THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY – PHASE 1 (SCOPING) ECONOMIC ANALYSIS AND SYNTHESIS

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FINAL REPORT

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Introduction

At the meeting of the environment ministers of the G8 countries and the five major newly industrialising countries that took place in Potsdam in March 2007, the German government proposed a study on 'The economic significance of the global loss of biological diversity' as part of the so-called 'Potsdam Initiative' for biodiversity. This proposal was endorsed by G8+5 leaders at the Heiligendamm Summit on 6-8 June 2007.

With this in mind, the German Federal Ministry for the Environment and the European Commission, with the support of several other partners, have jointly initiated preparatory work for this global study, which is named 'The Economics of Ecosystems & Biodiversity (TEEB)'.

The work is divided in two phases. In the first phase, the European Commission organised a web-based call for evidence organised by the European Commission from November 2007 to January 2008. This call for evidence invited interested stakeholders in Europe and worldwide, including government, academic, private sector, scientific, NGO and other experts, to submit evidence of relevant scientific and economic knowledge, highlighting key issues; case studies providing indications of the range of costs and benefits associated with the loss of biodiversity and the decline of ecosystem services; elements for development of a methodological approach. A summary of the contributions to the call, as well as a number of studies commissioned by the Commission and several member state governments, formed the input for an international expert workshop on 'The Economics of the Global Loss of Biological Diversity" was held on 5-6 March 2008 in Brussels, and provided ideas and recommendations on the way forward for the study. Preliminary findings from the first phase have been presented by Minister Gabriel, Commissioner Dimas and Mr Pavan Sukhdev at the High-Level Segment of the Ninth Conference of the Parties to the Convention on Biological Diversity (CBD COP-9) in Bonn, Germany, in May 2008, in the form of an interim report (pdf, ~8MB). The second, more substantial, phase of the study will run into 2009, and its final results will be presented at CBD COP-10 in 2010.

The present report is composed of three chapters, which address the project proposal's four objectives as follows:

Chapter 1

Task 1: Review evidence submitted in response to the Commission's call, in order to sift it and tease out key issues that need to be taken into consideration in designing the Review's economic approach.

Chapter 2

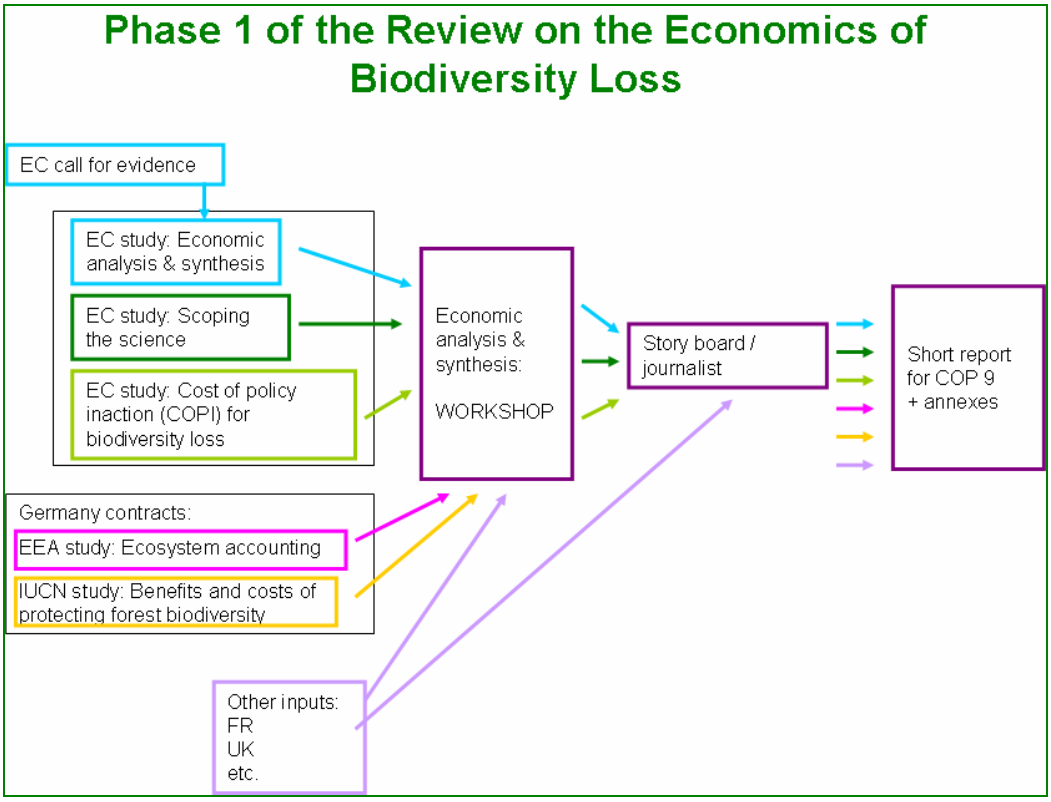
Task 2: Convene a workshop that involves experts and contributing parties from the call for evidence.

