Estimating the Overall Economic Value of the Benefits provided by the Natura 2000 Network

COMMISSION CONTRACT 07.0307/2010/581178/SER/B3

Synthesis Report

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Thanks also to Bio and Eftec for elements relating to their studies

September 2011
Revised December 2011
Finalised December 2011

Recommended citation:

ten Brink P., Badura T., Bassi S., Daly, E., Dickie, I., Ding H., Gantioler S., Gerdes, H., Hart, K., Kettunen M., Lago, M., Lang, S., Markandya A., Mazza, L., Nunes P.A.L.D., Pieterse, M., Rayment M., Tinch R., (2011). ***Estimating the Overall Economic Value of the Benefits provided by the Natura 2000 Network.*** Final Synthesis Report to the European Commission, DG Environment on Contract ENV.B.2/SER/2008/0038. Institute for European Environmental Policy / GHK / Ecologic, Brussels 2011

Acknowledgements:

We would like to thank the reviewers Dr Mike Christie, Stephen Nicol and Dr. Unai Pascual, for their insightful and stimulating comments throughout the study.

We would like to thank Johan Lammerant and his study team from Arcadis Belgium , EFTEC and ECNC for the useful inputs on the parallel project 'Recognising Natura 2000 Benefits And Demonstrating The Economic Benefits Of Conservation Measures', and Blandine Chenot and her study team from BIO Intelligence Service, Ecotrans, OÄR and Dunira Strategy for the useful inputs on the parallels study ' Estimating the economic value of the benefits provided by the tourism/recreation and employment supported by Natura 2000'.

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The Institute for European Environmental Policy (IEEP) is an independent not-for-profit institute. Based in London and Brussels, the Institute's major focus is the development, implementation and evaluation of EU policies of environmental significance, including agriculture, biodiversity, climate and energy, fisheries, governance, industrial pollution, eco-innovation, regional development, resource efficiency, sustainable consumption and production, transport and waste. IEEP also produces the award winning 'Manual of European Environmental Policy'. Website: http://www.ieep.eu.

Table of contents

Acronyms

CBD	Convention on Biological Diversity
GHG	Greenhouse Gas
CFP	Common Fisheries Policy
COPI	Cost of Policy Inaction
CVM	Contingent Valuation (Method)
EC	European Communities
EEA	European Environment Agency
ESS	Ecosystem Service
EU	European Union
FCS	Favourable Conservation Status
FTE	Full time Employment
GDP	Gross Domestic Product
GIS	Geographical Information System
HNV	High Nature Value
IEEP	Institute for European Environmental Policy
IUU	illegal, unreported and unregulated
JRC	Joint Research Centre
MA	Millennium Ecosystem Assessment
MPA	Marine Protected Area
MSY	Maximum Sustainable Yield
PA	Protected Area
PES	Payment For Ecosystem Service(s)
SAC	Special Areas of Conservation
SCI	Sites of Community Importance
SPA	Special Protection Areas
TEEB	The Economics of Ecosystems and Biodiversity
TEV	Total Economic Value
UK	United Kingdom
UN	United Nations
UNEP	United Nations Environment Programme
WHO	World Health Organization
WTP	Willingness-To-Pay

Estimating the Overall Economic Value of the Benefits provided by the Natura 2000 Network

A first assessment: synthesis report

PART A: AIMS AND APPROACH

I) Introduction: The Natura 2000 network and its benefits

The prime focus on the Natura 2000 protected area network is on the conservation of biodiversity, EU's unique and endangered ecosystems, species, gene pool and habitats. There has been an increasing, complementary interest in and recognition of the socio-economic benefits of biodiversity in general (MA, 2005; TEEB 2010, 2011) and from protected areas specifically (Kettunen et al 2009 & 2011, Stolton et al 2010, Gantioler 2010, Kettunen et al 2011) over the last decade.

In addition to its biodiversity benefits, the Natura 2000 network provides a range of benefits to society and the economy via the flow of ecosystem services (provisioning, regulating, cultural and supporting services). These support policy objectives beyond biodiversity, including climate change mitigation and adaptation, water quality and provision, food provision, jobs and livelihoods, cost savings, science and education, health and security, social cohesion and identity.

The recognition and demonstration of the wider socio-economic benefits of Natura 2000 can influence stakeholder attitudes and support for the Natura 2000 network, attract funding for conservation measures and other investment in and around sites, inform land-use (change) decisions, and help in the integration of protected areas in regional development planning and practice.

This report presents the results of a study by the Institute for European Environmental Policy (IEEP) with GHK, Ecologic Institute, Metroeconomica and EFTEC, to support the European Commission in providing a methodological framework for assessing the overall economic value of the benefits provided by the Natura 2000 network, carrying out a first assessment of the value of the Natura 2000 network, and recommending a way forward for future assessments to support the awareness of the economic co-benefits of Natura 2000 sites and network.

In order to estimate the value of the network, the 'ecosystem services' framework has been adopted within this study, building on Millennium Ecosystem Assessment (MA, 2005) and The Economics of Ecosystems and Biodiversity (TEEB, 2010 and 2011) – see the Glossary in Annex I for definitions and Chapter III and the full technical report of the study for wider discussion of the methodological framework.

Context: The Natura 2000 network, its coverage, rationale and benefits

The EU has a well-developed biodiversity conservation policy framework, which has been built up in response to international initiatives such as the Convention on Biological Diversity (CBD) and Bern Convention, and successive EU Environmental Action Programmes. At the heart of the EU's conservation policy framework are the Birds Directive[1] and Habitats Directive[2], which form the main legal framework for the protection of nature and biodiversity in the EU.

To achieve their objectives both Directives require two main types of activities. Firstly, the designation, implementation and management of sites that are particularly important for conserving and restoring EU biodiversity, and secondly, the strict protection of listed species as well as their breeding sites and resting places, wherever they occur. The establishment, protection and management of a coherent network of areas – known as the Natura 2000 network – is designed to protect the habitats and species targeted by the Directives.

The network comprises 26,000 sites and covers almost 18 per cent of the EU territory. It includes terrestrial Special Areas of Conservation (SACs), with an area of 59 million ha (0.59 million km^2), and terrestrial Special Protection Areas (SPAs) with an area of 49 million ha (0.49 million km^2). It also includes a growing marine protected area (MPA) network – now at 14.5 million ha[3]: 10 million ha^2 classify as SPAs and 13 million ha^2 as SCIs (note there is a significant number of sites that are both SCI and SPAs). The network is a core element of the wider EU green infrastructure, which together form a great part of our living natural capital.

The prime focus on the Natura 2000 protected area (PA) network is the conservation of the unique and endangered biodiversity in Europe; this includes rare habitats (e.g. cold water coral reefs), species (from keystone species to iconic charismatic species such as the Iberian Lynx) and genetic diversity (e.g. number of endemic species).

The benefits of protected areas to people, society and the economy include the supply of tangible resources such as water and sustainably produced crops and timber (provisioning services), and processes that regulate water and air quality, prevent natural hazards such as flooding and soil erosion, and mitigate climate change through storing and sequestering carbon (regulating services) (Dudley & Stolton, 2003; Brown et al, 2006; Campbell et al, 2008). Protected areas also provide cultural services, for example by supporting recreation and tourism, and maintaining cultural identity and sense of place (Butcher Partners, 2005; Eagles & Hillel, 2008).

These services are underpinned by the role that sites play in supporting the preservation of basic ecological processes (e.g. nutrient cycling), fundamental in maintaining the overall functioning of natural systems (supporting services noted). Healthy and well-functioning

[1] Council Directive 2009/147/EC on the conservation of wild birds (Birds Directive) adopted in 1979

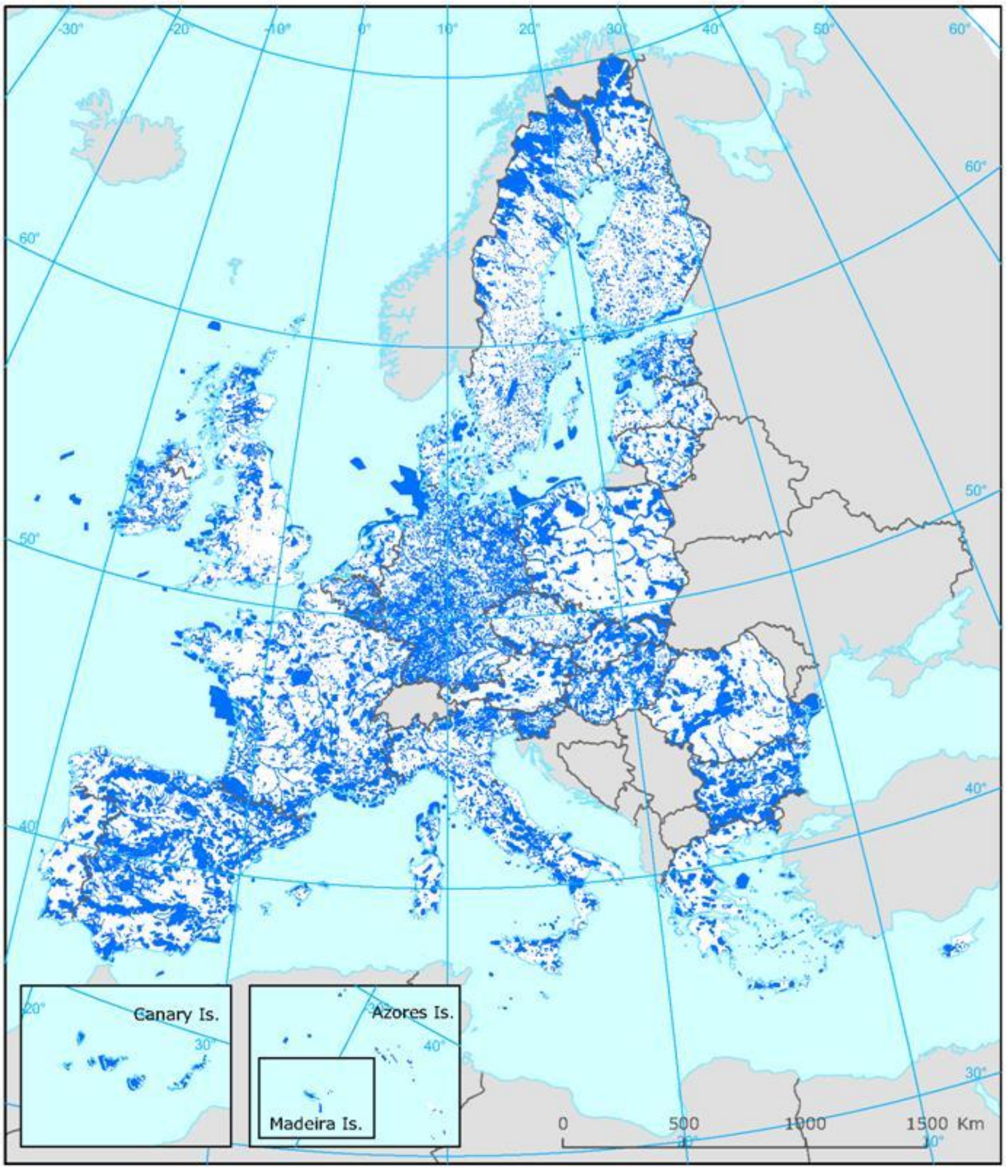
[2] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) adopted in 1992

[3] IP/11/1376: Press Release: Environment: Major expansion of Europe's protected natural areas available via http://europa.eu/rapid/

ecosystems sustained within protected areas can increase not only the range of ecosystem services, but also the resilience of ecosystems to resist and adapt to disturbances (e.g. climate change) also beyond the site level (Stolton et al, 2008; Dudley et al, 20010).

The Natura 2000 network, while almost complete at the terrestrial level, has yet to be finalised for marine protected areas (MPAs), and much of the network is still not yet reaching favourable conservation status (FCS) (see Glossary in Annex I for definitions). The systematic assessment covering the reporting period from 2001 to 2006[4] concluded that only 17 per cent of the 701 Annex I habitats were found to be in 'favourable' condition, though this is quite variable across the regions (see Figure 2 below).

Figure 1: Natura 2000 areas (terrestrial)



Source: http://www.eea.europa.eu/data-and-maps/figures/distribution-of-natura-2000-sites-across-eu-member-states-1

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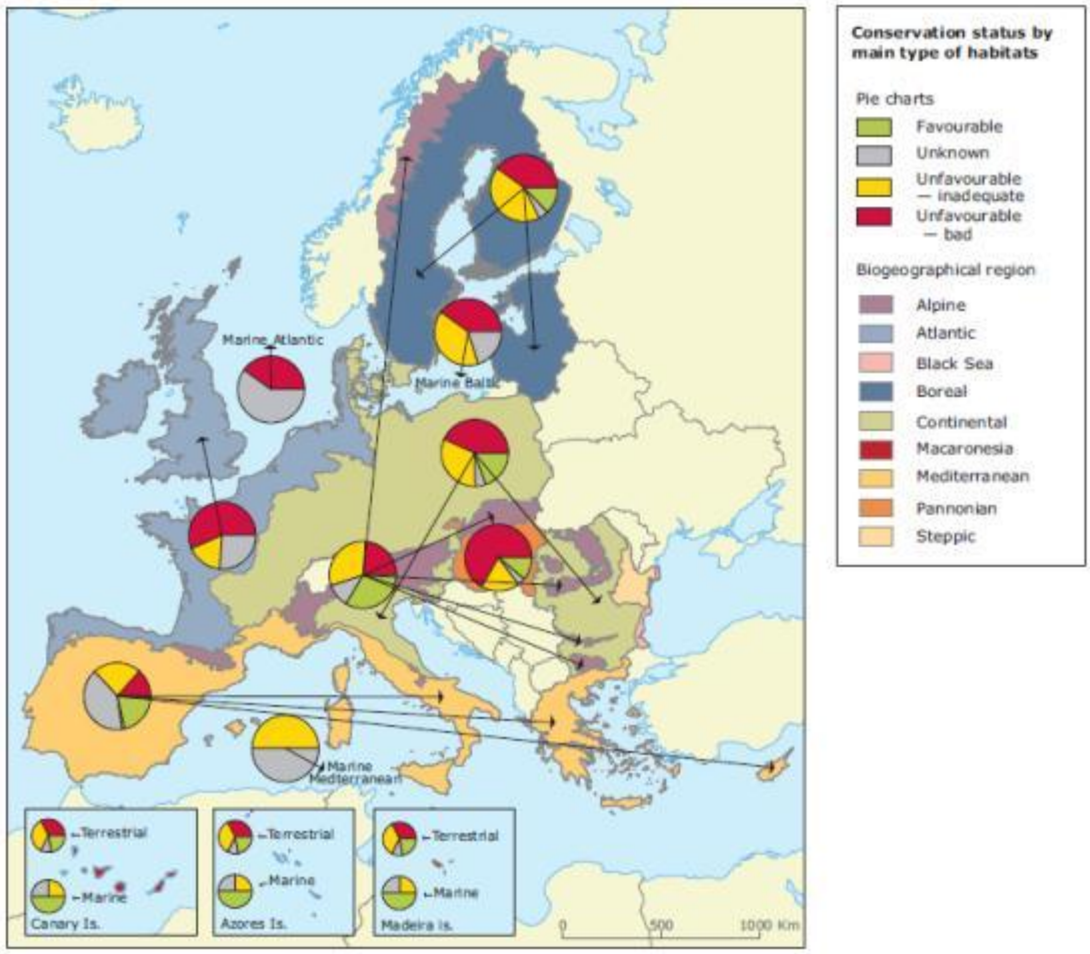
4 COM(2009) 358 final. Composite Report on the Conservation Status of Habitat Types and Species as required under Article 17 of the Habitats Directive. Brussels. Member States report every six years on their progress in implementing the Directive and the status of habitats and species of Community interest.

Figure 2: The conservation status of habitats in the EU's biogeographic regions



Note: How to read the map: in the Mediterranean biogeographical region (see Box 2.1 for an explanation of biogeograhical regions) about 21 % of habitats have a favourable conservation status but 37 % have an unfavourable (bad/inadequate) status.

Source: ETC/BD, 2008; SEBI 2010 Indicator 05.

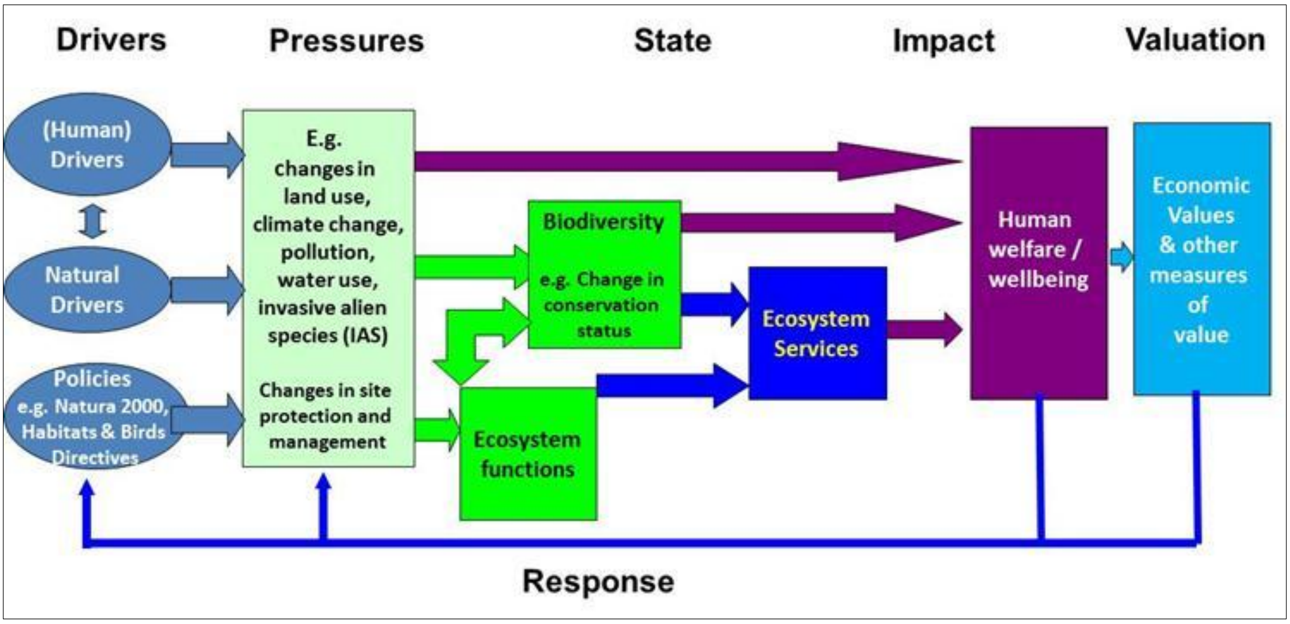
More needs to be done to improve the ecological status of the network. A healthier Natura 2000 network will also lead to a higher level of benefits provision to society and the economy as well as be more resilient to environmental pressures including climate change.

