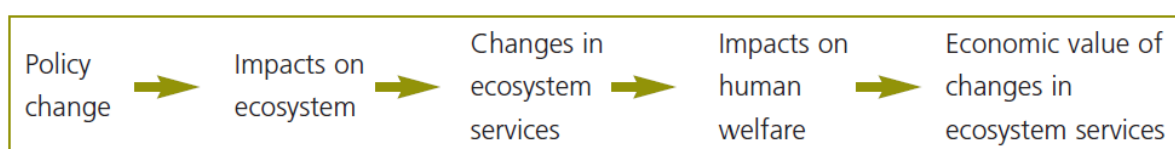
Table 1. Types of economic value most relevant to the categories of ecosystem service

Service type	Direct use	Indirect use	Non-use	Option value
Provisioning	□			□
Regulating		□		□
Cultural	□		□	□
Supporting	Supporting services are valued through the other categories of ecosystem services			

Source: Defra (2007)

- 4.8 For each of these categories there are two different ways that the value generated by ecosystem services can be calculated. The first is the **absolute value** derived by an ecosystem service (or the loss of value if the service were to be entirely removed). These values are usually very large but may not be helpful to inform public policy because completed removal (or creation) of a service is rarely an option that needs to be addressed by policy. The alternative is to calculate the **marginal value** of ecosystem service delivery that will arise from pursuing a particular policy option. For instance, a decision on whether to re-wet an upland blanket bog (for instance blocking drainage ditches to raise the water table) would be informed by a marginal valuation of the improved delivery of a range of services such as climate regulation (the sequestration of carbon in peat), flood regulation (the storage and slow release of rainfall), water provision (the supply of high quality water to downstream reservoirs) and aesthetic and cultural services (the benefits to people from knowing that this internationally important habitat, and associated wild species, is present and can be appreciated).
- 4.9 The use of marginal valuation to provide evidence for policy decisions is the reason why Defra, in its guide to the valuation of ecosystem services (Defra, 2007), recommends that valuation is based on an understanding of the impact pathway of policy change (**Figure 2**). In this approach, valuation is used to quantify the marginal (additional) benefits of changes in ecosystem delivery from different policy options.

Figure 2. Overview of impact pathway of policy change



Source: Defra (2007).

5 Economic valuation techniques and benefits transfer

5.1 As noted above, economic valuation seeks to attach a monetary amount to ecosystem services. This can be done in two ways.

- Firstly, there are **pricing approaches** which make use of 'real world' market-derived data to establish this monetary value. This is relatively easy for goods and services that are traded in commercial markets (such as supply of drinking water or energy) but is more difficult for services that are not (such as landscape quality).
- Secondly, there is the **Total Economic Value (TEV) approach** which uses a variety of techniques to assign a monetary value where one cannot easily be obtained from 'real world' markets. These techniques involve estimating public preferences for changes in ecosystem services.

5.2 Some of the main economic techniques used in these approaches are summarised in **Table 2** and their suitability for valuing different services is shown in **Table 3**.

Table 2. Summary of different valuation techniques

Revealed preference (RP) methods rely on data regarding individuals' preferences for a marketable good which includes environmental attributes. These techniques rely on actual markets. Included in this approach are: market prices, averting behaviour, hedonic pricing, travel cost method, and random utility modelling. Market prices and averting behaviour can also be classified under pricing techniques.

Stated preference (SP) methods use carefully structured questionnaires to elicit individuals' preferences for a given change in a natural resource or environmental attribute. In principle, SP methods can be applied in a wide range of contexts and are the only methods that can estimate non-use values which can be a significant component of overall TEV for some natural resources. The main options in this approach are: contingent valuation and choice modelling.

Pricing approaches provide a different, albeit overlapping, classification to TEV, referring to approaches that use observed market prices either as direct measures of economic value of an ecosystem service (e.g. market prices, avertive expenditure, damage costs avoided) or as a proxy for the value (referred to as cost-based approaches).

Cost-based approaches to valuing environmental goods and services consider the costs that arise in relation to the provision of environmental goods and services, which may be directly observed from markets. Included under this heading are: opportunity cost; cost of alternatives, and replacement costs. However, as these methods are based on costs, they do not strictly measure utility (and are therefore not included under the TEV framework), that is, they are non-demand curve methods and need to be used with care.