Task 3: Analyse and synthesise the workshop outputs drafting and finalising a Discussion Paper that presents key considerations and options for the Review's economic approach.

Chapter 3

Task 4: Build an inventory of relevant resources

The Figure below presents a graphical illustration of the entire process of Phase 1 of the Review, from the EC Call for Evidence to the presentation of the preliminary findings at the Ninth Conference of the Parties to the Convention on Biological Diversity in Bonn, Germany, in May 2008.



Part I:

Critical evaluation of the Contributions to the Review:

Synthesis of Submitted Evidence

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1. Introduction

Biodiversity requires our attention for two reasons. First, it provides a wide range of direct and indirect benefits to humans. Second, human activities have contributed, and still contribute, to unprecedented rates of biodiversity loss, which threaten the stability and continuity of ecosystems as well as their provision of goods and services to humans. A great deal has been written on the causes and consequences of the biodiversity loss witnessed in recent years. This synthesis critically evaluates the collection of the papers sent to the call, reviewing the notion of biodiversity value and the application of economic, monetary valuation methods for its assessment. Two things should be noted at the outset. First the evidence analysed in this report is only that received until mid-January when the call was officially closed. Further contributions have been received since then and will be used for the Review on the Economics of Ecosystems and Biodiversity but are not reflected in this report. Second that this report does not present an exhaustive review of the evidence received in the submissions. It only builds on them and teases some key issues (as requested in the terms of reference).

2. Setting the scene: defining the object of analysis

2.1 Multiple levels of life diversity and types of biodiversity

An important step in discussing the notion of biodiversity value is defining biodiversity. The United Nations Convention on Biological Diversity defines it as "… the variability among living organisms from all sources, including terrestrial, marine and the ecological complexes of which they are part …". Biodiversity encompasses four levels, as shown in Table 1. At the most basic level is genetic diversity, which corresponds to the degree of variability within species. Roughly speaking, it concerns the information carried by genes in the DNA of individual plants and animals. Species diversity refers to the variety of species. Empirical estimates of this are characterised by a large degree of uncertainty. In fact, only about one and half million species have been described so far, while scientists estimate that the earth currently hosts 5 to 30 million species. Less than half a

Table 1: Types of biodiversity

Type of diversity	Physical expression
Gene	Genes, nucleotides, chromosomes, individuals.
Species	Kingdom, phyla, families, genera, subspecies, species, populations.
Ecosystem	Bioregions, landscapes, habitats.
Functional	Ecosystem functional robustness, ecosystem resilience, services, goods.

Source: Nunes et al. (2003)

million have been analyzed for potential economic uses. Since genetic and species diversity are directly linked, the distinction between them is sometimes blurred.

Ecosystem diversity refers to diversity at a supra-species level, namely at the community level. This covers the variety of communities of organisms within particular habitats as well as the physical conditions under which they live. While a long-standing theoretical paradigm suggests that species diversity is important because it enhances the productivity and stability of ecosystems, it was later acknowledged that no general pattern needed to exist between species diversity and the stability of ecosystems, and that a system's robustness may be linked to the prevalence of a limited number of organisms and groups of organisms, sometimes referred to as 'keystone species'. However, a number of recent studies have found positive biodiversity effects on the productivity and resilience - i.e. the capacity to respond to disturbances in a constructive way - of some ecosystems (Balnavera, P.et al. 2006), even though the evidence is still fragmentary. The issue remains controversial[1].

Finally, functional diversity expresses the range of functions generated by ecosystems, including ecosystem life support functions, such as the regulation of the most important natural cycles (e.g. water and carbon) and primary ecosystem processes, such as photosynthesis and biogeochemical cycling. While not synonymous with resilience of an ecosystem, functional diversity is key to ensuring such resilience. Unfortunately, a system's functional robustness is still generally poorly

[1] For an analysis of this relationship for various types of ecosystems, see Review on the Economics of Biodiversity Loss: Scoping the Science, Balmford, Rodrigues, et al., 2008 (study made for DG Environment of the European Commission in the context of TEEB Phase I).