II) Methodology for assessing EU wide benefits of Natura 2000

Methodological Framework

This study has employed an **ecosystem services** approach to assess the benefits delivered by the network, and to examine their value. By protecting Natura 2000 sites and requiring conservation action, the network should enhance the functioning of ecosystems, which in turn deliver benefits to society and the economy (Figure 3).

Figure 3: Benefits of Natura 2000



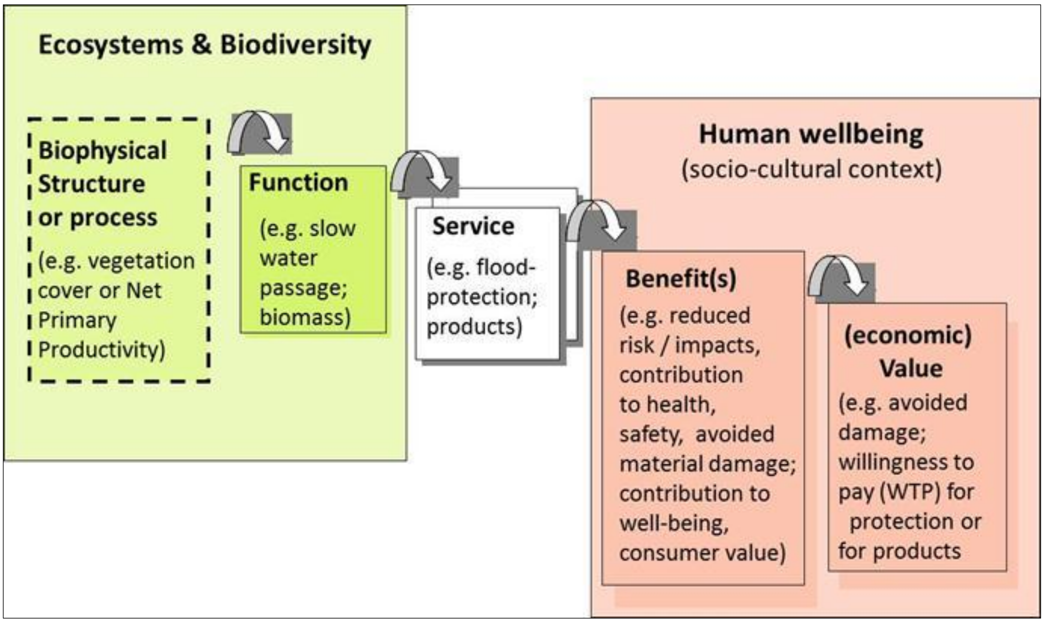
Source: Adapted from Braat and ten Brink et al (2008)

The Millennium Ecosystem Assessment (MA) provides a framework for categorising, assessing and valuing the services delivered by ecosystems. Sites deliver a range of provisioning, regulating and cultural services that enhance human welfare. These are underpinned by supporting services, which benefit people indirectly[5].

Some services are directly linked to species' detailed composition and diversity (e.g. pollination, cultural services). Others, like flood regulation, depend on the role of physical structures and processes at the ecosystem scale. These ecosystem services, in turn contribute to human wellbeing by providing a range of environmental, social and economic benefits – see Figure 4.

[5] Care needed to avoid double counting.

Figure 4: Contribution of Ecosystems and Biodiversity to Human Wellbeing

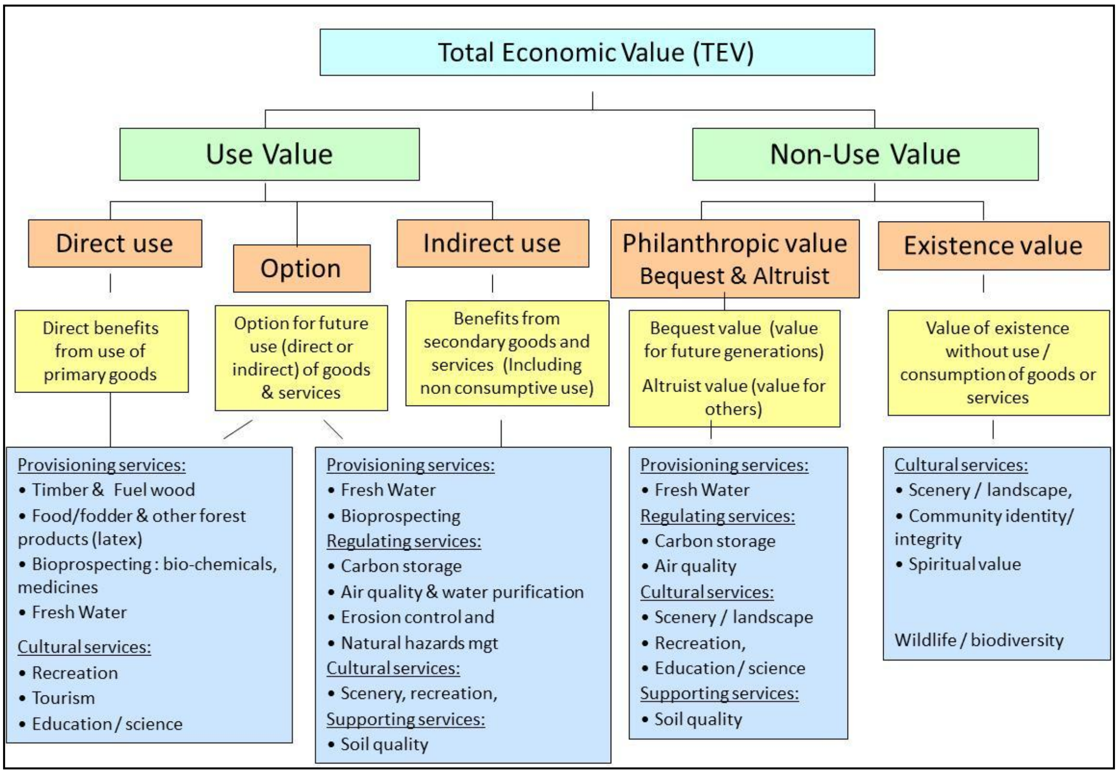


Source: TEEB 2011, adapted from Haines-Young and Potschin (2009) and Maltby (2009)

To examine the overall value of the multiple benefits delivered by Natura 2000 sites, we employ a Total Economic Value framework (Figure 5). This recognises that the values associated to the Natura 2000 sites result from their direct use by people (for example in the provision of food, fibre, fresh water and genetic resources, as well as cultural uses such as for recreation) as well as their indirect uses (for example in regulating air, water and climate). In addition, people derive non-use values from the existence of sites and their protection for future generations. It should be recognised that this framework captures only the value of Natura 2000 from an anthropocentric viewpoint – i.e. the benefits that sites provide to people – and that biodiversity has an intrinsic value that is independent of human thoughts and values. These intrinsic values – while an important motivation for establishing the network - cannot be captured by the ecosystem services framework and are not therefore estimated.

It should also be noted that, in general, ecosystem services assessments are still in a stage where their science base (ecology and economics) is still under development. The assessment carried out in this study built on the best science available to date (e.g., MA, TEEB) and relies conceptually on existing ES typologies and knowledge (e.g. on trade-offs, resilience etc.). As these concepts are still being refined, and the literature used were produced in different periods (and mostly before the MA and TEEB), a mismatch between data sources for the assessment (case study valuations) and conceptual (scientific) underpinning of the report may exist (e.g., double counting in some case studies, suboptimal research design, etc.). Furthermore, it should be acknowledged that this assessment is based on the current state of the world as we know it today. It is likely that the supply and demand drivers of Natura 2000 will change over time and therefore today's assessment may not be easily extrapolated to the future. These nuances should therefore be kept in mind, although the report strived to be on the frontline of the debates and data used by the most recent exercises, such as TEEB.

Figure 5: The Total Economic Value (TEV) framework in the context of Natura 2000



Source: White et al, 2011, adapted from Kettunen et al (2009), adapted from Pearce & Moran 1994

Benefit / Value transfer

This assignment has involved the development and application of benefits transfer methodologies (now increasingly termed 'value transfer'), using existing valuation evidence of the benefits of Natura 2000 sites as a basis for estimating the benefits of the network as a whole. Benefit transfer involves the application of values obtained in one context (the 'study site') to estimate the value of benefits in another context (the 'policy site')[6]. It provides a cost-effective means of deriving overall value estimates, but needs to be applied with great caution, taking care to ensure that the values used are robust, relevant and applicable to the policy site.

Assessing Overall Benefits - Alternative Methods

The study used four different methods to assess the overall value of the benefits of Natura 2000 sites and to aggregate them to assess the overall benefits of the network: an ecosystem service-based, a territorial-based, a site-based and a habitat-based approach. The territorial-based approach proved too weak given data and methodology issues and not used in the final assessments. The table below provides a description of the three methods that were used in the final work, as well as their pros and cons.

[6] There are different types of benefits transfer: *unit benefit transfer* – e.g. multiplying a mean unit value (per household or per hectare) from a similar site by the quantity of the good/ service at the site being assessed; *adjusted unit benefit transfer; value function transfer* and *meta-analytic value function transfer*. See the Full Report for further discussion and sources.

Table 1: Methods for Benefits Estimation and their Strengths and Weaknesses

Method	Description	Strengths	Weaknesses
Ecosystem Service Based	This approach focuses on the contribution of Natura 2000 to the delivery of individual ecosystem services, seeking to quantify and value each service.	Consistency of approach for valuing each individual service. By focusing on particular services, may provide relatively robust lower bound estimates of value of benefits.	Geographic variations in service delivery make estimation at network level difficult. Only certain services can be valued so likely to underestimate benefits of the network.
Site Based	Benefits estimates are available for a number of different Natura 2000 sites. These can be scaled up to estimate the benefits at network level.	Draws on data from a relatively large number of studies (though still small compared to optimal). Recognises and has the potential to account for the different characteristics of sites and the nature and value of services they deliver.	Difficulty of accounting for wide variations in estimates between sites (unless very large base data). Amalgamates estimates produced using different methods. Difficulty of knowing how available estimates relate to overall characteristics of network and providing a robust basis for upscaling.
Habitat Based	Site based estimates can be used to estimate per hectare values for individual habitats, which are then combined with data on extent of habitats at network level, to provide EU wide estimates.	Provides a logical basis for upscaling, as similar habitats are likely to deliver similar types of services across the network (although the value of many services varies significantly by location). Data are available on area of individual Natura 2000 habitats, providing a basis for upscaling.	Variations in service delivery can be expected within habitats, according to location. Difficulty of accounting for wide range of benefits estimates for certain habitats. Lack of estimates of benefits of some habitats. Amalgamates estimates produced using different methods.

A range of **key methodological issues** have been taken into account in the course of assessment. They include the issue of gross and incremental benefits of Natura 2000, the additionality of benefits, opportunity costs and trade-offs, spatial variations in benefits and values, non linearity and thresholds, discounting, aggregation and scaling up, double-counting and ecological knock-on or ecological multiplier effects. These are discussed in detail in the Full Technical Report.

PART B: DERIVING AN AGGREGATE TOTAL VALUE OF SERVICES FROM NATURA 2000

III) The total Value of the Natura 2000 network - a first assessment

This section presents overall estimates of the value of the benefits delivered by the Natura 2000 network, based on aggregation of **site-based** and **habitat-based** data.

Site-based estimates of Natura 2000 benefits

Overview of approach

Various studies are available of the benefits provided by different Natura 2000 sites. These studies indicate that different sites deliver different benefits and that estimates of the value of these vary widely – this may reflect the value of the benefits themselves as well as the degree to which they can be valued comprehensively and accurately.

Compiling data at the site level provides a basis for scaling up across the network as a whole. Site based estimates can be pooled to give a range of per hectare values for sites. While different studies may focus on different services and benefits, reflecting the different characteristics and locations of sites and the services they deliver, this is not necessarily a problem if the individual studies are robust and provide a relatively complete and consistent approach to benefits estimation.

Advantages of this approach are that it enables a relatively large number of existing benefits estimates to be employed, and that it recognises the natural variations in sites and their characteristics and values. A key disadvantage is that it combines values from a range of different studies employing different methods and assumptions, whose consistency may therefore be questioned. Furthermore, scaling up from the site to the network level presents methodological issues and challenges, given the variability of site based estimates.

Available Benefits Estimates

An extensive review was undertaken of studies assessing the value of services delivered by Natura 2000 sites. The analysis focused on studies that:

1. **Cover a wider range of ecosystem services** provided by the sites in question, in order to enable a reasonably complete assessment of benefits. While data constraints often preclude comprehensive analysis of the value of ecosystem services, studies that focused on one or two services only were excluded from the assessment. Since most values identified covered certain services only, they are likely to provide a conservative estimate of the benefits of the network;
2. **Provide estimates of the annual per hectare value of benefits**, or enable such an estimate to be derived. Estimating benefits on a per hectare per annum basis provides a standardised basis for the analysis and upscaling of values.

3. **Relate to terrestrial and coastal sites only** – the benefits of marine sites are considered separately below.

The review provided 34 different estimates of the value of the benefits of Natura 2000 sites, from 20 different studies. A summary of studies and their value estimates is given in Annex II. This analysis revealed that the available estimates give a wide range of values for the benefits of Natura 2000 sites, ranging from just less than €50 per hectare per year to almost €20,000 per hectare per year. The range of values identified underscores that sites are not uniform, while estimates of the value of the services they deliver also vary according to the methods used and data available.

Variations in value estimates reflect differences in:

- The location and characteristics of different sites (including their condition, scarcity and substitutability);
- The ecosystem services delivered, which vary by habitat and location relative to people and natural resources;
- The value placed on those services by people and by markets;
- The extent to which studies have been able to estimate ecosystem service delivery and its value;
- The methods used in valuation, and the assumptions used in benefit estimation; and
- The role of non-use values which can form a significant share of the total value.

Although the available values have a wide geographical spreads, the majority come from North West Europe, particularly the UK and the Netherlands, which raises some concerns about their representativeness of the network as a whole. While it is possible to take account of some variations between Member States when scaling up to the EU as a whole (e.g. by adjusting for variations in GDP), it is likely that the sample of values does not fully account for variations in ecosystem service delivery across the network.

Estimating the benefits for the EU27

Two methods are employed to upscale these estimates to the EU level:

a. Simple upscaling based on mean and median per hectare values for sites;
b. Upscaling of GDP adjusted mean and median per hectare values for sites.

Development of alternative approaches (including a typology of sites and the development of a benefit transfer function) was also explored, and is discussed below, but proved to be unworkable due to limitations in the data available.

As the second approach was considered more robust and feasible for this study, we only focus here on this. A discussion on other possible approaches is provided in the Full Technical Report (ten Brink et al, 2011).

Use of GDP adjusted per hectare values

The value of benefits can be expected to vary according to differences in income levels between Member States, which affect the value of ecosystem services and willingness to pay for them. Each of the site-based estimates was adjusted for differences in GDP per capita in Purchasing Power Standards, in order to provide income adjusted estimates of the value of benefits per hectare. The adjustment used Eurostat indices of national GDP per capita, on the basis that Natura 2000 sites provide benefits at the national level, and most studies estimate benefits to the national as well as the local population.

Because the available estimates are concentrated among higher income Member States, adjusting them for differences in GDP per capita reduces the overall benefit estimates (Table 2).

Table 2: Estimated benefits at EU27 based on up-scaling of GDP adjusted site based estimates

Basis for upscaling	Value per hectare (€)	Value EU27 (€M)
Mean	3,441	313,520
Median	2,447	222,951

Upscaling using these per hectare values gives overall benefit estimates of between **€223 billion and €314 billion** annually for the Natura 2000 network as a whole. This should be seen as a first illustrative estimate of the scale of the annual benefits and not as a robust precise result.

Habitat-based estimates of Natura 2000 benefits

Overview of approach

It is also possible to use estimates of the value of services delivered by different habitats as the basis for estimating the value of the benefits of the Natura 2000 network. Because similar habitats can be expected to deliver similar types of ecosystem services, we can expect the value of services to vary by habitat. Data are available for the area of different habitats in the network, and can be used as a basis for up-scaling habitat based values.

This is similar to the site-based method and involves compiling estimates of the value of benefits delivered by different habitats. These may be derived from studies focusing on a particular habitat (e.g. benefits of marine protected areas) or on particular sites dominated by a single habitat. A range of values can be derived for each habitat, and, combined with data for the area of each habitat covered by the network, used to provide estimates at the network scale.

This approach has some advantages in that there is likely to be some consistency in the types and levels of services delivered by a habitat, while good data on the areas of each habitat covered by the network are available. Disadvantages relate to the consistency and reliability of different benefits estimates, the likelihood that data will be unavailable for certain habitats, and the known variations in delivery of some services within habitats. For example, while some services such as climate regulation may be reasonably consistent between different forest sites, the value of others such as water purification will vary significantly according to the location of the forest (for example in relation to pollution sources, water supplies and centres of population). This presents challenges in extrapolating benefit estimates across the habitat as a whole.

Relevant data sources include: data from Cost of Policy Inaction (COPI) (Braat et al 2008; ten Brink et al., 2009 and the TEEB database (van der Ploeg et al 2010) and TEEB studies on value of services delivered by different habitats; and studies of individual sites as above where these have a predominant habitat or values broken down by habitat.

Available Benefits Estimates

The first step is to calculate the mean and median values for each habitat type identified through the literature review. To calculate the habitat values, the site based studies summarised above were grouped by broad habitat types, using the Habitat Directive Classification. This was not straightforward, as the studies reviewed did not use the Natura 2000 habitat classification system in their reports. Judgement was required to associate the habitat included in the studies reviewed with the Natura 2000 classification system. In addition, several of the values identified were based on studies of sites that contained more than one habitat type. When this was the case, the value contained in the study was assigned to the predominant habitat type for the site in question.

The mean and median value for Natura 2000 sites, by hectare, and adjusted for differences in GDP (from 2010 Eurostat figures), were calculated based on the entire range of values identified. The results of these calculations are presented in the table below.