Non-economic valuation – deliberative or participatory – approaches tend to explore how opinions are formed or preferences expressed in units other than money. The choice is not a case of either economic or non-economic valuation methods but of using a combination of both, as required by the context of the decision.

Source: Defra (2007)

Table 3. Choice of valuation methods for different ecosystem services

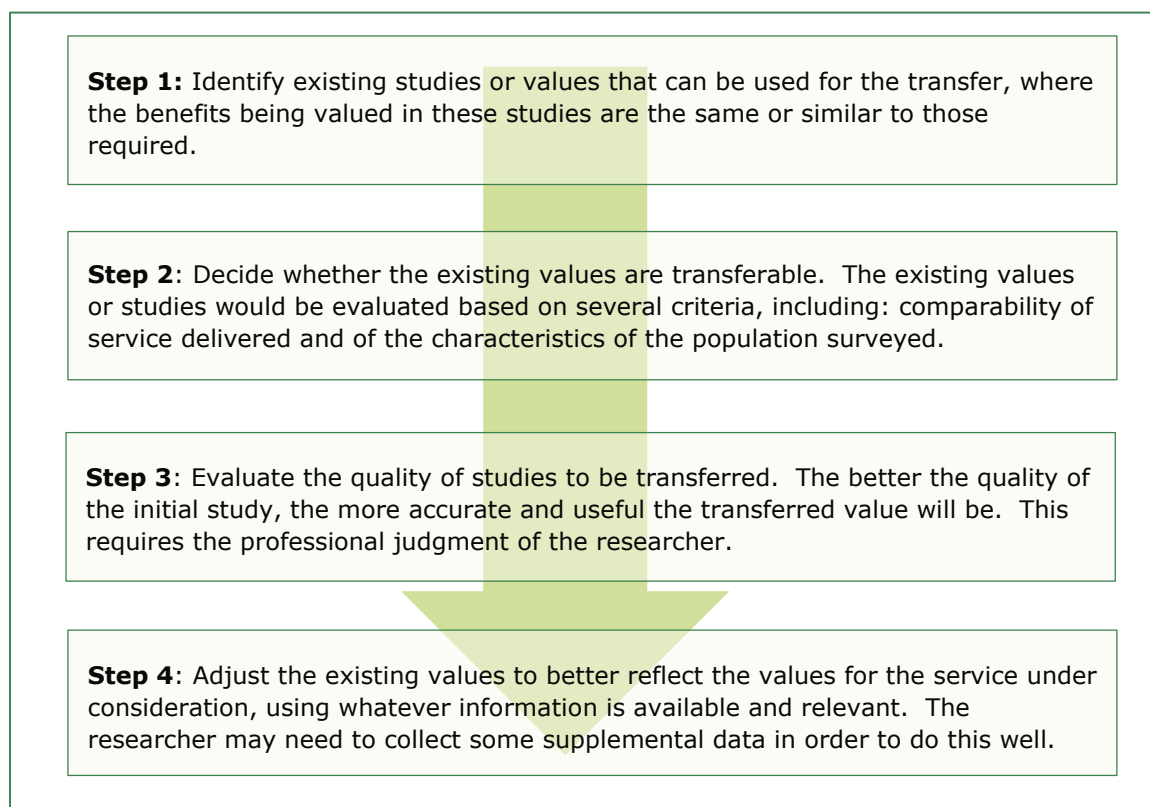
Valuation method	Element of TEV captured	Ecosystem service(s) valued	Benefits of approach	Limitations of approach
Market prices	Direct and indirect use	Those that contribute to marketed products e.g. timber, fish, genetic information	Market data readily available and robust	Limited to those ecosystem services for which a market exists
Cost-based approaches	Direct and indirect use	Depends on the existence of relevant markets for the ecosystem service in question. Examples include man-made defences being used as proxy for wetlands storm protection; expenditure on water filtration as proxy for value of water pollution damages	Market data readily available and robust	Can potentially overestimate actual value
Production function approach	Indirect use	Environmental services that serve as input to market products e.g. effects of air or water quality on agricultural production and forestry output	Market data readily available and robust	Data-intensive and data on changes in services and the impact on production often missing
Hedonic pricing	Direct and indirect use	Ecosystem services that contribute to air quality, visual amenity, landscape, tranquility i.e. attributes that can be appreciated by potential buyers	Based on market data, so relatively robust figures	Very data-intensive and limited mainly to services related to property
Travel cost	Direct and indirect use	All ecosystems services that contribute to recreational activities	Based on observed behaviour	Generally limited to recreational benefits. Difficulties arise when trips are made to multiple destinations
Random utility	Direct and indirect use	All ecosystems services that contribute to recreational activities	Based on observed behaviour	Limited to use values
Contingent valuation	Use and non-use	All ecosystem services	Able to capture use and non-use values	Bias in responses, resource-intensive method, hypothetical nature of the market
Choice modelling	Use and non-use	All ecosystem services	Able to capture use and non-use values	Similar to contingent valuation above