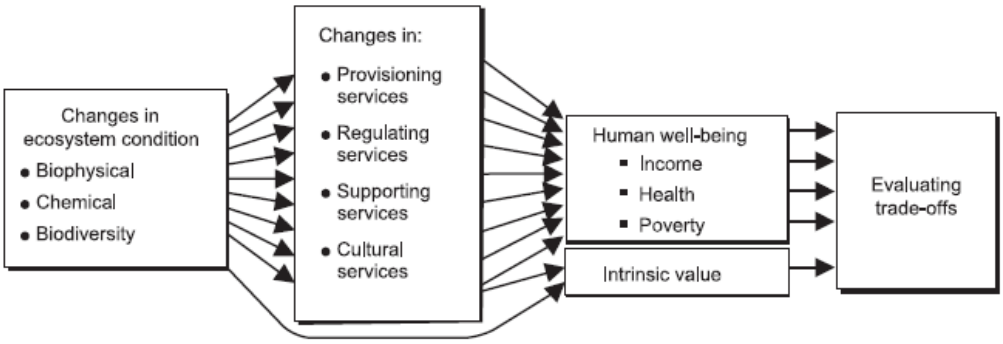
understood and we often do not know the critical functional thresholds associated with the variety of environmental conditions at different temporal and spatial scales. From a management point of view, in most cases a safe strategy seems to be to require a minimum level of biodiversity for any ecosystem to be sustained. A low level of ecosystem resilience can cause a sudden decrease in biological productivity, which in turn can lead to an irreversible loss of functions for both current and future generations.

2.2 Ecosystem services-based approach

The Millennium Ecosystem Assessment (MA, 2005) has fundamentally changed the way that scientists are thinking about the value of biodiversity. In that assessment biodiversity is valued through its impact on the different ecosystems' ability to provide services. In turn, ecosystem services play a crucial role in offering a wide range of benefits, and are therefore important steering forces of human well-being. The MA distinguishes four broad categories of benefit: provisioning services, cultural services, regulating services and supporting services – see Figure 1[2].

Figure 1 – Mapping the links between biodiversity, ecosystem services and human wellbeing

[2] Although the prevailing orthodoxy now is to give ecosystem services centre stage and to view biodiversity as valuable when it enhances those services, one should note that not all scientists agree with this perspective. Indeed there is increasing scientific evidence that biodiversity has a more central role and in fact underpins the supply of ecosystem services, even though the issue remains controversial (Balnavera, P. et al., 2006). Positive biodiversity effects have been found on the productivity of many ecosystems – which are crucial to the provision of many services such as food or wood – and on their resilience, e.g. their capacity to respond to disturbances in a constructive way.



A paper by Barbier et al (2007)[3] addresses the value of ecosystems and ecosystem services, as the basis for understanding the value of the biodiversity that underpins those services. It reviews the state of the art on the valuation of different types of ecosystem service, and ways in which the value of ecosystems may be changing relative to the value of other capital stocks. The valuation of ecosystem services makes it possible to identify the opportunity cost of using biodiversity in particular ways. Valuation provides a means of testing the environmental sustainability of anthropogenic activity, i.e. whether human activities are leading to a reduction in the value of ecosystems. Farber et al. (2006) also argue that ecosystem management options should be evaluated by coupling service change assessments with valuations of these changes. More recently, Nunes et al. (2008) explore and apply the potential of this framework to the European context so as to value the impact of climate change on biodiversity, and human well-being, taking into account the different ecosystem types, and respective ecosystem services.

3. Loss of Biodiversity

At the global level, the MA analysis of ecosystem services revealed that 60 percent of all Earth's ecosystems are degraded. The RSPB, in their submission, believe that the degradation of these services could grow significantly worse during the first half of this century and is a barrier to reducing global poverty and achieving the eight Millennium Development goals. It is the poor, who have few alternatives, who suffer most when such 'free' services are lost or degraded. The submissions made to the call identified several areas where the loss of biodiversity and of biological

[3] See Annex I for a brief overview of the papers submitted to the Call.

services was important or even critical. Table 1 lists the main contributions that were received on this topic.