Table 3: Natura 2000 habitat values, per hectare

	GDP adjusted, 2011 €/Ha/year				
Habitat Directive Classification (Natura 2000 habitat code)	**Count**	**Min**	**Max**	**Median**	**Mean**
Coastal and Halophytic Habitats (1)	6	743	3,954	3,053	2,651
Coastal Sand Dunes and Inland Dunes (2)	2	3,863	9,849	6,856	6,856
Freshwater Habitats (3)	8	371	4,685	1,231	2,256
Temperate Heath and Scrub (4)	3	1,009	17,336	5,252	7,866
Sclerophyllous Scrub (Matorral) (5)	0	-	-	-	-
Natural and Semi-natural Grassland Formations (6)	5	77	5,875	1,156	1,898
Raised Bogs and Mires and Fens (7)	3	136	12,956	951	4,681
Rocky Habitats and Caves (8)	0	-	-	-	-
Forests (9)	5	**347**	**4,969**	**924**	**2,309**
All habitats	32	77	17,336	1,721	3,323

Source: *Grouping of site based estimates, from literature review for this study.*

Estimating the benefits for the EU27

These per hectare values can be combined with data for the area of each habitat across the Natura 2000 network to estimate the value of benefits for the network as a whole.

Data on the area of each habitat in the Natura 2000 network was identified in Mücher et al. (2009). This information is used to estimate the total value of the Natura 2000 network, by habitat, based on median, mean and mean excluding outlier values. The results of this analysis are presented in Table 4: below.

Table 4: Estimated Natura 2000 habitat values

Habitat Directive Classification (Natura 2000 habitat code)	Estimated area (million ha)	Median	Mean
Coastal and Halophytic Habitats (1)	15.0	45,884	39,849
Coastal Sand Dunes and Inland Dunes (2)	1.5	9,993	9,993
Freshwater Habitats (3)	6.2	7,628	13,977
Temperate Heath and Scrub (4)	11.5	60,284	90,285
Sclerophyllous Scrub (Matorral) (5)	4.0	-	-
Natural and Semi-natural Grassland Formations (6)	11.6	13,373	21,964
Raised Bogs and Mires and Fens (7)	7.8	7,450	36,672
Rocky Habitats and Caves (8)	4.1	-	-
Forests (9)	29.4	27,189	67,956
Total (7 habitats)	***83.0***	171,802	280,695
Estimated Total for Natura 2000 Network (9 habitats)	**91.1**	188,587	308,118

Estimates are made for 7 habitats for which values are available, and scaled up to the Natura 2000 network as a whole.

This method gives estimated values of between **€189 billion** and **€308 billion** per annum, depending on whether the median or mean values are used. The figures are slightly lower than for the site-based estimates, because the most widespread habitats (such as forests) have slightly lower estimated per hectare values than the average.

The way forward

The above first estimates offer order of magnitude value ranges for the gross benefits of the Natura 2000 network. These should be taken as illustrative estimates which can help communicate the economic value of the range of socio-economic co-benefits stemming from the ecosystems covered by the Natura 2000 network.

There is a clear need for further site based studies which are more geographically spread across the EU, that cover a wider range of ecosystem services and are done in a comparable manner which would help create an improved evidence base for future assessments – as well as being immediately useful to demonstrate benefits for the local to national to EU stakeholders. The road map and details for the way forward is presented in Part E.

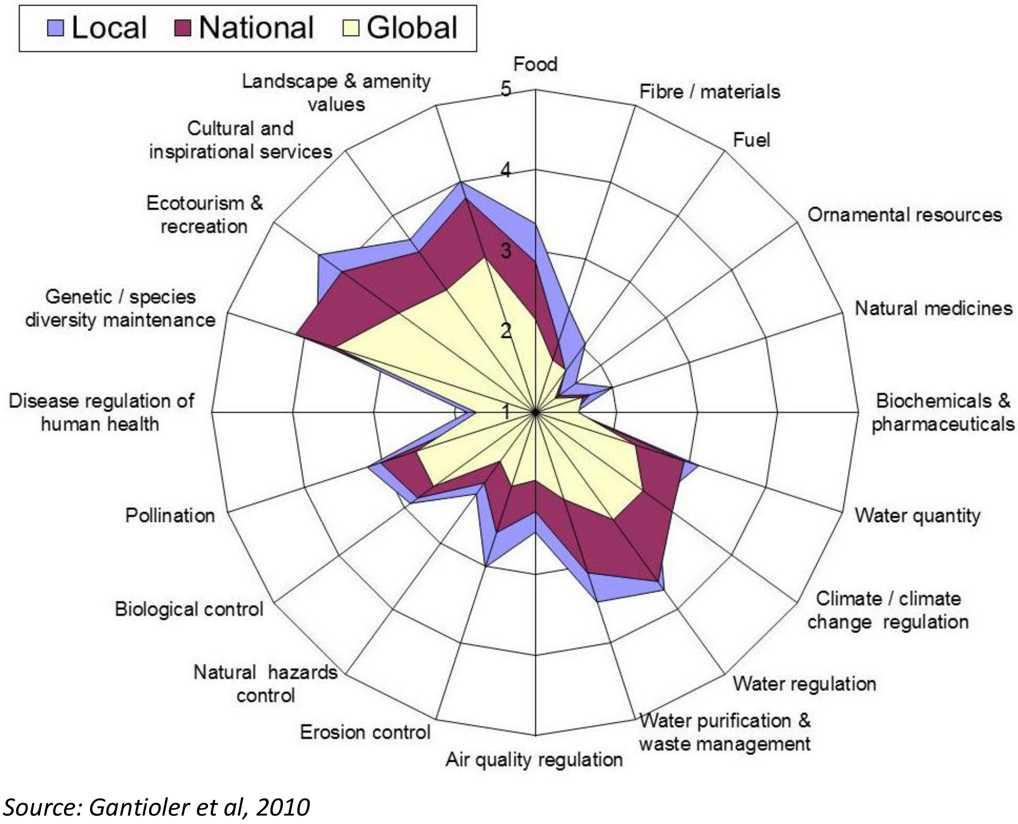
PART C: THE VALUE OF DIFFERENT ECOSYSTEM SERVICES FROM NATURA 2000

IV) Overview of Ecosystem Services

The Natura 2000 network leads to benefits to society and the economy through the delivery of different ecosystem services, with the importance of each service varying between sites, depending on site characteristics, location, and the type and level of interaction between the ecosystem and the social and economic systems or, to put it differently, between the ecological/green infrastructure (with Natura 2000 site core connected areas within this wider green infrastructure) and the economic and social structures. As noted above, the level of knowledge of the different ecosystem services varies and is changing fast as more attention is paid to the issue.

A study by Gantioler et al. (2010) explored what experts consider to be 'key' benefits associated with Natura 2000 (structured interviews were carried out with more than 110 individuals from 26 Member States, including representatives of national governments, NGOs, stakeholder groups and academia). The interviewees were requested to estimate (on a scale of 1 to 5) the importance of Natura 2000 in providing different ecosystem services - at local, national and global level - to obtain an indicative overview of the level of appreciation and the perceived relevance of Natura 2000 in providing those services. The results are presented in Figure 6 below.

Figure 6: Perceived relevance of Natura 2000 in providing different ecosystem services at local, national and global level (on a scale of 1-5)



Source: Gantioler et al, 2010

This was an exploratory assessment and is an interesting starting point for the discussions here. The values depend on the specific site and significant variations can be expected for each of the 'overall' judgements noted below.

The following sections summarises the assessment of the benefits of Natura 2000 network for a core set of ecosystem services selected for this study. This is a first attempt to develop an aggregate value for the Natura 2000 network as a whole. Given existing gaps in evidence and data, the site specific nature of many services, and a range of methodological challenges, these assessments of different services present different levels of answers. The aim here was to only present aggregate numbers for the network as a whole where sensible, and to note where approaches should only be seen as 'experimental'.

We start by presenting the value of carbon storage and sequestration – this is included first given the high policy relevance and since that the values assessed are relatively robust. We further provide key insights on the benefits of natural hazard mitigation and climate adaptation, the value of tourism and recreation (this is a summary of a parallel study by Arcadis et al, 2011 forthcoming), water provision and purification, food-related provision (fish provision in marine areas and pollination and agricultural production in terrestrial areas), and health, identity and learning benefits.

V) Natura 2000's fundamental role in climate mitigation - The Carbon storage and sequestration benefits of Natura 2000

Introduction

In general carbon stock density appears to be relatively high across Europe (Campbell et al., 2008). Many Natura 2000 sites harbour several ecosystems that are important current stores of carbon and offer significant opportunities for further carbon sequestration, including sites located on forested lands, wetlands, agricultural lands, and marine and coastal ecosystems. In particular Northern European countries, where boreal forests are predominant, show much higher carbon storage potential in terms of high carbon density in the soil and biomass. Therefore, a careful assessment of carbon potential and economic consequences associated with Natura 2000 habitats may provide important insights on the cost-effective land-use policy and management practices on Natura 2000 sites, which in turn can influence ecosystem progress that affect greenhouse gases (GHGs) fluxes[7] over a period of several years to a few decades, and contribute to climate change mitigation and adaptation strategies in Europe.

Evidence and Results

A comprehensive economic valuation of carbon benefits provided by Natura 2000 sites needs a solid scientific base. The present estimation of the carbon benefits is built upon the 2003 IPCC Good Practice Guidance (GPG) *for Land Use, Land Use Change, and Forestry (LULUCF).* The valuation framework was developed following three key steps:

Step 1. Characterisation of the status quo (SQ) or baseline scenario in 2010.

This step involves profiling the current carbon economic value provided by all Natura 2000 sites in Europe in a reference year (2010). To calculate the total carbon stocks by habitat type, the simplest and most practical way is to multiply carbon density (tC/ha) of each habitat type by the total area of the existing habitat. In our study, estimated carbon density stored by different habitat types was derived based on a review of the literature and selected from the studies that included habitat types most relevant to the Natura 2000 habitat classification. Furthermore, the carbon sequestration services are translated into monetary terms by applying a range of carbon prices to reflect the damages caused by different degrees of climate change impacts.

All in all, our valuation estimates indicate that the total carbon value of all Natura 2000 habitats as a whole[8] lay between €607 and 1,130 billion in 2010, depending on

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[7] CO_2 fluxes between the atmosphere and ecosystems are primarily controlled by uptake through plant photosynthesis and release via respiration, decomposition and combustion of organic matter.

[8] Note that for the carbon analysis a low area of Natura 2000 network was used (51.5 million hectares, using 2009 data), given data availability and methodological needs. Data source: *EEA data 2009 (http://www.eea.europa.eu/data-and-maps/data/natura-2000-eunis-database).* This underlines that the results further below should be seen as a very conservative estimate.

the choice of carbon prices. These are values of the stock of carbon and not the annual sequestration rate. Among all others, the forest habitats contain the highest carbon value in the network, ranging between €318.3 and 610.1 billion in 2010. The second highest carbon value is contained in the dryland (grassland) system, ranging between €105.6 and 196.5 billion in 2010, followed by marine and inland water ecosystem, which account for €92 to 171 billion and €84.2 to 156.7 billion, respectively[9].

Step 2. Characterisation of a future scenario by 2020 – the EU policy target year.

This step involves the study of policy-driven land use changes and the assessment of their respective impacts by 2020, in terms of changes in carbon stocks in the above ground biomass and below- ground soil organic matters. Given that CO_2, the most common GHG, is sequestered in biomass and soils in forests, wetlands and grasslands at higher rates than in cropping systems, we can identify a number of management practices on Natura 2000 sites that can result in an increase in soil organic carbon and carbon sequestrated by biomass.

Onsite measures that positively affect carbon fluxes include the restoration of wetlands, the improvement of grassland and the establishment of agroforestry ecosystems. On the contrary, policies that passively manage the existing protected areas or encourage land conversions from grassland to croplands will cause the release of stocked CO_2 to the atmosphere and reduce carbon stored in the ecosystems.

These considerations led us to focus on two types of possible future paths regarding the Natura 2000 sites management in Europe, i.e. (1) a **policy ON scenario,** where full Protected Area coverage (terrestrial PAs + fuller MPAs) with a move to full favourable conservation status will be evaluated; and (2) a **policy OFF scenario** where no additional action is taken and where some elements of degradation may occur across the Natura 2000 sites by 2020. More specifically, to assess the impacts of 'policy ON' scenario on carbon stocks, we separately evaluate:

a. the **quality improvement** of the existing Natura 2000 sites, based on the net annual change of C-stock (tC/ha/yr) due to improved land-use management (IPCC, 2000). This is referred to as Option 1; and
b. the **quantitative changes** of Natura 2000 site in terms of changing in land-use composition and conversions between different land uses, where the 'stock change method' (Penman et al. 2003) is used to estimate the economic consequences of a hypothetic EU policy which is aiming for **at least 10 per cent increase in forest-protected area in all the Member States by 2020, with respect to their national forest coverage in 2010**. This is referred to as Option 2.

9 In order to value the carbon sequestration services of Natura 2000 habitats in monetary terms, a range of carbon prices are applied to reflect the damages caused by different degrees of climate change impacts. In the present report, we chose to use the European Commission values of €17.2 /tonne in 2010 and €39/tonne in 2020 (EC, 2008 and DECC, 2009) as the lower values, and those building on a French study - €32 and €56/tonne in 2010 and 2020 respectively (Centre d'Analyse Stratégique, 2009) - as the higher values.

For both of these options the total carbon value provided by Natura 2000 sites in 2020 can be estimated by multiplying the estimated total carbon stocks in 2020 by the carbon price in that year.

On the contrary, if neither of the policy ON options were undertaken, we then place ourselves in a **Policy OFF - 'policy inaction' scenario**, where the economic gains from improved policies on Natura 2000 sites are not forthcoming. In particular, the policy OFF scenario refers to a scenario in which the EU will not provide any future investments in the Natura 2000 habitats protection and management. As a consequence, certain degrees of natural degradation may occur on many sites and thus result in the release of CO_2 to the atmosphere or loss of carbon value. However, it is scientifically uncertain, whether and to what extent, the Natura 2000 habitats may degrade in the context of policy inaction. For this reason, in the absence of reliable information, we assume a zero rate of degradation, meaning that by 2020 the total quantity of carbon stocked in these habitats will remain the same as in 2010 (Status Quo).

Step 3. Interpretation of policy impacts and associated losses/gains on carbon value by comparing the selected policy scenarios and the SQ.

The results derived from both qualitative and quantitative evaluation of potential policy (ON and OFF scenarios) impacts can be integrated in cost-benefit analysis of the policy alternatives and provide important insights on cost-effectiveness of these polices. In Table 5 and Table 6 below, we summarise the estimated total carbon stocks and the respective economic values of Natura 2000 habitats, under different policy scenarios.

Table 5: Estimated total carbon stocks by Natura 2000 habitats (GtC)

Scenarios	Total	Marine Total	Inland Water Total	Dryland ESS Total	Cultivated ESs Total	Forest & Other Wood Land Total	Inland rocks, Screes, Sands, Permanent Snow & ice	Other land
Policy OFF Scenario in 2020	9.61	1.46	1.33	1.67	0.43	4.47	0.25	0.00
Scenario Policy ON-1 in 2020	9.78	1.46	1.33	1.74	0.45	4.55	0.25	0.00
Scenario Policy ON-2 in 2020	9.89	1.46	1.33	1.55	0.39	4.92	0.25	0.00

Note: see Table A4 in Annex 2 in FULL Technical Report for detailed results

Table 6: Total Economic value of carbon services provided by Natura 2000 habitats (Billion €, 2010)

General habitats	Policy OFF – 2020		Policy ON_1:qualitative improvement - 2020		Policy ON_2: quantitative land-use changes – 2020	
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
Marine Total	208.6	299.6	208.6	299.6	208.6	299.6
Inland Water Total	191.0	274.3	191.0	274.3	191.0	274.3
Dryland ESs Total	239.5	343.9	248.7	357.1	221.5	318.1
Cultivated ESS Total	62.2	89.3	64.5	92.6	55.6	79.8
Forest and Other Wood Land Total	639.7	918.6	651.8	936.0	703.7	1010.4
Inland rocks, Screes, Sands, Permanent Snow and ice	35.6	51.1	35.6	51.1	35.6	51.1
Other land	0.0	0.0	0.0	0.0	0.0	0.0
Total	1376.7	1976.8	1400.3	2010.6	1416.0	2033.3
Δ wrt Policy OFF (Δ%)	-	-	+23.6	+33.8	+39.3	+56.5
Note: see Table A6, A7 and A8 in Annex 2 in FULL Technical Report for detailed results						

A policy scenario (Policy ON), where full Protected Area coverage (terrestrial PAs + fuller MPAs) with a move to full favourable conservation status is estimated to generate a gain of at least a total of 1.7-2.9 per cent by 2020 compared to a policy inaction scenario (Policy OFF), where no additional action is taken to conserve the current Natura 2000 sites over the next decade.

VI) Natura 2000 as a tool for security: Natural hazards benefits and climate adaptation

Introduction

Among the wide range of benefits they provide, protected areas are known for their important role in mitigating the damaging impacts of natural disasters (e.g. TEEB, 2011; MA, 2005). In particular, protected areas are recognized to maintain healthy, intact and robust ecosystems, which help mitigate the impacts of disasters and restore destroyed or degraded areas (Mulongoy and Gidda, 2008). Protected areas play as well an important role in decreasing the vulnerability of communities to disasters and reducing their physical exposure to natural hazards, often providing them with livelihood resources to withstand and recover from crises (ibid).

In general, ecosystems affect both the probability and severity of extreme events, and they can moderate their effects. For example, inland waters, such as lakes and wetlands, are traditionally considered to be very important for the temporal regulation of water flow, mainly by accumulating water during wet periods (reducing peak flow). There is evidence that floodplain wetlands have the effect of reducing or delaying floods.

Natura 2000 sites can and have played a significant role in prevention and mitigation of extreme natural events. Moreover, due to population increase and climate change impacts, it is expected that the vulnerability of human settlements to natural hazards will increase in the future.