Source: Defra (2007), based on etec (2006)

- 5.3 It should be noted that undertaking these techniques is usually a complex process that can be resource intensive (for instance requiring public surveys). However, the important point in terms of the objectives of this paper and the valuation of services provided by Wales's N2K sites, is that there is an accepted means of adopting the results of existing valuation studies and applying them in broadly similar circumstances. This is known as **benefits transfer**.

- 5.4 Expressed mostly simply, the benefits transfer method involves a four stage process, as shown in **Figure 3**.

Figure 3. Application of the benefits transfer method



Source: Adapted from a US website: http://www.ecosystemvaluation.org/benefit_transfer.htm

6 Existing research and guidance

- 6.1 An advantage of the benefits transfer approach is that valuation studies undertaken in other countries can be applied (with suitable adjustments). For instance research on the recreational value provided by National Parks in the United States or studies in France on the value to communities of flood water storage on farmland might be transferred to the UK.
- 6.2 Internationally, The Economics of Ecosystems and Biodiversity (TEEB) Programme has examined the many benefits that society gains from natural systems (<http://www.teebweb.org/>). Different strands of this large programme have reported on the valuation of ecosystem services in different sectors of the economy and in different biomes.
- 6.3 A consortium of Universities in Belgium and the Netherlands undertook a valuation study for the Flemish Government on the ecosystem services in Flanders, also producing a toolkit on valuation techniques (LNE, 2010). In France, the Government's Centre for Strategic Analysis has reviewed the policy context, evidence and methodological approaches for establishing reference values for ecosystem service delivery in France that could be spatially disaggregated to Departmental level (Chevassus-au-Louis et al. 2009).
- 6.4 Such is the level of international interest in the valuation of ecosystem services that a number of academic institutions have started to provide online compendia of valuation studies. These include the Environmental Valuation Reference Inventory which includes summaries of around 380 UK valuation studies and is a source recommended by Defra³ - see **Figure 4** for the website home page.

³ <https://www.gov.uk/ecosystems-services>

Figure 4. Home page of the Environmental Valuation Reference Inventory



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- 6.5 In the UK, there are a number of sources of information about existing valuation studies that can be adopted or adapted for new ecosystem service valuation studies. These include the Valuing Nature Network (<http://www.valuing-nature.net/>), the Ecosystems Knowledge Network <http://ecosystemsknowledge.net/resources/tools-guidelines/valuing/economic>, both of which have links to other projects in the UK and overseas.
- 6.6 The UK National Ecosystems Assessment (NEA) provided the first comprehensive overview of the state of the natural environment in the UK (UKNEA, 2011) and this large research programme, which is now in its second phase, has involved a number of research outputs that provide an economic valuation of ecosystem services (see for instance Morris and Camino, 2011).
- 6.7 A number of guidance documents have been prepared by bodies like the UN Environment Programme (UNEP, 2013) and Defra (eftec, 2009) to ensure that consistent standards are maintained in the use of benefits transfer in the valuation of ecosystem services.