Table 1: Submissions to the call for evidence of the loss of biodiversity and of biological services

Submission By	Service	Region	Comment
Hoppichler	Biological resources in alpine and mountain regions	Austria	Information used as basis for public intervention and strategic discussions (NQ)
Smale and King	Plant and livestock genetic resources	Worldwide	ECOGENLit (NQ)
Wright	Loss of trees in Canadian forests	Canada	Beetle pest (Q)
Gast	Natural ecosystems	Columbia	Land cover change, disease incident, coffee production and crop protection measures (Q)
Gast	Deforestation	Columbia	Causes and patterns of deforestation and ecosystem fragmentation (Q)
Bearzi	Dolphins	Mediterranean	Historic population of Mediterranean common dolphins in decline (NQ)
Graham	Biodiversity loss caused by agriculture	UK	Importance agro-environmental schemes to conservation of biodiversity (NQ)
Ninan	Endangered species in Western Ghats, one the eight hottest biodiversity hotspots in the world	India	Time series analysis (1993-2002) of endangered species such as tigers, elephants and leopards (Q)

Table 1: Submissions on the loss of biodiversity and of biological services (cont.)

Submission By	Service	Region	Comment
Natural England	Biological species and habitats	UK and England	Biodiversity Indicators and action plans (1995-1999) (Q)
Pan-European Common Bird Monitoring Scheme (PECBMS)	Losses of European birds species	EU/Europe	EBCC/BirdLife (1980-2005) (Q)
Thomas	Species extinctions due to Climate Change	Worldwide	Projection of species' distributions for future climate scenarios by 2050 (Q)
Van Beukering	One-horned rhinoceros in Terai region of Nepal	Nepal	The declined population of one-horned rhinoceros due to poaching and the loss of habitat (NQ).
Costanza	Fynbos ecosystem, a global centre of floral diversity	South Africa	Threatened mountain Fynbos ecosystem due to invasive alien plant species (NQ)
Keith Brander	Loss of genetic diversity of fish stocks due to fisheries-induced evolution	Denmark	Adopting Evolutionary Impact Assessment will support the sustainable harvesting (NQ)
Worm	Accelerating loss of populations and species in marine ecosystem	Worldwide	Marine biodiversity loss is increasingly impairing the ocean's capacity to provide food, maintain water quality, and recover from perturbations (NQ).
Balvanera	Ecosystem functioning and services	Worldwide	Meta-analysis of the effect of biodiversity on ecosystem functioning and services (Q)
Sniffer	Loss of biodiversity due to fragmentation	UK	Benefits of constructing ecological networks in urban areas (NQ)
Bernard E. Vaisière	Loss of crop diversity due to less natural pollination	Worldwide	Agricultural intensification jeopardises wild bee communities and their stabilising effect on pollination services (Q).
Anil Kumar	Disrupted ecological services and loss of biodiversity due to the decreasing of rice crops.	India	Effect of converting rice field to other land uses (Q)
Natural England	Loss of upland blanket peat and coastal and inter-tidal habitats	UK	These habitats have important biodiversity value (NQ)

Table 1: Submissions on the loss of biodiversity and of biological services (cont.)

Submission By	Service	Region	Comment
WWF	Reduced biodiversity in the cork oak forest ecosystem	Western Mediterranean region	Key examples of threatened species found in the Mediterranean cork oak landscapes: Iberian Lynx, Iberian Imperial Eagle, Barbary Deer, Black Vulture, Black Stork (Q)
Farooquee	Loss of agro-biodiversity in Indian Central Himalaya.	India	New crops pose threats to traditional crop diversity of high altitude regions (NQ).

(Q): Quantified
(NQ): Not quantified

As we can see from Table 1, human activities have led to a significant reduction of biodiversity. The main points that should be noted are the following:

i. Several significant cases of biodiversity loss have been registered in national, regional and worldwide spheres;

ii. Not all the submissions provided a quantification of the loss involved;

iii. Most of the studies considered refer to species diversity and landscape diversity, occurring in areas ranging from Europe to Latin America and Asia;

iv. Forests are the ecosystem type examined most frequently in this assessment of studies on biodiversity loss.