Sites' potential to control extreme events depends on the ecosystem types they host and their characteristics. For instance, an ecosystem's ability to mitigate avalanches is directly related to its forest cover and tree density; sites located along catchments areas (e.g. river slopes and floodplains) and coastal zones are likely to play a role in regulating water flows. Although the benefits arising from natural hazards risk reduction are very site-specific, well-functioning ecosystems in disaster-prone areas can offer efficient mitigation services, often at a lower cost than man-made measures

Overall, growing attention is being paid to ecosystem-based solutions for natural hazards mitigation. Increasing evidence suggests that, in many cases, a degradation of natural ecosystems is likely to lead to exacerbated consequences of natural hazards (Dudley et al., 2010). Using ecosystem-based rather than man-made solutions has often proved to be significantly cost-efficient, and natural hazards protection measures are increasingly being incorporated into land-planning strategies. However, it has to be noted that the exact functioning of ecosystems in natural hazards mitigation is still insufficiently understood and needs to be improved (see e.g. TEEB, 2011 ; MA, 2005).

Evidence and results

Natural hazards have caused significant damage across the EU over time. Extreme events in Europe have led to over eighty thousand cases of premature mortality over the period 1980 to 2010. Around 15 million people in Europe have been affected over the period with an associated cost estimated at around €163 billion. This equates to an annual average damages of €7 billion/year.

Europe has suffered over 100 major damaging floods in recent years. It has been estimated that, since 1998, floods have resulted in about 700 fatalities, the displacement of about half a million people and at least €25 billion in insured economic losses (EEA, 2004).

It is also widely acknowledged that the flooding risk in Europe is increasing as a result of climate change - i.e. due to higher intensity of rainfall as well as rising sea levels (IPCC, 2001). Additionally, there has been a marked increase in the number of people and economic assets located in flood risk zones (European Commission, 2007). The value of the regulation that is provided by different ecosystems is therefore likely to be escalating, given an increase in human vulnerability to natural hazards (TEEB, 2010).

There are a number of studies which recognise the importance of Natura 2000 sites for natural hazards prevention. For instance, in the analysis of the Azoras Islands Natura 2000 site by Cruz and Benedicto (2009), the regulation of extreme events is ascribed the highest level of importance, although no explicit valuation exercise was possible. It is noted, however, that floods and landslides are very frequent in the area, and in 1997 caused 29 deaths and around €20 million in damages. Similarly, in Oaş-Gutâi Plateau and Igniş site in Romania and in Białowieża Forest in Poland flood protection has been assigned a high level of importance although, due to the lack of data, a valuation was not possible (Kazakova and Pop, 2009; Pabian and Jaroszewicz, 2009) – see also Box 1 below for some additional examples.

In general, the valuation of ecosystems’ ability to mitigate natural disasters, such as floods, storms and avalanches, is a very complex issue. Due to the functional variability of the sites and other influencing factors, such as proximity and position of a site to human settlements, the actual delivery of natural hazards mitigation varies from area to area. Moreover, the amount of valuation studies and the degree of representative values that could be used for benefit transfer and wide approximation – especially for Natura 2000 sites - is very limited. As such, it has been difficult to identify examples in the EU where there is a direct linkage between protected areas and natural hazards control. Due to these difficulties, it was not possible, within the context of this study, to provide an estimate of the overall benefits of the Natura 2000 network related to natural hazards protection.

Box 1: Some examples of natural hazard mitigation services within the context of Natura 2000

In Kalkense Meersen Natura 2000 site, in Belgium, it has been estimated that the restoration of the original river landscape by means of wetlands and estuarine habitats restoration can bring flood mitigation benefits between €640,000 – 1,654,286 per annum (Arcadis Belgium et al., 2011 forthcoming).

With regard to flooding, the Natura 2000 network has an important role to play in particular in mountain areas, where floods often originate. Mountain areas are also generally more flood-prone due their topography, hence they are most likely to benefit directly from natural protection. Considering that 43 per cent of Natura 2000 sites are located in mountain areas, the regulation of water discharges and of natural storage mechanism in these areas can benefit many river systems throughout Europe (EEA, 2010).

In the Alpine region in Switzerland the use of forests is recognised as a major component of disaster prevention. Today Swiss forests, making up 17 per cent of total land, are managed mainly for their protective function. (ISDR, 2004; Dudley et al., 2010)

VII) Natura 2000 as a motor of the economy / oil of society - The tourism and recreation benefits

Introduction

The project 'Estimating the economic value of the benefits provided by the tourism/recreation and Employment supported by Natura 2000' (BIO Intelligence Service, 2011) estimated the benefits of tourism, recreation and employment supported by the entire Natura 2000 Network. The economic value of the benefits provided by tourism and recreation (i.e. market on non-market benefits) that refer to use values, and the direct and indirect employment supported by the Natura 2000 network were taken into account.

In assessing the benefits of tourism and recreation, it is important to distinguish between:

- The **recreational benefits** derived by visitors to Natura 2000 sites – i.e. the value of the recreational experience itself; and
- The **economic impacts** that expenditures by these visitors deliver to local economies, by supporting employment and incomes. These are important benefits of the network, although they do not provide estimates of the value of recreational benefits themselves. It should be noted that tourism expenditures can provide important benefits for local economies, but, since most of this money would be spent elsewhere in the absence of Natura 2000, aggregate expenditures do not constitute an overall estimate of benefits at EU level.

Evidence and results

Estimates of the recreational benefits that Natura 2000 provides to visitors were made by transferring benefits from other studies, which have used travel cost and contingent valuation methods to estimate the consumer surplus per visit. The economic impacts from tourism and recreation were calculated based on multipliers that were generated by the consolidated input-output tables from Eurostat. Non-market benefits related to recreation, on the other hand, were calculated on the basis of a site-based approach. The overall employment opportunities provided by the Nature 2000 network were calculated based on a land-use approach and scaling-up on a per-hectare basis. The authors estimate that:

- the value of recreational visits to Natura 2000 sites is €5-9 billion per annum, based on estimates of visitors' willingness to pay;
- the total expenditures related to tourism and recreation supported by Natura 2000 are between around €50 and €85 billion in 2006;

- the expenditures exclusively related to the visitors who have affinity for Natura 2000 sites (i.e. around 21% of visitors to Natura 2000) are between €9 and €20 billion in 2006, generated by around 350 millions of visitor days;
- The total expenditures provided by tourism and recreation support between 4.5 and 8 million Full Time Employment (FTE) jobs. The benefits generated by the visitors with affinity for Natura 2000 would support from 800,000 to 2 million FTE jobs. This compares to a total of about 127 million FTE jobs in the EU27 (in 2009)[10], and about 13 million jobs in the tourism sector (in 2008)[11].
- Natura 2000 sites have supported on average about 12 million FTE jobs each year in the EU during the period 2006-2008. This includes about 1.5 million jobs in agriculture, 70,000 jobs in forestry, around 200,000 jobs in fishing, 3.1 million jobs in recreation (excluding employment generated by hotels and restaurants), and 7 million jobs in the other industries.

According to Eurostat, median gross annual earnings of full-time employees across all industries in the EU were €12,236 in 2006. Taking this number as a basis, 11,870,000 jobs supported by the Natura 2000 network provide incomes of about €145 billion per year. This must be considered as a rough estimate for two main reasons:

- The overall employment supported by the Natura 2000 network was estimated by scaling up data related to the dominant activities performed in a site, and stated in the Natura 2000 database. The authors state that '[the] estimates are subject to a relatively high degree of uncertainty, given the relatively small information basis from which the estimates were drawn and the multiple uncertainties related to the data gathering process.'
- The earnings figures applied (€12,236 per FTE) do not take account of the spatial distribution of Natura 2000 sites in the EU. In order to refine the results, one would have to calculate the economic benefits provided by direct and indirect jobs on a Member State basis, taking account of income differences in relation to the number of people employed (jobs supported).

10 Eurostat, Employment in Europe 2010 - Statistical annex: http://ec.europa.eu/employment_social/eie/statistical_annex_key_employment_indicators_en.html

11 Eurostat tourism database: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Tourism_employment#Database

VIII) Natura 2000 and 'free' resources for / value for money in the economy and society: Water purification and supply benefits (and waste)

Introduction

Water purification and provision are important ecosystem services that are provided by natural ecosystems, including protected areas such as Natura 2000. The economic value of water purification and provision will vary in each case depending on the type of ecosystem: in general, ecosystems that have intact groundcover and root systems are highly effective in improving water quality (Brauman et al 2007).

While it has not been methodologically feasible, given the site specificity of the benefits, to develop a robust EU wide assessment of the benefits of the Natura network for water purification and provision, it is clear from case examples that the Natura 2000 network can lead to cost-effective means of water purification and supply, offering significant savings over man-made substitutes.

Evidence and results

A number of major European cities, including Munich, Berlin, Vienna, Oslo, Madrid, Sofia, Rome, and Barcelona all benefit from natural filtration in different ways. These municipalities save money on water treatment due to natural treatment from the ecosystems. The savings can be passed on to consumers, resulting in lower utility costs for EU residents – see table below.

Table 7: Economic value of water filtration benefits from protected areas in Munich, Vienna, Berlin and Oslo.

City	Method of protection	Total area protected (hectares)	Land use	Amount of water supplied	Approximate number of people served	Benefits	Estimated annual value of water filtration based on m^3 produced	Estimated annual value of water provision based on m^3 produced
Munich	Protected areas and conversion to organic agriculture	6,000	1/3 agriculture, 2/3 forest	301,000 m^3 per day	1 million (80% of the city)	Decreased pesticide and chemical residues No treatment required	€8,624,915	€12,635,211 - €47,168,232
Vienna	Strict protection, Vienna Water Charter	Over 60,000	All protected forest	400,000 m^3 per day	1.7 million (entire city)	No water treatment required	€11,461,681	€16,790,978 - €62,721,903
Berlin	Groundwater protection zones	23,000 (1/3 of the city of Berlin)	Urban landscape, 40% 'green areas'	585,000 m^3 per day	3.5 million (entire city)	Less contamination	€16,762,709	€24,556,805 - €91,730,783
Oslo	Landscape protection area	25,200	All protected forest and lakes	250,000 m^3 per day	455,000 (85% of the city)	Minimal treatment required	€7,163,551	€10,494,361 - €39,201,189

Information from the four European cities of Berlin, Vienna, Oslo and Munich allows an illustration of the benefits of protected areas for water purification and provision. Using benefit transfer, it can be estimated that the annual economic benefits of *water purification* range between €7 and €16 million and of *water provision* between €12 and €91 million per city. The average per capita benefits range between €15 and €45 per year for both water purification and provision combined in the four European cities analysed. This compares to average household water bills of €200 per year in the case of Germany.

This underlines that benefits can be indeed significant, and lead to substantial actual and potential cost savings from ecosystem based water purification and provision, both for companies (in terms of reduced operational costs) and citizens (reduced water bills). It will be important for cities to explore the role of natural capital (protected areas, wider green infrastructure) in the purification and provision of water and ensure that such considerations are integrated in the water management plans required under the Water Framework Directive.

Other examples of water purification and provisioning benefits, within and outside Europe, are noted in the table below. The variation between these values is accounted for by the different ecological functions of the ecosystems, the varying interactions with economic and social systems, and how the supply and demand for the services relate.

Table 8: Overview of valuation studies – water purification and provision

Source	Original Value	2009 Value (EUR)[1]	Valuation Method	Location	Biome
Water purification					
Brenner Guillermo, J. 2007	403 USD/ha/yr	527	Benefit Transfer	Spain	Forests
Brenner Guillermo, J. 2007	3191 USD/ha/yr	4173	Benefit Transfer	Spain	Freshwater
Cruz, A. de la and J. Benedicto 2009	18,1 EUR/ha/yr	27	Replacement Cost	Portugal	Temperate forest and grassland
Water provision					
Cruz, A. de la and J. Benedicto 2009	99.7 EUR/ha/yr	122.3	Replacement Cost	Portugal	Temperate forest and grassland
Butcher Partners Limited 2006	39.8 NZD/ha/yr	22.9	Avoided Cost	New Zealand	Grasslands
Anielski, M. and S.J. Wilson 2005	0.076 CAD/ha/yr	0.06	Direct market pricing	Canada	Temperate and boreal forests

[1]Adjusted by purchasing power parities and inflation

Sources: TEEB database, van der Ploeg and de Groot, 2010

Significantly more empirical research is needed to estimate the economic benefits of water-related ecosystem services provided by the Natura 2000 network to any level of robustness. The Full Technical Report can be consulted for an experimental assessment, which was carried out within this study[12].

The work currently undertaken by the European Commission's Joint Research Centre (JRC) on an EU-wide ecosystem service assessment (Atlas of Ecosystem Services, see Maes et al. 2011) could provide a means to link spatial data, such as the availability of water-related ecosystem services, to socio-economic data, and thus allow to account for demand-side characteristics at the local scale. In this way, a fine-tuned assessment of the water-related economic benefits of the Natura 2000 network seems possible. In particular, research is needed in two major fields:

- Primary valuation of (water-related) ecosystem services in protected area contexts. To date, the dependence of people (or water utilities) on protected areas can often only be estimated by analysing the design of relevant PES schemes. More primary research is needed on the dependence of communities on hydrological systems in protected areas. The use of Geographical Information Systems (GIS) can be helpful in this context.
- The EEA Land Ecosystem Accounts (LEAC) can provide a means to locate hydrological systems which are of high value to people. The work done by JRC is a first step in the identification of aquatic ecosystem services on a large geographical scale. Future work will need to include demand-side characteristics to take account of value differences in water scarce or water abundant regions, respectively.

12 Based on a very simplified extrapolation (exploratory assessment), the estimated annual value of natural water purification provided by forest and freshwater habitats in the Natura 2000 network could be estimated at €2.2 – €25 billion and the estimated annual value of freshwater provided by the entire Natura 2000 network could be in the order of €2.8 – €3.2 billion. These ranges should be seen as an experimental assessment and not formally used.

IX) Natura 2000 and food: Marine protected areas and fish, and terrestrial protected areas, pollination and agriculture

Food security and provision: Marine Protected Areas

Introduction – Marine Protected Areas

The Natura 2000 network is still developing in the marine environment, and has faced practical and conceptual challenges such as lack of data on seabed habitats and identifying representative areas for mobile species. Nevertheless Natura designations are in place in coastal, inshore and offshore areas, and some of these have been subject to different types of economic analysis.

Current work means that an assessment of the habitat areas covered by a complete marine Natura 2000 network may be possible in 5 years.[13] At the same time, increasing effort in marine valuation is creating an evidence base which can be used, along with appropriate assumptions and judgement, to assess the values attributable to the marine Natura 2000 network. Nevertheless, the lack of monetary evidence for many impacts, and even the lack of non-monetary quantitative evidence, remains a major challenge, in particular for individual sites. One approach to the lack of evidence on impacts has been to use expert judgement to plug data gaps (as in the Impact Assessment for the UK Marine Bill); other impact assessments have focused on quantifiable costs and limited consideration of benefits primarily to qualitative descriptions (as in the individual Impact Assessments for specific UK MPAs).

Extrapolating from the UK results to the EU level can only be very approximate, because the figures are based on value estimates for UK seas, and because we do not have information about the specific network and its habitats. The UK results show that the final estimate is quite sensitive to the details of network configuration: the values estimated ranged from about €71/ha per year to €132/ha year depending on the designation strategy.

To be conservative, we extrapolate based on the lowest value network, which provides general protection with somewhat increased representation of OSPAR habitats. In terms of annual equivalents, the values are approximately €1.4-1.5 billion per year for the current area of protection (4.7%), €3.0-3.2 billion per year for protection of 10% of sea area, and €6.0-6.5 billion per year for protection of 20%. The higher figures apply to stronger protection measures. They are only approximate annual equivalents and in fact the initial annual values would be lower, rising to higher values as the protection reaches its full impact on habitats and services. An EU network with stronger focus on particularly valuable habitats would be expected to give higher values.

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13 Doug Evans, European Topic Centre for Biodiversity, pers comm. 20/7/11

***Fisherie*s**

The influence of marine protected areas on fisheries is a controversial topic. Natura 2000 management measures are likely to lead to a reduction and/or change (but in most cases not elimination) of fishing pressures. This may result in initial decline in catches from the site itself, but that could enhance local populations and recruitment processes, and potentially even improve carrying capacities through effects on habitats. Fish can move out of the site to sustain or increase yields of nearby fisheries. So the Marine Protected Areas created through the network may have positive effects on overexploited fish stocks generally. Closed areas can already be used in fisheries management as a means of allowing overexploited stocks to recover and enhancing fishery productivity. On the other hand, if the fishing effort reduction within the site is simply displaced to increase efforts in adjoining areas, this could have negative impacts. The extent of these impacts is extremely difficult to predict, because of uncertainty about four key factors:

- The extent and location of the network;
- The level of protection, and in particular the types of fishing that will/will not be allowed in certain areas, and the efficacy of enforcement;
- The ecological relationships governing the resulting impact on fisheries, including the importance of reserve sizes and network effects; and
- The effectiveness of the revised Common Fisheries Policy (CFP) in controlling any displacement of fishing effort from protected areas, and more generally returning stocks to Maximum Sustainable Yield (MSY) levels.

Longer term, these complexities are compounded by potential fish-species range shifts in response to climate change.

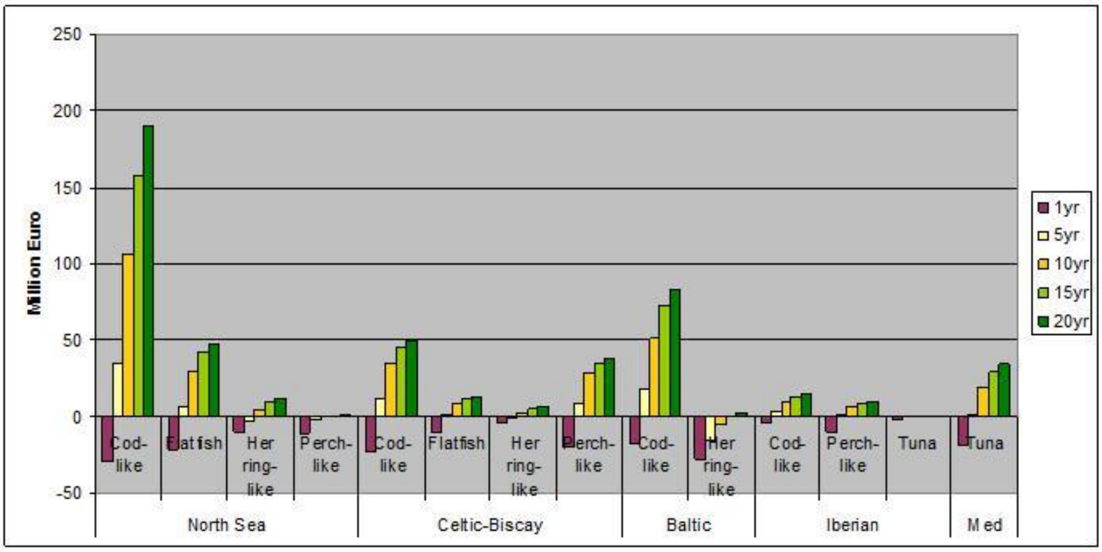
Although fisheries productivity can be valued at regional or national levels, identifying the contribution of specific sites is difficult. Existing evidence is patchy and it is not possible to draw firm conclusions about the marginal impact of protecting sites. The fisheries benefits (or costs) of marine reserves will depend on management outside the reserves. Generally, benefits arise in particular where there is high effort prior to reserve implementation: if there are effective effort control mechanisms in place, fisheries' benefits from reserves may be small.