7 Information required to value the services from the Welsh Natura 2000 network

- 7.1 The previous sections of this paper has shown that there are a wide range of existing studies that might be transferred to economic valuations of the ecosystem services provided by Wales's N2K sites and features. The UK NEA provides the best peer-reviewed source of evidence and where information is not available in sufficient detail from the NEA, international programmes such as TEEB are likely to be able to fill this in the majority of cases.
- 7.2 Assuming, a suitable valuation study can be identified for a given service and/or N2K feature, this must be applied to the situation in Wales. The pathway of ecosystem service delivery (Figure 1), shows that services are delivered by definable quantities of environmental attributes (which may be an area of habitat or number of species) and may be affected by definable amounts of human management (for instance livestock grazing) or natural processes (for instance rainfall or erosion). The inventory of ecosystem services on Wales N2K sites and features that was commissioned by the LIFE Natura 2000 Programme/Natural Resources Wales in 2015, shows that, of the two types of feature of European importance on N2K sites, it is normally habitats that are responsible for providing ecosystem services rather than species. For most services, it will therefore be important to base the valuation of services on the quantity of habitat (taking account of the condition of that habitat) present and subject to the change measured through the valuation. For the species features where the inventory shows a link to ecosystem service delivery (as is the case for those that generate human activities such as salmon fishing or bird watching trips, or have an emblematic role that helps to define human perceptions at a site or landscape scale such as the otter or the red-billed chough), separate valuations of their contributions to service delivery may be possible, providing there is evidence on which to base these valuations.
- 7.3 The designation of Special Protection Areas (SPAs) on the basis of their bird species interest alone (habitats are not classed as features for the purpose of designation of SPAs) means that the services delivered by these sites must be done at a species level for the featured birds, where this is possible. Unless additional habitat information (such as is available from the Site of Special Scientific Interest notifications and monitoring) is included, the valuation of services from SPAs is likely to be more limited than that possible for SACs, where habitat feature data is available.
- 7.4 As noted earlier, a key decision is needed on whether to apply absolute or marginal valuation. If the latter, then the baseline and altered state of service provision needs to be defined (usually based on assumptions about an enhancement in the condition of N2K sites or features). Which of these approaches is taken depends on what the information is required for. If the purpose is to demonstrate how enhancing the management and condition of N2K sites will justify the use of public resources to do this, a marginal approach will be needed.
- 7.5 It is worth noting that most economic valuation studies take a relatively high level, coarse grained approach that does not distinguish detailed differences in the condition of habitats or the numbers of species. These studies are useful in that they are likely to be applicable in a range of similar geographies and situations but are limited in the extent to which they can inform the value of different types of environmental management or quality. A typical example is the valuation of recreational fisheries in Nordic countries undertaken through a contingent valuation postal survey (Toivonen et al, 2004) which examined the value of different types of fishing but did not explore the value of different fish species or habitat types.
- 7.6 At the other end of the spectrum, some valuation studies are much more specific about the ecosystem service, the location and environmental conditions being studied. These are likely to have a much narrower applicability to other circumstances, but where a match does occur, are likely to allow a deeper understanding of the benefit of different management options. An example is the economic assessment of the benefits arising from marine protected areas designations in the UK (Frid C, 2010) which, though narrow in scope, could be relevant to a valuation of the benefits of N2K sites in Wales.

8 Limitations and ways of addressing these

- 8.1 This section examines the challenges and constraints implicit in the valuation of ecosystem services that would need to be addressed in any study of the value of services from Welsh N2K features and sites.

'Broad and shallow' versus 'narrow and deep' approaches

- 8.2 The distinction made in the previous paragraphs (6.5 and 6.6) between high level but broadly applicable ('broad and shallow') valuation studies and those with a more specific and detailed focus ('narrow and deep') is an important one that would need to be addressed in a project to value the services provided by N2K features and sites in Wales.
- 8.3 As noted at the start of the previous section, a good deal of work that is relevant to a valuation of the services provided by N2K sites in Wales has already been undertaken as part of the UKNEA. This has identified suitable reference values through the benefits transfer approach and applied them at a broad habitat level to, for instance, wetlands, woodlands and coastal habitats, peat soils and rivers. Applying these reference values to the high level (for instance broad habitat) metrics available for N2K sites in Wales should give useful data without the need for significant new research, and would require the skills of a general environmental economist without specialist ecological knowledge.
- 8.4 However, these valuations will be of limited value in helping to quantify the benefit of different environmental management regimes or the enhanced protection of specific species (such as might be needed to justify a publicly funded programme of action). Where specific courses of action are being considered (for instance the large scale rewetting of upland blanket bogs, the enhanced protection of a sea-bird nesting site or managed coastal realignment to create new inter-tidal habitat), it is likely that more narrowly focussed valuation studies that can be applied to these circumstances would be needed. A search of international 'benefits transfer libraries' (see. Para. 5.4) would be needed and it is likely that specialist ecological knowledge would be required to assess the applicability of other studies to the particular circumstances being proposed in Wales. Such an approach would be more resource intensive but would produce evidence that was more valuable in policy terms, compared to a 'broad and shallow' valuation derived from the UKNEA.