A closer look at one of submissions - about biological resources in the Austrian alpine and mountain regions - shows that the lower mountain slopes and valley bottoms of the Austrian Alps have been completely cleared of forests since the Middle Ages. Human activities have led to a reduction of the total share of forests in the last century by approximately 30 percent, an increase on the 20-25 percent that was registered in the 18th/19th centuries. At the same time the composition of tree species has changed significantly, showing an enormous increase in the percentage of Norway spruce, and also of Scots pine and European larch, while the numbers of Common beech and other deciduous tree species including the Silver fir have declined. The report states that in traditional meadows and pastures the number of plant species varies between 30 and 60 whereas there are often no more than 5 species in levelled, intensively farmed grassland. Finally, the

function of biodiversity to provide protection against natural disasters is of great general and economic importance to tourist centres and their facilities located in the high Alps as well as the tourist infrastructure provided by traditional agriculture and forestry. Apart from the natural danger created by flooding, ever-present in some areas of the river network, in addition there are also man-made flood risks resulting from the construction of inappropriate ski-runs and roads as well as inadequate agriculture and forestry.

4. Alternative perspectives on biodiversity value

In this section we present the framework that is used most often for the valuation of biodiversity and ecological services. As we will see there is no broad consensus on the underlying concepts. Often differences between scientists and economists derive from disagreements about these concepts. Hence it is important to be clear about the literary basis for the economic approach to biodiversity loss.

Given the four levels of diversity, it should be evident that there is no single notion of biodiversity. In addition, this section presents other considerations, which suggest that biodiversity value can be interpreted in various ways (see Nunes and van den Bergh, 2001):

(1) *Instrumental* vs. *intrinsic valuation*. Many people, including various biologists and other natural scientists, do not feel comfortable with placing an instrumental value on biodiversity. The common argument is that biodiversity has value on its own, without being used by humans – also known as intrinsic value. A more extreme version of this perspective even claims that that instrumental valuation of biodiversity, often translated in monetary terms, is a nonsense exercise. Many people, however, do accept the attribution of a monetary value to biodiversity arguing that, like any other environmental good or service, it is an outcome of an anthropocentric, instrumental point of view, bearing in mind the benefits of biodiversity for humans in terms of its production and consumption opportunities. Two specific motivations are as follows. First, making public or private decisions that affect biodiversity implicitly means attaching a value to it. Second, monetary valuation can be considered as a democratic approach to decide about public issues. Finally, some subscribe an intermediate attitude by arguing that the monetization of biodiversity benefits is possible, but that it will always lead to an under-estimation of the 'real' value since 'primary value'

of biodiversity cannot be translated in monetary terms. As Gowdy recently said "… although values of environmental services may be used to justify biodiversity protection measures, it must be stressed that that value constitutes a small portion of the total biodiversity value…".

(2) *Monetary* vs. *physical indicators*. Monetary valuation of biodiversity is anchored in an economic perspective, based on biological indicators of the impacts of biodiversity on human welfare. The economic value of biodiversity can be traced to two important sources. First, biodiversity can serve as an input into the production of market goods. Second, biodiversity can be interpreted as a direct contributor to individual utility or wellbeing: for example, the human pleasure derived from experiencing nature. Economic valuation of biodiversity is based on using monetary indicators, interpreted by economists as a common platform for comparing and ranking alternative biodiversity management policies. On the other hand, physical assessments of biodiversity value are based on non-monetary indicators. These include, for example, species and ecosystems richness indices, which have served as important valuation tools in the definition of "Red Data Books" and "Sites of Special Interest". It is not guaranteed, however, that monetary and physical indicators point always in the same direction. In this sense, they should best be regarded as complementary methods for assessing biodiversity changes. In some cases monetary values can be given to these physical indicators, bringing together the two approaches.

(3) *Direct* vs. *indirect values*. The notion of biodiversity's direct value is sometimes used to refer to the use of biodiversity by humans for production and consumption. The term 'indirect value' was recently proposed by Barbier (1994) in relation to biodiversity and described as "… support and protection provided to economic activity by regulatory environmental services…". In the literature one can also find other terms, such as 'contributory value', 'primary value', and 'infrastructure value' of biodiversity, that refer to the same notion (Costanza *et al.*'s contribution to the Call for Evidence provides such a classification).

(4) *Biodiversity* vs. *biological resources*. Whereas biodiversity refers to the variety of life, at whatever level, the term *biological resources* refers to the manifestation of that variety. According to David Pearce (1999), "… much of the literature on the economic valuation of 'biodiversity' is actually about the value of biological resources and it is linked only tenuously to the value of diversity…". The precise distinction is not always clear, and the two categories seem to be at least overlapping. In this Call for Evidence the submissions use both concepts when discussing the issues.