This complicates assessment, not least because fisheries management is dynamic: in particular, it is difficult to estimate how successful current attempts to reform the EU CFP, and allow European fisheries to recover from decades of overexploitation, may be. Beare et al (2010) documents the change to fish stocks in the North Sea as a result of the effective suspension of commercial fisheries during World War II. A dramatic change in age composition is observed. Recruitment to fish populations does not respond as dramatically as age structure, which is likely because other environmental conditions also influence it, and the effective closed period was not long enough for fish age structures to take effective on reproduction. The paper concludes that, had fishing been prohibited for a longer period of time than the six years of the Second World War, a population equilibrium with a higher proportion of older fish would have been established. Maintaining such an equilibrium would have likely allowed a higher sustainable yield value, even if the total biomass catch was the same.

However, the management-dependent nature of fisheries benefits can be considered in a very simplified form by basic bio-economic modelling of fishery production, for example as assessed at the European level in the context of avoiding illegal, unreported and unregulated (IUU) fishing by Eftec (2008). The research models the influence on fisheries of IUU fishing, through dynamic bio-economic models specified across Large Marine Ecosystems (LMEs; e.g. North Sea, Celtic-Biscay Shelf), for commercial groups of fish species (e.g. Tuna and Billfishes, Cod-likes). This specification for LMEs and commercial groups avoids some (but not all) of the problems associated with competition among stocks and questions of achieving maximum sustainable yield (MSY) for individual stocks simultaneously.

It is possible to adapt the above method to assess the impacts of reducing effort, allowing stocks to recover. If we assume that protection of the Natura 2000 network can be represented by a 10% reduction in fishing effort – i.e. that fishing effort falls in the protected areas and is not simply displaced outside – then the models predict the results presented in the figure below. Catches at first fall (due to lower effort) but rapidly increase (due to increased stock sizes). Not all fish stocks are modelled – those included represent 46% of EU landings. If the non-modelled stocks respond in similar fashion, we might expect roughly double the value, i.e. a total of approximately €1 billion per year after 20 years.

Figure 7: Possible change in annual fishing values arising from reduced fishing effort associated with Natura protection



These estimates can be criticised on a number of grounds. They assume that the only source of reduction in fishing effort arises through Natura 2000 protection, and this is unrealistic given the on-going reform of the CFP. Further, they do not address the possible impacts of changes in carrying capacities or improvements in age structure. Off-site export of fish biomass is considered, but only approximately, in that the models effectively assume perfectly mixed stocks (the models are not spatial). Possible price changes are ignored. At best, therefore, these results might be viewed as indicative of the order of magnitude of potential for fisheries benefits to be achieved through Natura designations. To derive better estimates, it would be necessary to consider spatial models with more detailed representation of fish stocks and reproduction, as well as the spatial distribution of fishing effort, in conjunction with consideration of the reformed CFP. This would be a major undertaking, well beyond the scope of the present work. Perhaps the best approach would be to use Ecopath With Ecosim models (www.ecopath.org) for the marine systems.

Food security and provision: Terrestrial Protected Areas

Pollination

Pollination represents an essential ecosystem service for human wellbeing, being a key ecological process on which natural and agricultural systems depend (e.g. TEEB, 2011; Millenium Ecosystem Assessment, 2005; Balmford et al, 2008). It is estimated that insect pollinators are directly responsible for 9.5 per cent (around €153 billion) of the total value of the world's agricultural food production in 2005 (Gallai et al. 2009). Insect pollination is also estimated to increase the yields of 75 per cent globally important crops and is responsible for an estimated 35 per cent of world crop production (Klein et al., 2007).

Protected areas provide habitats and breeding grounds for pollinating insects and other species with economic and/or subsistence value (TEEB, 2011). The available area of natural habitat has a significant influence on pollinator species richness, abundance, and pollinator community composition. Habitat area in the neighbourhood of crop fields has been found to be strongly related to a direct measure of the pollination service measured here in terms of pollen deposition provided by bees. Hence, as a network of natural and semi-natural habitats, Natura 2000 has a significant role to play in securing continuous provision of pollinating service in the EU.

The importance of Natura 2000 in providing pollination services has also been recognised by key stakeholders. In a survey assessment carried out to estimate the level of appreciation and awareness of Natura 2000 related ecosystem services, pollination was identified as one of the most relevant ecosystem services (Gantioler et al., 2010). However, from the existing evidence on pollination it is very difficult to provide any quantitative or monetary value of the benefits stemming from the Natura 2000 network. This is due to the fact that there is generally very sparse evidence on the values of pollination, especially in the context of Europe or protected areas, and where there is it tends not to differentiate between pollination from protected areas or from wider green infrastructure. Box 2 below presents selected examples of valuation studies in the EU, and Box 3 illustrates the potential of mapping this ecosystem service.

Box 2: Pollination values

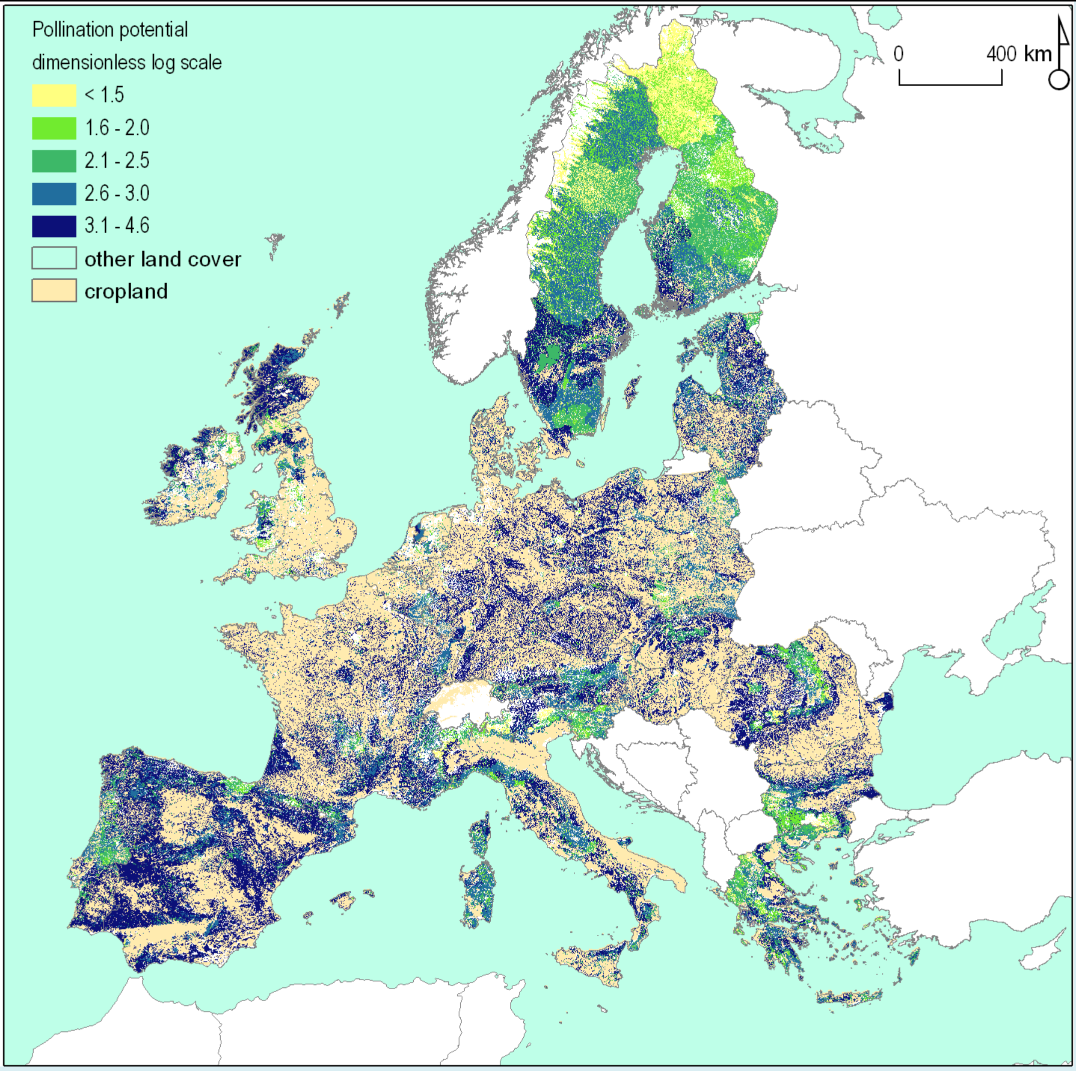
Examples from the EU context

- The annual economic value of insect-pollinated crops in the EU-25 is about €14,2 billion (approximately 10 per cent of the annual economic value for all food production in 2005). The number for global agricultural production amounts to €153 billion. (Gallai et al., 2009; for a more detailed analysis of this study see Annex 3)
- Using the methods of Gallai et al. (2009), the United Kingdom's National Ecosystem Assessment estimated the economic value of biotic pollination as a contribution to crop market value in 2007 at €629 million (England: €532 million, Northern Ireland: € 28 million, Scotland: €69 million, Wales: unknown) (UK NEA, 2011)
- A recent EEA report (EEA, 2010) identifies the importance of natural pollination, particularly for alpine herbs, forests and semi-natural grasslands. Although the actual importance of pollination in the mountain ecosystems remains poorly known, it is important to acknowledge this in the context of our study - considering that 43 per cent of Natura 2000 sites are located in the mountain areas.
- Klein et al. (2007) found that the production of 87 out of 115 leading global crops (representing up to 35 per cent of the global food supply) were increased by animal pollination.

Box 3: Pollination potential mapping

Significant work in the area of ecosystem services mapping has been done by the European Joint Research Centre. In its recent Scientific and Technical Report (JRC, 2011) alongside maps of other ecosystem services, a map based on an indicator for pollination potential has been developed. In this regard, dependency ratios from Klein et al. (2007), visitation rates of pollinators based on distance relationships from Ricketts et al. (2008) and a spatial distribution of crops from Grizzetti et al. (2007) were used. From this data maps of 'the pollination potential or the capacity of natural ecosystem to provide pollination services to croplands' were constructed at the aggregated level and at more detailed 1 km resolution (see figure below). Ideally, future mapping exercises could combine ecosystem services mapping with Natura 2000 maps to better identify the services provided by the Natura 2000 sites.

Figure 8: Pollination potential, 1km resolution



Source: JRC, 2011

Agriculture and Natura 2000

Agro-ecosystems directly contribute to the provision of food for human consumption through supporting the world's agriculture. Biodiversity and ecosystems have also an indirect role in world's food supply by, inter alia, allowing nutrient and water cycling or soil formation – see Table below, outlining the biodiversity benefits to agriculture.

Table 9: Biodiversity benefits to agriculture through ecosystem services

Provisioning	Regulating	Supporting	Cultural
• Food and nutrients • Fuel • Animal feed • Medicines • Fibres and cloth • Materials for industry • Genetic material for improved varieties and yields • Pest resistance	• Pest regulation • Erosion control • Climate regulation • Natural hazard regulation (droughts, floods and fire) • Pollination	• Soil formation • Soil protection • Nutrient cycling • Water cycling	• Sacred groves as food and water sources • Agricultural lifestyle varieties • Genetic material reservoirs • Pollinator sanctuaries

Adapted from UNEP, 2007. *Global Environment Outlook. GEO 4: environment for development.* United Nations Environment Programme. Malta. p. 172.

Source: Adapter from UNEP, 2007

Protected areas, such as the Natura 2000 sites, are often managed under agricultural schemes while still contributing to the principle of sustainable development and nature conservation. Contrary to the widely-held view, designation of Natura 2000 sites does not aim to put all human activity on hold. In fact, many of the Natura 2000 sites are valuable also thanks to the way they have been managed before their designation, and it is often desirable to continue with these activities to maintain the area's species and habitats in favourable conservation status. As such, there is a great interest in finding solutions which would let Natura 2000 farmland remain productive, while at the same time maintaining and ideally improving its natural environment.

From this perspective, organic agriculture represents a promising agricultural management option for some of the Natura 2000 sites and protected areas under agricultural land-use. Although it does not necessarily imply high nature conservation value, it can offer clear benefits for biodiversity when compared to conventional forms of agriculture. Due to lower cultivation intensities and bigger share of natural areas, more indigenous species are present in the sites under organic farming, which in turn creates more intact and better-functioning ecosystems.

It is also likely that the support for Natura 2000 and High Nature Value (HNV) farming in the EU offers significant synergies, however it is currently difficult to determine their potential overlap. It is known that Natura 2000 network is protecting a significant portion of HNV farming area, especially parts that are of recognised biodiversity quality (for further information see Paracchini, 2008). Conversely, HNV farming directly benefits conservation of Natura 2000 farmland habitats, being either within actual sites or in the wider countryside.

From the current available data it is difficult to estimate the portion of agricultural output directly attributable to the Natura 2000 network. As of now, it is possible to estimate only the portion of Natura 2000 area under agricultural use. Integrating the Natura spatial data with the Farm Accountancy Data Network (FADN) would allow a better determination of the agricultural output derived from Natura 2000 sites. Such integration is a pre-condition for any future estimation of agricultural benefits related to the Network.

It has to be noted that Natura 2000 farming also plays a significant role in the maintenance of local breeds and local plant and tree varieties adapted to valuable semi-natural habitats, as they are likely to play an essential role in future agricultural adaptation strategies. Replacement of these species by a smaller number of more productive breeds and crop varieties, which has been underway in the last decades, has proved to be one of the causes of biodiversity degradation and led to an increased vulnerability of the sector to external pressures such as climate change.

See Box below for some examples of the positive interrelation between agriculture and Natura 2000.

Box 4: Some Examples of Farming in the Context of Natura 2000

Being the first major farming for conservation project in Ireland, the Burren LIFE Project seems to offer a good 'value-for-money' solution with minimum estimated economic return of 235%. (Rensburg et al, 2009)

Organic agriculture has been recognised as a particularly useful option within the Mount Etna national park in Sicily and the Sneznik regional park in Slovenia (EEA, 2010)

Traditional agriculture, and primarily sheep farming, has significantly contributed to the well-preserved and stable conservation status of habitats, flora and vegetation in the Island of Pag, in Croatia. Agriculture and conservation here co-exist, facilitating the production of the traditional cheese of Pag, and hence contributing to the local economy. The continuity of this situation is in the interest of local population. (Sundseth, undated)

In a Rhön grassland area in south east Germany, mostly included in Natura 2000, an infrastructure for locally produced sheep products has been developed. Mowing and grazing through the use of sheep helped with site management, while a market for locally produced Natura 2000 products has been established. (Sundseth, undated)

X) Natural 2000 and our health, identity and learning

The role of ecosystems in supporting human health is manifold. First, naturally functioning ecosystems can regulate the range and number of species that are dangerous to human health. For example, a number of species (e.g. birds and insects) are known to be vectors of human diseases (e.g. malaria, dengue fever, Lyme disease etc.). Disease control is usually more crucial in some developing countries. Nevertheless, also in the EU the well functioning of ecosystems can be beneficial in keeping the populations of some species under control, e.g. affecting competition on resources and predation.

Natural ecosystems are also a source of potential discoveries for pharmaceutical firms, although the benefits in the European context are rather limited in comparison to developing countries. For example, Gantioler et al (2010), from a review of existing evidence and interviews with national stakeholders, found that the role of Natura 2000 in preserving genetic and species diversity was recognised to be of high importance, but that the value of actual benefits gained from using sites for food, fibre, medicines and pharmaceuticals is currently low. Indeed, while Natura 2000 offers some potential for new commercial discoveries, there is no evidence of current interest in Natura 2000 sites as a resource for bio-prospecting.

Furthermore, natural ecosystems are known to play an important role in supporting physical and mental health by providing possibilities for outdoors activities, recreation and relaxation. Protecting the diversity of species and habitats helps to maintain a wider variety of possibilities for recreation, e.g. providing different natural settings and more opportunities for wildlife watching.

Finally, it is to be noted that ecosystems also play a positive role in protecting human health via a number of other functions, e.g. through the mitigation of natural hazards, and particularly by maintaining air quality. Ecosystems help to regulate air quality by removing contaminants, through physical processes such as filtration and biological processes such as decomposition and assimilation. The natural vegetation, and especially trees and woodlands, improves air quality through the uptake, transport and assimilation of a wide range of gaseous and particulate air pollutants. Air quality regulation is especially supported by the maintenance and management of healthy forests with diverse vegetation structures and features increasing the surface area for the removal of pollutants.

Furthermore, access to natural compounds also plays a significant role in modern pharmaceutical research and development. It has been estimated that 25 per cent of the drugs sold in developed countries and 75 per cent of those sold in developing countries were developed using natural compounds (Pearce and Puroshothamon, 1992), demonstrating that biodiversity is of value to pharmaceutical firms in their efforts to develop new drugs.

PART D: REALISING THE BENEFITS OF NATURA 2000

XI) Realising the Benefits: restoration and conservation for biodiversity and co-benefits.

A Completed and well-managed Natura 2000 network delivers the most co-benefits

As outlined in Part A, the Natura 2000 network is to a large extent complete for terrestrial areas with the focus now moving increasingly towards management activities (see below). On the contrary, the marine component of the network still requires more attention. It is commonly acknowledged that, despite increasing threats to the marine environment, progress in establishing marine protected areas (MPAs) has been very slow, particularly for the high seas. Globally it has been estimated that only 0.7 per cent of world's oceans are currently designated as MPAs (World Database on Marine Protected Areas 2011). In the EU, marine areas currently account for close to 20 per cent of the total Natura 2000 network with significant gaps still existing, especially in offshore waters (Natura 2000 Barometer 2010).