The risk of double counting

- 8.5 Many of the guidance documents on economic valuation (see for instance etec, 2010) highlight the potential danger of double counting economic benefits when valuing different services separately. This can occur when the benefits received by society from different services are the same or overlap, or where the same economic inputs (such as land management) contribute to several services.
- 8.6 The ecosystem services inventory that has been prepared for the Welsh N2K sites and features takes a more fine-grained approach to classifying different services (with 41 services) than other studies such as the MEA (31 services) or the UKNEA (12 services – see Figure 10 in the NEA Synthesis report). This increases the potential for overlap of benefits and suggests that some merging of the services in the N2K inventory would help overcome this risk.
- 8.7 The potential for double-counting is particularly high for the cultural services, where the benefits to society in terms of physical, mental and spiritual well-being can be difficult to disaggregate to individual services. So, for instance, a valuation of the benefits of improved protection of bottlenose dolphins in Wales's marine Special Areas of Conservation (SACs) would need to assess the increased value of services such as (from the N2K inventory) 'Active organised leisure pursuits', 'Sense of place & distinctive natural character', 'Links to language, fiction, poetry, painting & music', 'Personal connections with the environment' and 'Use of the environment for learning, training and scientific research'. In this case, it might be appropriate to apply the benefits transfer approach to three sets of value, one covering active organised pursuits associated with dolphin watching tourism activity, one covering people's willingness to pay for the aesthetic and spiritual benefits of knowing that dolphins are plentiful off the coast of Wales and one based on the value of dolphin populations for educational and research activities. This approach should reduce the scope for double counting in this example.

Other potential limitations

- 8.8 It should be noted that while valuation is a key tool for embedding the ecosystem service concept in policy decisions, it is not appropriate for all environmental management decisions. Examples where valuation is not appropriate or will have a limited role are summarised below. This section is taken from RSPB (2009).
- **Marginality.** Valuation is appropriate for small changes; where many decisions are taken. It makes sense to value the change in service flow from conversion of a hectare of forest but not from conversion of the world's entire forests. The only sensible answer to the costs of losing the world's forests would be infinity.
 - **Threshold effects.** These occur when a reduction in biodiversity to a certain level causes a sudden collapse in an ecosystem's ability to deliver services. The demise of some of the world's most profitable fisheries, such as the Grand Banks cod fishery off Newfoundland Canada, is an example of a threshold change in a once thriving population. For potentially large but uncertain environmental changes, or where an ecosystem or service is deemed susceptible to large reactions from further change, economics should be subordinate to scientific evidence.
 - **Complexity.** The ability to accurately value services is limited by the complexity of nature itself. Accurate quantification of service provision is seldom easy, let alone measuring the change in service delivery associated with different land or marine use options.
 - **Undervaluation.** The TEV of a system will always be less than the Total Systems Value. TEV does not capture the infrastructure value associated with the underpinning, life support functions of healthy systems. Additionally, TEV excludes intrinsic values and, for practical reasons, we can only ever estimate values for a subset of services.
 - **Moral considerations.** The TEV framework does not include intrinsic values and some decisions, for example one which may commit a species to extinction, are beyond the bounds of economics.
- 8.9 So, as RSPB (2009) states, where valuation is used it should generally be one component of a broader decision-making framework. This indeed is the advice of the UK Treasury, which recommends the use of multicriteria decision analysis when faced with a combination of monetary measures and qualitative data.