(5) *Genetic* vs. *other life organization levels*. Scientists face an important decision when valuing biodiversity: which level of diversity is under consideration. Some scientists, especially from the natural sciences domain, tend to focus on genetic and species levels, whereas others, including social scientists, tend to study species and ecosystems levels. Naturally, such a decision is crucial for the assessment of biodiversity value since it anchors the choice of the most appropriated indicators, cornerstone of any valuation study of biodiversity. Again the submissions refer to different levels of biodiversity, although it is probably the case that the ecosystem level is the most frequently used.

(6) *Levels vs. changes of biodiversity.* Much of the work done to provide monetary values of biodiversity is structured in terms of levels – measuring the consequences of the loss of a whole set of ecosystem services or a type of diversity in a given location. While interesting, it is less useful as a guide to policy than values provided for small or medium sized changes in biodiversity. These are more frequently experienced and can be avoided by taking appropriate action. At the most general level one can argue that the world's biodiversity is of infinite value because without it no economic activity would be possible. (e.g. Costanza *et al.* 1998). While true, such a statement has little significance to policy-makers.

(7) *Holistic* vs. *reductionist approaches*. According to a holistic perspective, biodiversity is an abstract notion, linked to the integrity, stability and resilience of complex systems, and thus difficult to disentangle and measure. In addition, the insufficient knowledge and understanding of the human and economic significance of almost every form of life diversity further complicates the translation of physical indicators of biodiversity into monetary values. For these reasons, economic valuation of biodiversity is regarded as a hopeless task by many scientists (Ehrenfeld 1988). The paradigm used in the economics literature takes a different view – a reductionist perspective – in which one is assumed to be able to disentangle, or separate the total value of biodiversity into different economic value categories, notably into use and passive use or nonuse values (Pearce and Moran 1993).

(8) *Expert* vs. *general public assessments*. Economic valuation starts from the premise that social values should be based on individual values. Therefore, when deciding for a general public valuation context, it is agreed that all individuals, from every educational level and with all types of life experiences, should be are involved in the valuation exercise. Such a valuation process benefits from clear and legitimate democratic support. Another view assumes that laypersons cannot judge the relevance and complexity of biodiversity-ecosystems-functions relationships. Instead, judgments and evaluation of biodiversity changes in this view should be left to experts, notably

biologists. An example of an intermediate 'solution' is to use experts to inform laypersons sufficiently before confronting them with special economic valuation tools. The submissions that were received and assessed represent both views.

From the above nine considerations it is clear that many different biodiversity value perspectives can be distinguished This means that different opinions about biodiversity value may in fact be based on different perspectives. This does not mean that one is right and the other is wrong. Evidently however, it is crucial to understand the underlying perspective. The next section will clarify this point for the subsequent evaluation of empirical valuation studies.

5. Biodiversity as a source of economic value

The general features for economic valuation of biodiversity will be characterized with reference to the set of perspectives presented in the previous Section. First, economic valuation of biodiversity is based on an instrumental perspective of the value of biodiversity. This means that the value of biodiversity is anchored in a human perspective interpreted as the result of an interaction between who attaches value, humans, and the object of valuation, biodiversity goods and services flows. In other words, an economic valuation subscribes to an anthropocentric value orientation (see point (1)).

Second, humans elicit biodiversity value in terms of the benefits obtained from using, experiencing, and consuming biodiversity goods and services. In general terms, the value of biodiversity can be assessed in terms of its impact on the provision of inputs to production processes, in terms of its direct impact on human welfare, as well as in terms of its impact on the regulation of the nature-ecosystem-ecological functions relationships (see point (3)).

Third, we must recognize that most of the economic valuation studies lack a clear and uniform perspective on biodiversity as a distinct, unequivocal concept and most of the time the studies end up valuing changes in biological resources levels (see point (4)).

Fourth, while explicit biodiversity change is defined according to the level of diversity being considered, the economic valuation is frequently based on the species and ecosystems levels of diversity (see point (5)).

Fifth, the economic valuation of biodiversity is most frequently pursued through explicit biodiversity changes, which are marginal or small (see point (6)). There are, however, some cases in which large changes in different levels of biodiversity have been measured.

Sixth, economic valuation of biodiversity changes is based on a reductionist approach since it is stands on the idea that one is capable of disentangling the total economic value of biodiversity into two basic values - use and non-use – which reflect different human motivations (see point (7)).