Increasing the coverage of MPAs, including completing the Natura 2000 network in marine areas, is important also from the perspective of delivering socio-economic benefits. Research shows that appropriately designed and managed MPAs can provide a good conservation and sustainable management strategy for a range of species, particularly fish (Kettunen et al 2011). It has been estimated that conserving 20 to 30 per cent of global oceans through MPAs could create a million jobs, sustain fish catch worth US$70–80 billion/year and ecosystem services with a gross value of roughly US$4.5–6.7 trillion/year (Balmford et al 2004). Furthermore, the improved ecosystems' health and conservation status of both terrestrial and marine protected areas and of the wider Natura 2000 network is understood to improve the resilience of the functioning of the ecosystems – i.e. their ability to withstand pressures (e.g. climate change, pollution). This is expected to improve service provision (with improved health/connectivity) or reduce the loss of service provision, in light of climate change or other pressures risking degrading the ecosystem health.

Designation of areas valuable for biodiversity into Natura 2000 sites does not automatically guarantee that their favourable conservation status is maintained or restored. While designation is a valuable first step, appropriate management and restoration of Natura 2000 sites is needed to ensure that the set conservation objectives - and related socio-economic co-benefits - are reached in practice. This requires sufficient financial resources, capacity to carry out management activities in an effective manner and continued support from both stakeholders and decision-makers alike. This report clearly illustrates that a well-managed Natura 2000 network can provide multiple benefits to both biodiversity and people. Without appropriate management regime, however, the effectiveness of Natura 2000 network is significantly reduced, undermining the supply of ecosystem services as well as conservation.

In parallel to this study assessing the total economic value of the benefits provided by the *whole* Natura 2000 network, work has taken place to identify the total economic value of the *changes* to ecosystem services as a result of taking conservation measures in Natura 2000 sites (Arcadis Belgium et al., 2011). The study has developed a tool specifically to value the changes in ecosystem services resulting from conservation measures taken in designated Natura 2000 sites. The tool has been tested with 11 sites reflecting a range of the different geographies, habitat types and socio-economic circumstances across the EU and candidate countries.

For the majority of the sites the tool has produced results with a moderate level of confidence that shows that conservation measures produce changes to ecosystem services that benefit people. As well as enhancing genetic and species diversity, in general, the conservation measures studied:

- Enhance cultural ecosystem services, including non-use value for landscapes and biodiversity, and visitor values;
- Sometimes increase carbon storage, although evidence that could be applied was limited to inter-tidal and forest habitats;
- Are expected to have positive impacts on regulating services. This area often lacks specific evidence (e.g. on air quality or erosion control), but some water quality and quantity regulation benefits could be valued;
- Can sometimes reduce provisioning services (e.g. reducing agricultural intensity) and sometimes increase them (e.g. maintaining or introducing grazing to maintain specific habitats).

The study also highlighted opportunity costs related to conservation and the implementation of management measures. In several cases reductions in intensity of provisioning services (e.g. agricultural outputs, timber) due to implementing a conservation regime were noted. However, when wider ecosystem services evidence (e.g. regulating services like carbon storage, and cultural services like landscape value) were taken into account, measures for which analysis was complete showed, as far as could have been assessed, net positive values for undertaking conservation measures.

Engaging stakeholders: attracting more support and resources

The ultimate success of the Natura 2000 network in reaching its set goals depends on the engagement of all relevant stakeholders in maintaining the network. Demonstrating socio-economic benefits arising from the management of the site can help to gain support among the different stakeholders. Furthermore, the assessment of these benefits can help to identify and address possible conflicts in a more precise and fair manner.

Demonstrating benefits can pave the way towards incentivising and creating new partnerships for conservation and/or sustainable use of Natura 2000 sites. In particular, it can help to provide new and innovative funding sources for site management (Kettunen et a. 2011, Gantioler et al 2011).

It has in fact been estimated that the management of Natura 2000 would require around €5.8 billion / year (Gantioler et al., 2010). It is difficult to determine the overall funding available to support the network. However, the financial allocations for Natura 2000 from the EU budget are between €550 – 1150 million / year (Kettunen et al 2011). The estimated figures represent only 9-19 per cent of the financing needs. Existing financial resources are not yet adequate to ensure effective management of the network. This conclusion is also supported by the recent assessment of the status of the network, which concluded that only 17 per cent of both the habitats and species conserved under the Habitats Directive were in favourable conservation status (see Chapter 2). Consequently, it appears that the lack of adequate resources currently poses a significant risk for reaching the conservation objectives and also diminishes the amount of associated co-benefits from Natura 2000 sites.

In light of the current economic crisis, there is a clear risk that investment in protected areas may lose momentum and its places within the EU political agenda, and hence that fewer resources are made available for their management and protection. It will therefore be important to identify new and innovative sources of funding to ensure an effective functioning of the network. These could include, for example:

Broader access to existing public funds (e.g. EU funding)*:* The existing public funding for biodiversity conservation is known to be very scarce. However, significantly more resources are available to support environmentally sustainable development of different regions and localities. Identifying and demonstrating links between the Natura 2000 network (e.g. its individual sites) and broader socio-economic benefits, such as natural risk management, climate change mitigation and adaptation, water management and tourism, can facilitate the access to a broader set of EU funds, including funds dedicated to support regional and rural development (i.e. European Regional Development Fund, European Social Fund, European Fisheries Fund and European Fund for Agriculture and Rural Development).

Payments for environmental services (PES)*:* Evaluating the benefits of conservation can attract funds from stakeholders benefiting from the ecosystem services provided by Natura 2000 areas. The benefits of habitat conservation to water retention and quality in an area can form a basis for establishing a payment scheme where the users of water contribute to maintaining, managing and/or restoring the Natura 2000 site and its natural abilities to regulate the water flow. Similarly, as demonstrated in the study, Natura 2000 areas play a significant role in both storing and capturing carbon, this way mitigating climate change. Depending on the future developments, this might make (certain) Natura 2000 areas eligible to receive funding from carbon offsetting schemes.

Revenues from certified products and/or sustainable tourism*:* With the markets for sustainably produced and/or biodiversity-friendly products increasing, there are also increasing opportunities to develop markets for certified products from or associated with Natura 2000 areas. For example, several products such honey, meat and even beer have already been associated with the management of Natura 2000 site (Kettunen et al 2009[14]). Similarly, as the assessment in Section C shows, the network continues to provide significant opportunities for recreation and tourism, including related businesses. These revenue streams can provide a funding source that helps to cover some opportunity costs of Natura 2000 and also actively contribute towards the management of the sites (i.e. being channelled into covering the costs of management activities).

Public-private partnerships*:* The opportunities outlined above create possibilities for engaging a broader range of stakeholders in managing the Natura 2000 network. Several business sectors can be brought on-board, including companies depending on a steady supply of clean water, businesses benefiting from the natural beauty and other characteristics of the site, or businesses seeking to create markets for biodiversity-friendly products. In several occasions the conservation and/or restoration of ecosystems and their services provide cost-effective solutions for areas such as water management and flood mitigation, therefore they are being increasingly considered as good investment by different businesses.

14 Kettunen, M., Bassi, S., Gantioler, S. & ten Brink, P. 2009. Assessing Socio-economic Benefits of Natura 2000 – a Toolkit for Practitioners (September 2009 Edition). Output of the European Commission project Financing Natura 2000: Cost estimate and benefits of Natura 2000 (Contract No.: 070307/2007/484403/MAR/B2). Institute for European Environmental Policy (IEEP), Brussels, Belgium. 191 pp. + Annexes.

PART E: SUMMARY OF RESULTS, CONCLUSIONS, RECOMMENDATIONS AND WAY FORWARD

XII) Summary of results and future needs

The prime focus of the Natura 2000 protected area network is on the conservation of the unique and endangered biodiversity in Europe; this includes rare habitats, species and genetic diversity. In addition, the Natura 2000 network provides a range of benefits to society and the economy via the flow of ecosystem services (provisioning, regulating, cultural and supporting services). These also support policy objectives beyond biodiversity, in particular climate change mitigation and adaptation, water quality and provision, food provision, jobs and livelihoods, cost savings, science and education, social cohesion and identity.

Assessing the benefits associated with the Natura 2000 network it's crucial, not only to stress the importance of conservation and the risks of degradation, but also to communicate the need for funding, help address stakeholders' (mis)perceptions on the importance of the sites, and help integrate the sites into the wider ecological-social-economic fabric of the regions. In addition, the EU committed in Nagoya to the CBD Strategic Plan, which includes targets for the assessment of the benefits of natural capital and integration into national accounts. Further assessment of Natura 2000 benefits, and indeed those of wider green infrastructure and other living natural capital, will be essential for this to be achieved and ensure that policy makers at local, national and international level have the full evidence base available to take account of the value of Natura 2000 in their decisions.

Given existing data and research available, **this study derives some very broad estimates for the overall economic benefits of the Natura 2000 network across the EU.** This builds both on an analysis of existing site – and habitat-based valuations, as well as on our own estimate of selected ecosystem services.

A first estimate for the value of the benefits of the (terrestrial) Natura 2000 network – scaling up from existing site-based studies – suggests that these could be **between €200 and €300 billion per year at present** (or 2% to 3% of EU GDP[15]). This value should be seen as 'gross benefits' delivered by sites, rather than the net benefits of the Natura 2000 designation and associated conservation measures.

The estimate is based on a relatively small number of studies scaled up to the EU level using the benefit transfer method. There are many methodological issues associated with this approach that are recognised in the report. This range should therefore be seen as an indicative first estimate, which would benefit from further refinement through subsequent analysis. Furthermore, it should be noted that this value includes both market and welfare values, so the comparison to GDP should be seen only as an illustration of scale.

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15 EU budget 2011 http://ec.europa.eu/budget/figures/2011/2011_en.cfm

The **ecosystem-service analysis** allowed us to identify some preliminary values for a set of services. Among those selected for the assessment, it should be noted that some services were amenable to a relatively robust estimate (namely carbon storage and tourism) while others could only undergo a more illustrative/experimental analysis. Furthermore, the number of services covered is but a subset of the services that the network offers, hence offering but a partial picture of the total benefits of the network. Nevertheless, the mix of ecosystem services here estimated seems to broadly match with the overall site-based benefits assessment of €200 to €300 billion/year. Much more work, however, is clearly needed to derive a robust order-of-magnitude estimate (see road map in next section) and the services contribution to the whole.

A summary of key results by ecosystem service is provided below. The individual estimated values, what they relate to, their level of 'robustness', and future research needs is shown in Table 10.

Carbon: The Natural 2000 network provides a critically important service of storing carbon, revealing essential synergies of biodiversity with climate mitigation and adaption; improvements in land management will increase the carbon benefits

Thanks to the data and methodologies already available, the benefits of Natura 2000 associated with carbon storage are the most amenable to a quantitative and monetary assessment.

In general, Natura 2000 sites store carbon at relatively high densities compared to EU land area as a whole. Many sites protect several ecosystems that are important current stores of carbon and offer significant opportunities for further carbon sequestration, including sites located on forested lands, wetlands, agricultural lands, and marine and coastal ecosystems. It is estimated that the Natura 2000 network currently stores around 9.6 billion tonnes of carbon, equivalent to 35 billion tonnes of CO_2, which is estimated to be worth between €600 billion and €1,130 billion (stock value in 2010),[16] depending on the price attached to a tonne of carbon (i.e. to reflect the value of avoided damage of climate change by avoided GHG emissions).

It can be expected that in the future these carbon values will increase, especially if the conservation status of the network improves. A policy scenario (Policy ON), where full Protected Area coverage (terrestrial PAs + fuller MPAs) with a move to full favourable conservation status is estimated to generate a gain of at least a total of 1.71-2.86% by 2020 compared to a policy inaction scenario (Policy OFF), where no additional action is taken to conserve the current Natura 2000 sites over the next decade.

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[16] To do: ensure that understandable for non-economists.

Natural hazards: Natura 2000 sites offer potential significant cost savings and reduction of damage from extreme weather events

Natural hazards have caused significant damage across the EU over time. For the period 1990 – 2010, the value of economic losses from natural disasters in the EU-25 amounted to around €163 billion (or €16 billion a year). Moreover, due to demographic trends and impacts of climate change, it is likely that the vulnerability of human settlements to natural hazards will increase in the future.

Given the important functions that natural barriers and green infrastructures can provide, Natura 2000 sites can and have played a role in the mitigation of natural hazards, such as floods, avalanches or landslides. Using natural measures to mitigate impacts of natural disasters can lead to cost effective solutions which are often less expensive than manmade ones. It is, however, difficult to distinguish the role of Natura 2000 from that of other natural/protected sites and wider green infrastructures, given that each can play a role, and that their beneficial effects can spread to wider areas beyond the location of the green infrastructure/natural assets.

The site specific nature of natural hazards mitigation and the limited data availability on the role of Natura 2000 in reducing risks across Europe means that, at this stage, it is not yet possible to estimate Natura 2000 wide benefits.

Tourism: Natura 2000 is already proving to be an important motor of many local economies by attracting tourists, whose spending supports local economies.

The expenditure supported by visitors to Natura 2000 sites is around € 50-85 billion /year (in 2006). Only a share of the visitors is explicitly attracted by the Natura 2000 designation (most are simply attracted to the site for its aesthetic and landscape value). If only the expenditure of those visitors who have affinity for Natura 2000 designation is taken, the range becomes to €9-20 billion/year for 230-520,000 visitor days. The value of recreational benefits derived by the visitors themselves is estimated at € 5- 9 billion per annum.

Furthermore, protected areas can provide additional benefits to the **local and regional economy,** by attracting inward investment and enhancing local image and quality of life.

Marine Protected Areas: Marine Natura sites, as part of a wider network of connected marine areas, may have positive effects on overexploited fish stocks.

Marine Protected Areas (MPAs), as part of a wider network of connected marine areas, can potentially have positive effects on overexploited fish stocks, as well as support a range of regulating and cultural services.

The value of benefits delivered by the marine area currently protected by the network (equivalent to 4.7% of the EU's marine area) is approximately €1.4-1.5 billion per year. This would increase up to €3.0-3.2 billion per year if 10% of the sea area were protected, and €6.0-6.5 billion per year for protection of 20% of the sea area. The higher figures apply to stronger protection measures.

This should be seen as a ball park value, illustrative of the importance of this issue. To obtain more robust results would need an improved understanding of how protection will influence habitats, services and off-site fisheries; the level to which benefits will depend on details of protection; and network effects.

Water: Money can be saved via working with natural capital, saving water purification and provisioning costs

While it has not been methodologically feasible to develop an EU wide assessment of the benefits of the Natura network for water purification and provision, given the site specific nature of the benefits, it is clear from case examples that the Natura 2000 network can lead to cost-effective means of water purification and supply, offering significant savings over man-made alternatives.

To cite an example from central and northern Europe, for the four European cities of Berlin, Vienna, Oslo and Munich, protected areas have been estimated to bring average per capita benefits ranging between €15 and €45 per year for both water purification and provision combined. This compares to average household water bills of €200 per year (in Germany). This underlines that benefits can be indeed significant, and lead to substantial actual and potential cost savings from ecosystem based water purification and provision, both for companies (in terms of reduced operational costs) and citizens (reduced water bills). It will be important for cities to explore the role of natural capital (protected areas, wider green infrastructure) in the purification and provision of water and ensure that such considerations are integrated in the water management plans required under the Water Framework Directive.

Food security and provision:

Insect Pollination services are important in Europe – with an annual value estimated at €14 billion per year, which represents 10% of agricultural production for human food in 2005. However, the existing data does not allow us to identify which share of this is from Natura 2000 and which share from wider green infrastructure.

Many Natura 2000 sites also support important **agricultural practices**. Farmland covers almost 50% of the EU territory and agro-ecosystems represent 38% the surface of Natura 2000 sites. High Nature Value farming can offer significant benefits for biodiversity as well as helping to support local breeds, conserving genetic diversity and enhancing the resilience of the sector.

Table 10: Summary of results, what they relate to, the level of robustness and further needs in the area

Key:

Deep green	**Robust numbers – fine for publication, citation, without need for significant context.**	**Orange**	Illustrative/indicative numbers but use with care and not out of context of the being a first assessment
Light green	Illustrative/indicative – useable with due caveats.	**Red**	Weak / very experimental. Do not use
Italics text	*Experimental or illustrative*	**Bold text**	Key point, result
Abbreviations:	Bn = billion;		yr = year

Approach	Numbers	What they relate to	Level of robustness / usability	Needs
Site Based	**€223 – 314 bn /yr** *€251 – 360 bn /yr*	Grossing up from 35 values from 21 studies. - GDP adjusted site based - *Non adjusted site based*	**Best currently possible preliminary indicative value**. Use with care; lot of caveats. High dependence on studies from UK and Netherlands.	***Future needs:*** To have robust order of magnitude ~ ideally a minimum of 200 comparable studies should be available– across biogeographic regions. A priority would be to get wider geographic focus. ***Future needs:*** bottom up survey of ecosystem services (ESS) from sites and beneficiaries to help assess factors driving benefits.
Habitats Based	**€189 – 308 bn /yr**	Grossing up from 33 study numbers for 7 habitats - coastal, freshwater, heath and sand, grasslands, bogs and mires, forests.		
Territorial (extrapolation from national based studies)	*n/a as rejected for this study*	*Grossing up from Scotland, E&W and NL to rest of the EU*	*Not robust/useable. Was useful as a Straw man in the study*	A possible way forward would be to focus on smaller territorial scale. ***Future needs***: significant increase in studies, noting biogeographic regions as well as range of key site and context indicators.