9 Resources required

- 9.1 If the techniques and sources of evidence outlined in this paper are to be applied to the N2K features and sites in Wales, using the inventory of ecosystem services that has been prepared alongside this paper, additional work will be required by someone with appropriate skills and experience. This section examines the expertise and the likely amount of time that would be required.

Expertise

- 9.2 It is assumed that the valuation work would be done primarily through TEV benefits transfer and would not require new primary valuation studies (such as surveys of public willingness to pay for the benefits provided by N2K features). The exception to this might be where direct use benefits of N2K features and sites are relatively easy to establish, such as the value of specific recreational salmon fisheries (for instance rod licences and associated tourism services such as hotel bills) or the timber production from specific N2K woodland sites.
- 9.3 This means that expertise in market research and survey design will not be required and there will not be a requirement for a team of researchers to run a postal or telephone survey. The main expertise required will be in applied environmental economics and, specifically, the use of TEV approaches to value ecosystem services. These skills are held both in universities (for instance schools of environmental science) and in economic consultancies. Some third sector conservation bodies, such as the Wildlife Trusts and RSPB may also be able to provide these skills.
- 9.4 A difference between a 'broad and shallow' and 'narrow and deep' approach was distinguished above (para. 8.2), with the latter being more suitable for assessing specific management proposals or policy options. It was noted that identifying the suitability of reference values from other detailed valuation studies to the circumstances applying to Wales N2K features and sites (and to particular management options under consideration) might require additional ecological expertise. For instance, assessing the suitability of a valuation study on sand dune protection in south west France to the circumstances applying to west Wales would require knowledge of the natural processes in both situations. Sufficient knowledge might be available from within NRW or might be acquired from ecological consultancies, third sector conservation bodies or universities.
- 9.5 Ecological knowledge of the N2K sites on which ecosystem services are being valued, and specifically a good understanding of the environmental metrics available such as the size of populations or the area of habitat present, will also be required. This should be available from the NRW site managers or specialists.

Time

- 9.6 The advantage of the benefits transfer approach to economic valuation is that it is relatively resource efficient, particularly where reference values from other studies are judged to be directly applicable, as is likely to be the case in 'broad and shallow' assessment similar to those in the UKNEA.
- 9.7 Nevertheless, applying the approach to the service provided by N2K sites in Wales will require a number of preparatory steps which to a large extent will determine the time inputs required for the subsequent valuation work.
- 9.8 Firstly, as noted earlier (para. 7.5), the merging of some of the ecosystem services in the N2K ecosystem services inventory to avoid the risk of double counting will make the process simpler and less time-consuming. An initial task will be necessary to establish the services which should be subject to separate valuation, including those which merit the calculation of direct use valuation (such as several of the provisioning services).
- 9.9 Secondly, again as already noted (para. 7.2), the inventory recognises that ecosystem service delivery is normally associated with habitats rather than species (with the exception of economically significant or emblematic species or groups of species). In addition, existing reference values for service valuation are more likely to relate to habitats than to species. Sources such as the UKNEA value broad habitats rather than more specific ecological communities. There is therefore a task to examine each of the N2K habitat and species features

to determine whether it can easily be separately valued or whether merging with other habitat or species features is warranted. It is likely that the classification of SAC habitat features under 15 broad habitat types will be sufficient. For SPAs, as noted above the absence of habitats as defined features of the designation is likely to limit the extent of valuation unless other background habitat data is included.

- 9.10 Thirdly, decisions are required on the expected outcomes of the process and these will define the scope of the valuations to be undertaken. On the one hand, the valuation could measure the enhancement in ecosystem service provision that would arise from improving the condition of all features and sites – for instance from achieving favourable conservation status in each of the sites (a ‘broad and shallow’ approach – see para. 8.2). Alternatively, the valuation could focus on more bespoke conservation objectives, perhaps related to particular projects for which funding is being sought to examine the benefit of improving a specific area of habitat or increasing the population of a single species or group of species (the ‘narrow and deep’ approach).
- 9.11 Running through these tasks will require the involvement of a project steering group to prepare the brief and establish the decision criteria and a contractor to assemble the evidence. It is estimated that the contractor input is likely to be in the order of four to six days, three days for the client project manager and a further day for members of the project steering group.
- 9.12 After these initial preparatory tasks have been completed, the scale of the valuation task(s) should be clearer. The following estimate should therefore be regarded as subject to a large margin of error.
- 9.13 Running a TEV valuation for the whole N2K series in Wales, covering around a dozen ecosystem services and based on metrics of broad habitats and key species, is likely to require a commitment of around 20 days of contractor input (of which around five days of time could be reserved for establishing direct use values and 15 days for other values based on reference values identified through benefits transfer).
- 9.14 Alternatively, or in addition, running a TEV for a more bespoke project-based situation (for instance measuring the benefits of a given increase in a species population) is likely to require around four days of contractor time, including a level of specialist ecological input which could be provided by the client group, assuming suitable reference values can be established through benefits transfer. This time allocation would provide a high level ‘indicative’ valuation of potential benefits and would not be adequate for a rigorous cost benefit analysis of a large publicly funded programme. Project management and steering would be in addition to these time estimates.