Finally, the economic valuation of biodiversity results in a monetary indicator that sits alongside physical indicators. It has a strong appeal because it can be easily fitted to benefit-cost-analysis, a fundamental tool for the design of effective and broadly accepted biodiversity management policies. One should not take that, however, to imply that only monetary indicators are relevant. In some cases policies can be made to achieve physical targets at least cost and in others to value physical targets that can then be set as policy goals (see Cost Effectiveness Analysis in Section 6 below). Thus there are important relationships between the monetary and physical targets.

6. A classification of biodiversity benefits

6.1 Total Economic Value

Ecosystem services can affect the welfare of many people, even those living far away from the site concerned. In other words, people may derive satisfaction from knowing that there is an improvement in biodiversity for present and future generations, even if they would not benefit from it directly. Therefore, the relevant population is often not local, but global. These welfare gains are usually known as passive or non-use values. The consideration of both *use* and *non-use values* introduces the notion of *total economic value*[4]. Table 2 gives a widely-accepted classification of the

[4] A frequently-asked question concerns how TEV is related to the notion of *intrinsic value. Intrinsic value* is often regarded as a value that resides in the assets in question, especially in environmental assets, but that is independent from

economic values of biodiversity. *Total economic value* (TEV) is made up of the *use value* and *non-use value:*

- *use value* is a value related to the present or future use of a particular habitat by individuals. It can be subdivided into *direct use values and indirect use values. Direct use values* are derived from the actual use of a resource either in a consumptive way or a non-consumptive way (e.g. timber in forests, recreation, fishing); *indirect use values* refer to the benefits derived from ecosystem functions (e.g. watershed protection or carbon sequestration by forests);
- *non-use values* are associated with the benefits derived simply from the knowledge that a natural resource - such as a species or habitat - is maintained. By definition, such a value is not associated with the use of the resource or the tangible benefits deriving from its use. It can be subdivided into two parts that overlap according to its definition. First, there are *existence values*, which are not connected to the real or potential use of the good, but reflect a value that is inherent in the fact that it will continue to exist independently from any possible present or future use of individuals. Secondly, *bequest values* are associated with the benefits of the individuals derived from the awareness that future generations may benefit from the use of the resource. These can be *altruistic values,* when the resource in question should in principle be available to other individuals in the current generation.

Table 2: Classification of the Values of Ecosystems (Total Economic Value)

Use Values			Non-Use Values	
Direct Use Value	Indirect Use Value	Option Value	Bequest Value	Existence Value
Examples: Recreational use of parks, forests. Grazing Agriculture Fishery Gene Harvesting	Habitat provision Nutrient and soil retention Regulation of water quality and quantity	Future visits to sites of interest Future access to genetic material	Conservation of habitat for future generations.	Knowledge of the existence of marine biodiversity

A separate category is made up by *option values,* which are values attributed by individuals given the knowledge that a resource will be available for future use. Thus it can be considered like an assurance that a resource will be able to supply benefits in the future. The *quasi-option value,* which is sometimes classified as a non-use value, represents the value derived from the preservation of the future potential use of the resource, given some expectation of an increase in knowledge. The *quasi-*

human preferences. Since by definition TEV relates to the preferences of individual human beings, it cannot encompass an intrinsic value.

option value is important when the decisions on consumption are characterized by a high reversibility.

The concept of TEV is widely used in biodiversity economics but it is not free of significant criticism and a number of scientists have questioned its ability to capture actual values of natural resources and have proposed other value categories. One such category is called *inherent value* (Farnworth, 1981), defined as "values that support other values" in ecological systems. It includes natural processes of selection and evolution and the life support functions of ecosystems in an all-encompassing perspective.

Another category is the *contributory value*, which focuses on the fact that species can only survive in interactive relationships and therefore each species contributes to the survival of other species (Norton, 1986). Wood (1977) illustrates the importance of the contributory value in the example of the productive use of the wild species for the preservation of the resistance of cultivated plants. Because of their limited genetic diversity, cultivated plants can only perform minor adaptations to changes in environmental conditions. Wild species on the other hand possess higher adaptability to environmental conditions because of their higher genetic diversity. Thus, by crossbreeding with wild species we can preserve or improve the resistance of cultivated plants against disease or pests.

Finally, some scholars have stressed the importance of psychological values in determining the wellbeing that can be gained from different ecosystems (Nunes et al., 2004). While ecological values are meant to determine the well functioning of a system, psychological values are used to determine the perceived quality or the perception of nature. As such, differences between ecological and psychological values pertain to what is being valued: the quality of the system or how the system is perceived.