Carbon sequestration / storage	**Current Stock: €600 bn - €1130 bn** for the Natura 2000 network. **Policy On:** Over next **10 years,** there will be an **increase of €79-88** bn in carbon value if **ecosystem quality** is improved**; or €82-92 bn** if there is a 10% increase in **forest area.**	Stock value from carbon storage (living + dead carbon) and CO_2 value range 17.3 and 32 EUR/tCO_2 for 2010. Annual sequestration building on sequestration rates. Stock values are gross values. Policy-on values: increment.	**Relatively robust estimate for the value of the stock of (living) carbon.** Is an underestimate of the total value given that sequestration not addressed.	***Future needs:*** further breakdown, site corroboration. More an annual natural gains – sequestration. Look also more at soil carbon given that this is a complex issue.
Natural hazards	*Context values:* €160 Bn over 1980 to 2010 i.e. ~€5bn year losses SR: country indicative estimate: EUR 3.75 bn from restoration/planning	Country example: Slovak Republic: the national Landscape Revitalisation and Integrated River Basin Management Programme > ~ benefits of EUR 3.75 bn, mainly related to avoiding the costs of flood protection measures (Gov't of Slovak Republic, 2010).	Unable to produce numbers related to Natura 2000. Note that the losses noted in the left column do not represent current costs avoided by Natura 2000 or green infrastructure. It is currently not possible to say what these would be.	***Wider:*** Geographic Information Systems (GIS), survey of sites risks, impacts, role of Natura 2000, benefits.
Water – provision and purification	***<u>Provision</u>*** *Experimental ~ €22 billion/year* ***<u>Purification</u>*** *Experimental* €2.2 - €25 billion / year	***<u>Provision</u>*** Grossing up from 9 studies / values – but only 1 from the EU. ***<u>Purification</u>*** Grossing up from 3 values	**EU values currently experimental;** **use case examples as these communicate the benefits**	***For Future:*** survey / analysis of cities and beneficiaries .
Pollination	*Context values:* EU: Total €14 bn / year, which is 10% of agriculture productivity. World Pollination: €153bn/yr	General value of insect pollination	Order of magnitude robust, but not for Natura 2000 share. While it is clear that Natura 2000 sites are habitats for a wide range of wild pollinators for onsite agricultural activity and for nearby agricultural production, there is Insufficient data to be able to allocate share to Natura.	***Future:*** explore what the direct role of Natura 2000 is in wild pollination and the overall share. Useful to identify and assess specific sites that offer particular pollination value and output gains / input savings.

Marine	***Production services: food: fish*** €1 Bn per year off-site fisheries benefits ***Wider set of Marine ESS:*** €2.5-3.8 Bn per year improvement in 7 services	Approximate marginal benefits associated with protecting 10% of EU marine environment; range is for less-more restrictive protection. Based on transfer of expert judgement.	*Highly uncertain, order of magnitude estimates. Fisheries value only ballpark, dependent on CFP reform.*	*Full habitat data (5years); research and monitoring to understand the impacts of protection on services.*
Tourism expenditures	Around € 50-85 billion /year (in 2006) for 1.7 billion visitor days (~466,000 visitors/day average) considering all visitors Between € 9-20 billion/year considering visitors with affinity for Natura 2000 designation	Scaling up from a representative sample of 47 Natura 2000 sites	Order of magnitude rather than precise estimate (margin of error), comparable with economic indicators of tourism (e.g. the estimated value added of tourism and recreation for EU-27 is €505 bn)	*More data on tourism at site level (number of visitors and tourism spending)* *Better determination of the affinity of visitors for Natura 2000 designation*
Recreation (non market benefits)	4 € / visit i.e. between € 5-9 billion over the overall Natura 2000 network	Scaling up from a list of recreational values taken from the literature (National parks, Natura 2000 sites, habitats)	Rough order of magnitude rather than precise estimate, comparable with other recreational values for Natura 2000 sites	*More values from Natura 2000 case studies developed under a comparable protocol ; values on activities and attractiveness of sites*

Overall, it should be acknowledged that there are a range of methods to ascertain value, and the values derived themselves can be of different types – from real market values that can feature in companies' 'bottom lines', national accounts and GDP, to values representing wellbeing, which are meaningful at a social level, but invisible to the cash economy. The values also accrue to a wide set of beneficiaries and will have very different implications for protected areas funding. Only a small proportion of the estimated benefits of €200-300 billion are reflected in cash transactions, and in reality very little actually accrues directly to protected areas. This underscores a fundamental issue: while protected areas have value to economies and societies, this value are generally not visible directly (hence the need for assessment) and their related benefits rarely pay the site manager. The protected areas are important public goods, creating many private benefits, but generally provide far less return for their ongoing management, maintenance or improvement of conservation status.

XIII) The way forward: road map for valuation

Currently, only a few ecosystem services can be quantified and valued for the Natura 2000 network as a whole, given limitations in data and methodology. However, with additional investment in data and studies, it is expected that a fuller and more robust assessment of the benefits of Natura 2000 network in the EU can be achieved in the next ten years. Already by 2014 good progress can be made.

Table 11 below presents a '**road map'** of how different valuation approaches can be used and improved in the future. The time scales chosen include a reference point (now, i.e. 2011), key EU policy target years (2014 for the Biodiversity Strategy, and 2020 for the Biodiversity Strategy and CBD Strategic Plan), and an additional 2030 scenario. By 2050 (not included in the table), the values should be fully appreciated, even if many values will be site specific and dynamic (i.e. changing with population/demography, wealth, and a range of other factors) and methodological issues will naturally remain (e.g. on how to deal with migratory fish populations that go beyond EU waters).

Note that progress on economic valuation does not mean that other techniques (e.g. biophysical valuation, assessments or stakeholder assessments) become less relevant. On the contrary, **what is needed is progress with the range of tools to better define the contribution of nature to society and the economy as well as its intrinsic value.** Also, this study confirms that, while identifying the values of ecosystem services may be relatively feasible, measuring the ecosystem services specifically delivered by Natura 2000 sites remain a great barrier to economic valuation. This will be worth further efforts in future analysis.

It should be recognised that it will never be possible (nor, arguably, needed) to derive a precise, robust, static value of the Natura 2000. The value will always be dynamic, affected by population growth, demography, income, changing geographic conditions, interests and preferences, economic contexts and wider contexts (e.g. global carbon values and climate change). This, and the site specificity of functions, services and values, also mean that that there are limits to what can be assessed for the EU level as a whole.

Nevertheless, **there are strong merits in supporting the development of additional site-based benefits valuation for Natura 2000** in a manner that would allow a wider 'meta-analysis' to be carried out.

To allow a statistically significant (i.e., robust) analysis, **more data is clearly needed**. Ideally, data sources would at least encompass 200 quality comparable primary valuation studies on the benefits of Natura 2000 from across the EU Member States – i.e. around 20 studies per key factor driving benefits (standard rule of thumb to help get statistically significant answers). As temporal and spatial conditions are important and methods evolving, some past studies will not be useable in the future and new studies will be needed, based on a common methodology that builds on Member States' and TEEB approaches. Realistically, in the future it will be possible to update only a few of the figures/services currently estimated (e.g. change carbon values used) and new evidence and figures will have to be developed using state of the art tools (e.g. building on MA, TEEB framework and advances in methods).

Primary valuation will also be crucial to expand the evidence base. Value evidence is important in determining what the benefits of different sites and management options are, and forms a key input to policy and decision processes, notably regarding designation, allowable activities, and management methods. This does not mean, however, that primary valuation is required for all sites. Because there are many similarities across sites, the services provided and the human populations benefiting from them, value transfer methods can be used.

The development of '**benefit production functions/value transfer functions'** would therefore be desirable for an EU wide assessment, in order to identify and characterise key factors driving the benefit values. In practice this should be done separately for terrestrial sites and for marine sites, given the quite different drivers of value. What is needed is a transparent framework enabling to compare analyses and build on results from different methods in different contexts. The Millennium Ecosystem Assessment (MA) and TEEB frameworks offer a useful basis for this.

The potential for advancing valuation through improved use of **Geographic Information Systems (GIS) and mapping** is also very significant. The progress of the work of the JRC and EEA in mapping and use of ecosystem service indicators underlines the scope here for important advances. This could help with site-based assessment as well as with wider regional assessments. It is expected that these tools will be of particular support to the future assessment of carbon storage and sequestration, and also for water supply, with potential even as regards pollination (see e.g. Figure 7) as well as flood control, which are currently very difficult to assess given site specificity.

It would also be valuable to do an **analysis/survey of the level of ecosystem service provision from the different sites to different stakeholders** (across geographic levels) to quantify the inter-connections and explore the quantitative scale of benefits – for example in relation to specific benefits from carbon storage and sequestration of specific sites, the number of cities and people benefiting from water provisioning and purification and natural hazard control, and so on.

Concluding remarks: Needs and concrete steps to realise the benefits from Natura 2000

To realise these wider economic benefits of Natura 2000 will require the completion of the designation of sites in the network (for MPAs in particular), and due investment in restoration and management of protected areas so that the conservation objectives are reached, favourable conservation status attained, ecosystem health enhanced and wider economic benefits realised.

However, several factors such as slow progress in establishing MPAs still hinder ability of the terrestrial and marine network to reach its full potential, for the benefit of European biodiversity and people alike. In particular, it appears that the lack of financial resources to support the management of Natura 2000 is one of the key barriers for reaching the goals of biodiversity conservation in the EU, and the delivery of related socio-economic benefits. There is potential to mainstream biodiversity across EU policies (e.g. through the Water Framework Directive) and programmes and funding (e.g. the Common Agricultural Policy, the EU Cohesion Policy, the Common Fisheries Policy and the European Fisheries Fund). This holds for wider green infrastructure and natural capital considerations and particularly for the EU biodiversity policy's key asset – the Natura 2000 network.

There is a renewed need to understand and take account of the value of Natura 2000 in the many policies, instruments, programmes and funds. There is a new evidence base that conserving and investing in our biodiversity makes sense for climate challenges, for saving money, for jobs, for food, water and physical security, for cultural identify, health, science and learning, and of course for biodiversity itself.

Table 11: Road map for valuation of the benefits of Natura 2000 network: current estimates, change in confidence levels and needs/developments over time.

Key:

Deep green	**Robust method – should lead to robust numbers, fine for publication, citation, without need for significant context.**	**Orange**	Methods to be used with care, but can lead to illustrative/indicative numbers; results not to be presented out of context - first assessment
Light green	Fairly robust tools leading to Illustrative/indicative – useable with due caveats, transparent presentation of limits and what the numbers mean.	**Red**	Weak / very experimental methods, to explore ways forward. Do not use the results for decision making;
Italics text	*Experimental or illustrative*	**Bold text**	Key point, result
Abbreviations:	Bn = billion;		yr = year

	Now (2011)	2014 (Biodiversity strategy target)	2020 (BD strategy and CBD Strategic Plan target year)	2030
Multi-ecosystem services scaling up approaches – bottom-up approaches				
Territorial approach (i.e. country to country; eventually region to region)	**Not useable**	Unlikely to have enough information	Even with wider information, country differences likely too large for acceptable benefits transfer; unlikely that insufficient regionally specific information.	If done at a small regional basis with broadly similar contexts then this could be doable and valuable. [would be fully operational by 2050 – the 'vision' year]
Site Based	**Indicative/Illustrative values** – a bit better than experimental	More case examples – following protocol to allow comparability and urgent need for more geographic spread	More cases needed using common framework to allow a meta analysis to be carried and a benefits production function developed. Need broadening of geographic focus.	**200 comparable site study values needed as a minimum–** for a robust meta analysis: according to a common protocol to allow comparability, meta analysis and proper scaling up.
Habitats Based - terrestrial	**Indicative/Illustrative values** – a bit better than experimental	More case examples needed – following protocol to allow comparability. Need for	More cases needed: meta-analysis, develop production function (can build on site survey: qualitative / quantitative). Need representative	**200 comparable site study values** needed allowing meta analysis and proper scaling up to derive robust order of magnitude range.

		wider set of habitats.	coverage of key habitats.	
Habitats Based - marine	*Fundamental uncertainties make valuation ballpark at best.*	Scope for expanding use of expert knowledge (eg improve the method by using expert judgement for specific marine areas) plus increasing knowledge of where the marine sites will be. Need more case examples, strong research effort on particular sites, chosen strategically (most important services, treatable uncertainties).	Habitat data plus monitoring evidence of how habitat is responding to protection, better understanding of habitat ecosystem service links. More cases of strategic sites: do a first meta analysis develop production function (can build on site survey: qualitative / quantitative).	**100 MPA studies with 200 site study values –** to create a due basis for a constructive meta analysis: according to a protocol - to allow comparability, meta analysis and proper scaling up.
Individual Ecosystem Services approaches				
ESS approach – overall	**Currently only order-of-magnitude for 2 or 3 services (see below)**	For carbon storage, recreation and tourism, can be increasingly robust.	New primary valuation, and new spatial (e.g. GIS) data and methods should allow significant improvements. First generation natural capital accounts will also help.	Full integration into environmental accounts (natural capital and SEEA) will offer critical improvements . Cover increasing number of services – at local, regional, national and EU scales.
1. Carbon storage	Relatively robust, through limits in precision (as soil carbon and sequestration rates still not understood sufficiently); use of past Natura 2000 coverage and wide EUR/tCO2 value ranges	Increasingly precise Some progress on sequestration rates (i.e. not just stock of carbon), data availability in suitable for form entire Natura 2000 networks and dealing with overlap between SACs/SCIs and SPAs.	Progress on carbon storage in soils; increasing knowledge of sequestration rates. Development of carbon accounts will support valuation. Will be robust overall, but still limits regards soil carbon.	Good understanding. Full natural capital accounts as well as strong links to national accounts, supported by extensive valuation efforts.

2. Water provisioning	*Complicated as has to go through the site approach; A top down 'benefits to the sector' approach complicated by data availability / confidentiality*	More studies; city priority for studies give practical usefulness.	Include city survey and also water company survey/analysis as to 'free' inputs. Integration of ESS water provisioning in management plans under WFD will help. Probably still focused only on key areas that benefit	Cities/towns and water company value from Natura 2000 clear Demonstrated, inter alia, via PES schemes and investments. National water accounts (physical) and good integration in SEEA
3. Water purification	*Complicated has to go through the site approach*	Studies on ecological functions, services, values.	Experimental integration in management plans under WFD?	Full integration in management plans under WFD?
4. Flood control	*Context values and case examples*	Seek additional evidence on cost-effective use of Green Infrastructure /Natura 2000	Insights on capacity for Natura 2000 to benefit cities or others – where relevant. Increasing interest in from climate adaptation research.	Spatially modelled role of Natura 2000 as part of wider green (and grey) infrastructure in ecosystem based adaptation to climate change. Complications in estimate given that benefits are avoided losses.
5. Pollination	*The overall value can be calculated, but separating Natura 2000 from green infrastructure difficult.*	Key issue; evidence increasing for selective site based examples –for biophysical functions, impacts on productivity and value	Scientific modelling + GIS ,complemented by questionnaire to / interviews with sites managers and farmers to clarify role and importance of different sources of pollination (Natura 2000, which sites; other green infrastructure) and type of wild pollinators. Focus on sites neighbouring agricultural sites.	Full appreciation of the value of wild pollinators for all key sites – bottom up assessment Appreciation of top down value – ie share of output benefitting from wild pollinators from Natura 2000.
6. Organic produce	*Resources within study insufficient, need to look at gross and net*	Possible to create an indicative value; will be important to see in wider context of whole services	Good site specific understanding expected. More local and regional assessments. Data integration.	Value of Natura 2000 produce expected to be a well understood market and role in local economies.

7. Air pollution benefits	*Very site specific*	Some robust values for key cities potentially doable.	GIS + population, proximity, and air quality + ESS indicators. Expect for major cities	Allocation issues to Natura 2000, green infrastructure broadly resolved given GIS and improved spatial techniques.
8. Marine: Biomass production	*Fundamental uncertainties make valuation ballpark at best.*	Clarity over reformed CFP and use of ecosystem models allows understanding of role for MPAs in supporting fisheries	Habitats data should be available for all EU sea areas, scope for modelling benefits though uncertainties remain over ecological relationships. Off-site fisheries benefits remain a challenge to address	Monitoring of marine protected areas enables demonstration of measurable fisheries benefits. Work needed to model impact of climate change.
9. Tourism (and market based benefits of recreation)	The overall value of benefits can be calculated by a site-based approach, extrapolating data from a small and disparate sample of Natura sites. Difficult to identify a relationship between Natura 2000 and tourism indicators ('top-down approach'). Net benefits cannot be calculated.	Design of a reporting tool and experimenting it in a few sites => data base for a representative set of sites Better understanding, identification and quantification of the drivers of the level of tourism in Natura 2000 sites. Collection of data related to tourism for eligible Natura 2000 sites	Implementation of the reporting tool at EU level => data base for a large number of Natura 2000 sites Modelisation for same day visitors Collection of data for new elected Natura 2000 sites ; First comparison of before/after designation	EU database on tourism activities and benefits. Calculation of net benefits on the basis of the before/after situation.
10. Recreation (non market benefits)	site-based, very few sites with valuation data	More case studies at site level for Natura 2000-following protocol to allow comparability => a small sample of sites.	More case studies at site level for Natura 2000 => a representative sample of sites.	Methodological progress in the evaluation of non-market benefits

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ANNEX I GLOSSARY OF TERMS[17]

Altruistic value: The importance which individuals attach to a resource that can be used by others in the current generation, reflecting selfless concern for the welfare of others (intra-generational equity concerns).

Avoided Costs: The costs that would have been incurred in the absence of ecosystem services.

Benefits: positive change in wellbeing from the fulfilment of needs and wants.

Bequest value: The importance individuals attach to a resource that can be passed on to future generations, reflecting intergenerational equity concerns.

Biodiversity: the variability among living organisms, including terrestrial, marine, and other aquatic ecosystems. Biodiversity includes diversity within species, between species, and between ecosystems (UN, 1993).

Biome: a large geographic region, characterized by life forms that develop in response to relatively uniform climatic conditions. Examples are tropical rain forest, savannah, desert, tundra.

Biophysical valuation: A method that derives values from measurements of the physical costs (e.g., in terms of labour, surface requirements, energy or material inputs) of producing a given good or service.

Carbon sequestration: The process of increasing the carbon content of a reservoir

other than the atmosphere. (MA, 2005)

Consumer surplus: The benefits enjoyed by consumers as a result of being able to purchase

a product for a price that is less than the most that they would be willing to pay.

Contingent valuation: Stated preference based economic valuation technique based on

a survey of how much respondents would be willing to pay for specified benefits. (MA,

2005)

Cost-benefit analysis: A technique designed to determine the feasibility of a project or plan by quantifying its costs and benefits. (MA, 2005)

Direct use value (of ecosystems): The benefits derived from the services provided by

an ecosystem that are used directly by an economic agent. These include consumptive

uses (e.g., harvesting goods) and non-consumptive uses (e.g., enjoyment of scenic beauty). Agents are often physically present in an ecosystem to receive direct use value. (MA, 2005)

Driver (direct or indirect): any natural or human-induced factor that directly or indirectly causes a change in an ecosystem.

Ecosystem: Means 'a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit' (UN, 1993).