10 Summary and conclusions

10.1 The following conclusions can be drawn on the feasibility of valuing the benefits that can be derived from enhanced ecosystem service provision from N2K sites in Wales.

- This short paper explores the feasibility of placing a monetary value on the benefits that can be derived from the N2K features and sites in Wales. It refers to other similar work carried out elsewhere and identifies where the required information could be sourced or derived, and how calculations could be made. It estimates the resources that would be needed to undertake this work in terms of staff days and the skills and experience required.
- Economists have developed a variety of different ways of understanding and quantifying the value of goods and services and these can be applied to ecosystem services. These include direct use (usually involving established markets), indirect use (where market figures can be applied to non-market activities), non-use (where a value can be attached based on the importance people attach to services) and option values (which relate to future benefits). The use of the Total Economic Value (TEV) approach allows all of these values to be brought together.
- While techniques exist for calculating these values 'from scratch' in each circumstance where a value is required, the benefits transfer approach has been developed to allow values that have been calculated in one situation to be applied to other similar situations. Such is the level of international interest in the valuation of ecosystem services that a number of academic institutions have started to provide online compendia of valuation studies for use in benefits transfer valuations. These include the Environmental Valuation Reference Inventory which includes summaries of around 380 UK valuation studies and is recommended by Defra. Other research programmes such as the UKNEA and TEEB have already identified many valuation studies that could be applied to the ecosystem services provided by Wales's N2K sites and features.
- There is an important distinction between high level but broadly applicable ('broad and shallow') valuation studies and those with a more specific and detailed focus ('narrow and deep') that would need to be addressed in the specification for a project to value the services provided by N2K features and sites in Wales.
- The main expertise required will be in applied environmental economics and, specifically, the use of TEV approaches to value ecosystem services. These skills are held in certain universities and economic consultancies and may also be available from third sector conservation bodies. Ecological knowledge of the N2K sites on which ecosystem services are being valued, and specifically a good understanding of the environmental metrics available such as the size of populations or the area of habitat present, will also be required. This should be available from the NRW site managers or specialists.
- A number of preparatory tasks are required to define the requirements of the valuation and to simplify some of the information provided in the inventory of ecosystem services provided by N2K features and sites in Wales. Contractor inputs to these preliminary tasks are estimated to be in the order of four to six days with a further three days for project manager by the client and a further day for members of a project steering group.
- The preliminary work will determine the scale of subsequent valuation tasks which can only be estimated with a large margin of error at this stage. Running a high level TEV valuation using benefits transfer for the whole N2K assembly in Wales, is likely to require a commitment of around 20 days of contractor input. Alternatively, or in addition, running a TEV for a more bespoke project-based situation is likely to require around four days of contractor time assuming suitable reference values can be identified in existing studies. This time allocation would provide a high level 'indicative' valuation of potential benefits and would not be adequate for a rigorous cost benefit analysis of a large publicly funded programme. Project management and steering would be in addition to these time estimates.

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Additional resources available on the European Commission Natura 2000 website

(http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm):

- Estimating the overall economic value of the benefits provided by the Natura 2000 Network & Annexes
- Estimating the economic value of the benefits provided by the tourism/recreation and employment supported by Natura 2000
- Recognising Natura 2000 benefits and demonstrating the economic benefits of conservation measures: successful and innovative approaches to financing Natura 2000 needs