Ecosystem degradation: A persistent reduction in the capacity to provide ecosystem services. (MA, 2005)

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17 Building on TEEB (2010) and TEEB (2011)

Ecosystem services: the direct and indirect contributions of ecosystems to human well-being. The concept 'ecosystem goods and services' is synonymous with ecosystem services.

Ecotourism: Travel undertaken to access sites or regions of unique natural or ecologic

quality, or the provision of services to facilitate such travel.

Existence value: the value that individuals place on knowing that a resource exists, even if they never use that resource (also sometimes known as conservation value or passive use value).

Favourable Conservation Status: In layman's terms can be described as a situation where a habitat type or species is prospering (in both quality and extent/population) and with good prospects to do so in future as well[18].

Hedonic pricing: An economic valuation approach that utilizes information about the

implicit demand for an environmental attribute of marketed commodities.

Human well-being: concept prominently used in the Millennium Ecosystem Assessment – it describes elements largely agreed to constitute 'a good life', including basic material goods, freedom and choice, health and bodily well-being, good social relations, security, peace of mind, and spiritual experience.

Incentives (disincentives), economic: a material reward (or punishment) in return for acting in a particular way which is beneficial (or harmful) to a set goal.

Indirect-use value (of ecosystems): the benefits derived from the goods and services provided by an ecosystem that are used indirectly by an economic agent. For example, the purification of drinking water filtered by soils.

Intrinsic value: The value of someone or something in and for itself, irrespective of its utility for someone else. (MA, 200a)

Natural capital: an economic metaphor for the limited stocks of physical and biological resources found on earth, and of the limited capacity of ecosystems to provide ecosystem services.

Non-use value: benefits which do not arise from direct or indirect use.

Opportunity costs: foregone benefits of not using land/ecosystems in a different way, e.g. the potential income from agriculture when conserving a forest.

Primary valuation studies: Empirical valuation studies rather than those that rely on the transfer of values or value functions from other studies.

Production function: A function used to estimate how much a given ecosystem service

(e.g., regulating service) contributes to the delivery of another service or commodity which is traded on an existing market.

Public goods: a good or service in which the benefit received by any one party does not diminish the availability of the benefits to others, and where access to the good cannot be restricted.

Replacement cost: The costs incurred by replacing ecosystem services with artificial technologies.

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18 Assessment, monitoring and reporting of conservation status – Preparing the 2001-2007 report under Article 17 of the Habitats Directive (DocHab-04-03/03 rev 3)

Resilience (of ecosystems): their ability to function and provide critical ecosystem services under changing conditions.

Revealed preference: A method to assess possible value options or to define utility

(consumer preferences) based on the observation of consumer behaviour.

Scale: The measurable dimensions of phenomena or observations. Expressed in physical units, such as meters, years, population size, or quantities moved or exchanged. In observation, scale determines the relative fineness and coarseness of different detail and the selectivity among patterns these data may form. (MA, 2005)

Stakeholder: A person, group or organization that has a stake in the outcome of a particular activity.

Stated preference: Consumer preferences are understood through questions regarding willingness to pay or willingness to accept.

Substitutability: The extent to which human made capital can be substituted for natural

capital (or vice versa).

Threshold/tipping point: a point or level at which ecosystems change, sometimes irreversibly, to a significantly different state, seriously affecting their capacity to deliver certain ecosystem services.

Total economic value (TEV): a framework for considering various constituents of value, including direct use value, indirect use value, option value, quasi-option value, and existence value.

Trade-offs: a choice that involves losing one quality or service (of an ecosystem) in return for gaining another quality or service. Many decisions affecting ecosystems involve trade-offs, sometimes mainly in the long term.

Travel cost method: A revealed preference valuation method that infers the value of a change in the quality or quantity of a recreational site (e.g., resulting from changes in biodiversity) from estimating the demand function for visiting the site.

Valuation: The process of expressing a value for a particular good or service in a certain context (e.g., of decision-making) usually in terms of something that can be counted, often money, but also through methods and measures from other disciplines (sociology, ecology, and so on). (MA, 2005)

Valuation, economic: the process of estimating a value for a particular good or service in a certain context in monetary terms.

Value: The contribution of an action or object to user-specified goals, objectives, or conditions. (MA, 2005)

Vulnerability: Exposure to contingencies and stress, and the difficulty in coping with them.

Willingness to pay: The maximum amount that a person is willing to pay for a good they do not have.

Willingness-to-pay (WTP): estimate of the amount people are prepared to pay in exchange for a certain state or good for which there is normally no market price (e.g. WTP for protection of an endangered species).

ANNEX II OVERVIEW OF EXISTING VALUATION SITE-BASED STUDIES

All values have been estimated on a per hectare per annum basis, where necessary by estimating the annualised values where the source material expressed these as capitalised sums, and have been converted to euro at 2011 prices.

The per hectare values are derived from estimates of the value of services delivered by each site, divided by the area of the site. It is apparent from **Error! Reference source not found.** that the available estimates give a wide range of values for the benefits of Natura 2000 sites, ranging from just less than €50 per hectare per year to almost €20,000 per hectare per year.

Table A.12: Summary of valuation studies, by site

Site	Ecosystem services / types of benefit	Site value per ha per year (€, 2011 prices)	Reference
Pond Complex of Central-Limburg, Belgium	Provisioning services, tourism and recreation	1,406	Desmyttere and Dries (2002)
Scheldt estuary, Belgium	Regulating and provisioning ES (various)	3,990	Ruijgrok, E.C.M. (2007)
Skjern River restoration, Denmark	Biodiversity/ existence values, recreation, water purification and regulation, fibre production	1,218	Dubgaard et al (2002)
Protected forests in eastern Finland	Non market values measured through contingent valuation	403	Kniivila et al (2002)
La Crau, France	Non-market benefits (public WTP) + hay production	229	Hernandez and Sainteny (2008)
Donana, Spain	Range of ecosystem services, estimated through CVM	375	Martin-Lopez et al (2007)
Sites protected for Large Blue butterfly, Landau, Germany	Range of services and values including non-use values	6,932	Wätzold et al. (2008)
Burren, Ireland	Cultural services: tourism and recreation; Broader socio-economic benefits: beneficial externalities of conservation	2,714	Rensburg et al. (2009)
Wadden Sea N2K sites, Netherlands	Wide range of provisioning, regulating and cultural services	3,650	Kuik et al (2006)
River N2K sites, Netherlands	Use and non use values, estimated through hedonic pricing and benefit transfer	5,324	
Lake and marsh N2k sites, Netherlands	Tourism, recreation, non use values including biodiversity	5,944	
Dune N2K sites, Netherlands	Flood protection, recreation, non use values	13,198	
High fen and sandy soil N2K sites, Netherlands	Recreation, non use values	1,274	
Stream valley and hills N2K sites, Netherlands	Provisioning, amenity, recreation, non-use values measured through stated and revealed preference	4,974	

	methods		
Białowieża Forest, Poland	Recreation, amenity and existence, freshwater, range of provisioning services (e.g. food, timber), tourism, pest control.	2,799	Pabian and Jaroszewicz (2009)
Pico da Vara / Ribeira do Guilherme, Azores, Portugal	Water provision, quality & regulation. Recreation and eco-tourism. Landscape and amenity values.	642	Cruz and Benedicto (2009)
Lower Green Corridor, Romania	Provisioning services: fisheries, forestry, animal fodder; Regulating services: nutrient retention; Cultural services: recreation	512	Ebert et al. (2009)
Danube floodplains (7 countries, 60% in Romania)	Provisioning services, recreation, water purification	572	Gren et al (1995)
Maramures Mountains Natural Park, Romania	All ecosystem services	416	Ceroni (2007)
Clyde Valley Woods, Scotland	Recreation and non-use values (based on CVM of visitors and general public	5,665	Jacobs (2004)
Waukenwae and Red Mosse, Scotland	Recreation and non-use values (based on CVM of visitors and general public	14,769	
River Bladnoch, Scotland	Recreation and non-use values (based on CVM of visitors and general public	5,341	
Sands of Forvie, Scotland	Recreation and non-use values (based on CVM of visitors and general public	4,404	
Tips of Corsemaul and Tom Mor, Scotland	Recreation and non-use values (based on CVM of visitors and general public	19,763	
Strathglass Complex, Scotland	Recreation and non-use values (based on CVM of visitors and general public	87	
Lewis and Harris, Scotland	Recreation and non-use values (based on CVM of visitors and general public	155	
Sites of special scientific interest in England and Wales (almost 80% by area are N2K)	Range of 7 key provisioning, regulating and cultural services (gross)	7,926	GHK (2011)
Wallasea Island, England	Range of key ecosystem services	1,447	Eftec (2008)
Derwent Ings , England	Social benefits of N2K site, measured through CVM	1,318	Willis, K.G (1990)
Skipworth Common, England	Social benefits of N2K site, measured through CVM	5,987	
Upper Teasdale, England	Social benefits of N2K site, measured through CVM	1,150	
Alkborough Flats, North Lincolnshire, England	Range of ecosystem services	4,508	Everard, M. (2009)
Humber Estuary, England	Amenity and recreation, carbon	847	Luisetti et al (2010)
Blackwater Estuary, England	Amenity and recreation, carbon, fisheries	4,371	

ANNEX III EXAMPLES OF ECOSYSTEM SERVICES

The Table below shows a brief description of the different ecosystem services and provides some illustrative examples.

Table A.13: Examples of ecosystem services

Ecosystem service	Ecosystem Service description	Illustrative example
Provisioning Services		
Food	Natura 2000 can play a significant role by providing fish, directly supporting sustainable agricultural production, such as through organic farming, and indirectly supporting out-of-the-site agricultural production (i.e. through wild pollination, erosion control, water cycling etc.). Moreover, some Natura 2000 sites also provide various wild products, such as mushrooms, berries or game.	Being the first major farming for conservation project in Ireland, The BurrenLIFE Project seems to offer a good 'value-for-money' solution with minimum estimated economic return of 235%. (Rensburg et al,. 2009)
Water quantity	Ecosystems play a vital role in the global hydrological cycle, as they regulate the flow of water. Vegetation and forests influence the quantity of water available locally.	The benefits of freshwater provided by the Pico da Vara/Ribeira do Guilherme Natura 2000 park in Portugal are valued approximately €600,000 per year or €99 per hectare. Cruz and Benedicto (2009)
Raw materials	Ecosystems provide a great diversity of raw materials needed for instance for construction and fuel including wood, biofuels and plant oils that are directly derived from wild and cultivated plant species. There are also important Ornamental resources - Sustainably produced/harvested ornamental wild plants, wood for handcraft, seashells etc. Also ornamental fish.	Non-timber forest products such as rubber, latex, rattan and plant oils are very important in trade and subsistence – the annual global trade in such products is estimated to amount to US$11 billion (Roe et al. 2002).
Natural medicines - Biochemicals &	Biodiverse ecosystems provide many plants used as traditional medicines as well as providing raw materials for the pharmaceutical	80% of the world`s people are still dependent on traditional herbal medicine (WHO 2002), while the sale of medicines derived from natural

pharmaceuticals	industry. All ecosystems are a potential source of medicinal resources.	materials amounts to US$57 billion per year (Kaimowitz 2005).
Genetic/species diversity maintenance	Genetic diversity (the variety of genes between, and within, species populations) distinguishes different breeds or races from each other, providing the basis for locally well-adapted cultivars and a gene pool for developing commercial crops and livestock. Some habitats have an exceptionally high number of species which makes them more genetically diverse than others and are known as 'biodiversity hotspots'. In Europe, Mediterranean Basin with its particularly diverse flora is considered such a hotspot.	Crop Wild Relatives (CWR) are the wild ancestors of crop plants and other species closely related to crops. Hopkins and Maxted (2011) observed that they are likely to play a significant role in securing 21st century food security, because of their potential use in plant breeding to produce crops which withstand adverse impacts of climate change, increasing scarcity of nutrients, water and other inputs, and new pests and diseases.
Regulating services		
Air quality regulation	Trees or other plants also play an important role in regulating air quality by removing pollutants from the atmosphere. Many protected areas located in proximity to highly polluted areas might offer particularly high benefits.	The results of a study (Powe, 2002) have found net pollution absorption by trees in the UK to have reduced the number of deaths brought forward by air pollution by between 65-89 deaths and between 45-62 hospital admissions, with the net reduction in costs estimated to range somewhere between £222,308 and £11,213,276.
Climate/climate change regulation	Ecosystems regulate the global climate by storing and sequestering greenhouse gases. As trees and plants grow, they remove carbon dioxide from the atmosphere and effectively lock it away in their tissues. In this way forest ecosystems are carbon stores. Trees also provide shade whilst forests influence rainfall and water availability both locally and regionally.	In Mecklenburg-Vorpommern (Germany) an area of 29,764 ha (equivalent to about 10% of the area of drained peatlands in Mecklenburg-Vorpommern), has been restored between 2000 and 2008. This means that emissions of about 300,000 tCO_2-equivalents every year are avoided (with an average of 10.4 tCO_2-equivalents per hectare). When assuming a marginal cost of damage caused by carbon emissions of 70 € per tCO_2, the effort to restore peatlands avoids damage from carbon emissions of up to 21.7 million € every year, on average 728 € per hectare of restored peatlands. (TEEB Case study by Förster 2011 and the references within[19])

19 http://www.eea.europa.eu/atlas/teeb/peatland-restoration-for-carbon-sequestration-germany-1

Moderation of extreme events	Ecosystems and living organisms create buffers against natural disasters, thereby preventing or reducing damage from extreme weather events or natural hazards including floods, storms, avalanches and landslides.	In the Swiss Alps, healthy forests are a major component of disaster prevention. 17 per cent of Swiss forests are managed to protect against avalanches, landslides and rock falls. These services are valued at EUR 1.6 – 2.8 billion per year (ISDR, 2004, Dudley et al., 2009).
Water regulation	Certain ecosystems, such as wetlands or sand dunes, can influence the timing and magnitude of water runoff, regulate and mitigate floods and provide support to recharging of ground water resources.	In Kalkense Meersen Natura 2000 site, in Belgium, it has been estimated that restoration of the original river landscape can bring flood mitigation benefits between EUR 640,000 – 1,654,286 per annum (Arcadis Belgium et al., 2011).
Water purification & waste management	Ecosystems play a vital role in providing numerous cities with drinking water, as they ensure the flow, storage and purification of water. Furthermore, ecosystems such as wetlands filter effluents. Through the biological activity of microorganisms in the soil, most waste is broken down. Thereby pathogens (disease causing microbes) are eliminated, and the level of nutrients and pollution is reduced.	The city of Vienna obtains almost all of its drinking water from mountain springs originating in the Lower Austrian-Styrian high alpine zones. In December 2001, it was the first city in the world to protect its drinking water for future generations under Constitutional Law (Vienna Waterworks 2011).
Erosion control	Soil erosion is a key factor in the process of land degradation, desertification and hydroelectric capacity. Vegetation cover provides a vital regulating service by preventing soil erosion. Soil fertility is essential for plant growth and agriculture and well-functioning ecosystems supply soil with nutrients required to support plant growth.	A study by Ruijgrok et al. (2006) estimated that the value of erosion control in pristine scrubland areas in Europe and in Belgian grasslands was €44.5/ha, at 2008 prices (as in Braat et al, 2008).
Pollination	Insects and wind pollinate plants which is essential for the development of fruits, vegetables and seeds. Animal pollination is an ecosystem service mainly provided by insects but also by some birds and bats. Protected areas play a key role in harbouring wild pollinators which, if located in close proximity to agricultural fields, can help to increase yield and quality of many crops.	Using the methods of Gallai et al. (2009), the United Kingdom's National Ecosystem Assessment estimated the economic value of biotic pollination as a contribution to crop market value in 2007 at EUR 629 million (England: EUR 532 million, Northern Ireland: EUR 28 million, Scotland: EUR 69 million, Wales: unknown) (UK NEA, 2011)

Biological control	Ecosystems are important for regulating pests and vector borne diseases that attack plants, animals and people. Healthy ecosystems can effectively regulate pests and diseases through the activities of predators and parasites. Birds, bats, flies, wasps, frogs and fungi all act as natural controls.	Globally, more than 40 per cent of food production is being lost to insect pests, plant pathogens, and weeds, despite the application of more than 3 billion kilograms of pesticides to crops, plus other means of control (Pimentel 2008).
Disease regulation of human health Regulation of vectors for pathogens	A number of species, such as birds and insects, are known to be vectors of human diseases (e.g. malaria, dengue fever, Lyme disease etc.). In a natural state the functioning of ecosystems keeps the populations of these species under control.	Asian tiger mosquito (Aedes albopictus) in Italy poses a health risk as it is a vector for Dengue and Chikunguna fever and it also has painful stings. Costs related to preventing negative health impacts (e.g. eradication program and communication) amounts to 1.1 million EUR / year (Kettunen et al. 2008 and the sources within).
Cultural & social services		
Landscape & amenity values	People around the world derive aesthetic pleasure from natural over built environment. In particular, people value a specific or exceptional view (landscape values) and appreciate the beauty of nature (amenity values).	'In Denmark, houses in natural environments, when compared to similar houses elsewhere, sell for a 25 percent higher price (Dissing, 2002). This is particularly true where they are located within 30-45 minutes of an urban centre (e.g. Danish Lille Vildmose site) (Bostedt et al., 1991).'
Ecotourism & recreation	Ecosystems and biodiversity play an important role for many kinds of tourism which in turn provides considerable economic benefits and is a vital source of income for many countries. Cultural and eco-tourism can also educate people about the importance of biological diversity. Walking and playing sports in green space is a good form of physical exercise and helps people to relax.	'Non-market benefits of the Scottish Natura 2000 sites related to recreation were estimated by asking visitors how much they would be willing to pay for using the Natura 2000 sites for recreational activities which resulted in an estimate of around £1.5 million per year related to use values. (Jacobs report to Scottish Executive, 2005)'
Cultural values and inspirational services, e.g. education, art and research	Language, knowledge and the natural environment have been intimately related throughout human history. Biodiversity, ecosystems and natural landscapes have been the source of inspiration for much of our art, culture and increasingly for science.	'The Bialowieza Forest, a Natura 2000 site, is the focus of extensive scientific research. Bialowieza village has three scientific institutes and two education centres. The national park runs a Museum and Bison Reserve with highly educated staff and a good level of nature education on offer.' Pabian and Jaroszewicz (2009)

Sources: Building on TEEB 2011b, TEEB 2010, MA 2005; Kettunen et al 2009; Balmford et al 2008; TEEB Foundations 2010a