All three categories of value have some validity but none has really been developed into a tool that can be used to measure ecosystem values in a practical way. Moreover, it can be argued that much of what is intended is in fact captured through TEV under non-use values and indirect use values. Since TEV seeks to elicit social preferences it can be said to encompass psychological values and indeed, as Nijkamp et al (2006) note, psychological value is strongly correlated with the total economic value, because both measure social preferences.

6.2 Methods for Eliciting Components of Total Economic Value

The monetary valuation of biodiversity can proceed in different ways: using market price information or eliciting consumer's preferences through a wide range of non-market valuation methods.

Using Market Data

Market prices and costs can provide estimates of the increase in the value of commercial activities, such as timber extraction fishing etc., the value of revenues from tourism activities related to visits to natural areas and the value of contracts signed by firms and governmental agencies, also known as bioprospecting contracts. Arguably many important valuations of ecosystem services have been carried out using market data and many of the submissions to the call were examples of market-based values. In many cases, however, ecosystem services do not affect markets and market data are not available to value them. In such cases methods have been developed to derive consumers' preferences. They are divided broadly into two categories – revealed preference methods and stated preference methods.

Non-market methods: Revealed Preference

Revealed preferences techniques seek to elicit preferences from actual, observed market-based information that is indirectly linked to the ecosystem service in question. Preferences for environmental goods are usually revealed indirectly, when an individual purchases a market good to which the environmental good is related in some way. They are all indirect, because the service in question is not itself traded. The techniques included in this group are the travel cost method, the hedonic price and wage techniques and adverting behaviour. These techniques only capture use values, leaving non-use values out of consideration.

In the travel cost method researchers estimate the economic value of recreational sites by looking at the generalized travel costs of visiting these sites (Bockstael et al., 1991). The valuation is then based on deriving a demand curve for the site in question, through the use of various economic and statistical models. Where the individual makes a choice involving more than one site, the discrete choice models have used the random utility theory framework to value not only visits to different sites but also the attributes of sites, such as water quality. The travel cost techniques has been

widely applied, especially in North America, where Parsons[5] has assembled a list of over 120 such studies.

Another technique is the hedonic price method, which estimates the economic value of an environmental commodity, say, clean air or an attractive view, by studying the relation between that attribute and house prices (Palmquist, 1991). Hedonic price estimation has been applied to elicit environmental/ecosystem values associated with recreation, landscape values and genetic and species diversity. Hedonic techniques are particularly employed in valuing visual amenity, quality of soil assets and exposure to air pollution.

The averting behaviour method is characterized by representing the environmental choice through a 'cost function' for a service of interest (Cropper and Freeman, 1991). For instance, improvement of air quality can be assessed on the basis of savings in expenditures that were being undertaken to avert or mitigate the adverse effects of air pollution. Avoided cost damage costs, preventive expenditures, repair costs (or restoration), compensation costs, replacement costs, and relocation costs are specific instances of this method.

Finally, the production factor method estimates the economic value of an environmental commodity through an 'impact-pathway' approach, in which a change in the environmental attribute is linked to impacts on 'endpoints' that are relevant for human wellbeing. For example the benefits of tree planting via reduced erosion are measured first by the link between soil cover and erosion rates and then by the link between erosion rates and agricultural productivity. Such methods can be very useful to value many services provided by ecosystems, including forestry (timber and non-timber), agriculture (value of diversity in crops and use of genetic material) and marine systems (losses from overfishing, species invasion).

Perhaps the most successful application of the production function approach has been in valuing damages from air pollution, where the pathway is from emissions via concentrations to impacts on health, buildings and agriculture. It is more difficult, however, to apply the same method to value

[5] http://www.aere.org/resources/parsons.pdf, accessed November 22, 2007.

air pollution damages to ecosystems, primarily because the scientific links from concentrations to damages are not well understood. This issue was recently reviewed by the Commission whose conclusion was that more research is needed on 'ecological response assessment', which involves establishing a linkage between changes in ecosystems and exposure to air pollution. At present decisions on how much to protect ecosystems from air and water pollution is based on 'critical' loads, which determine the maximum concentrations of pollutants that can be tolerated in a system without causing significant damage. (Ecolas, 2007).

Non-market methods: stated preferences techniques

SP techniques are based on the simulation of the market through a questionnaire given to a sample of the affected population. In simulated market conditions, the supply side is represented by the interviewer, who typically offers to provide a certain amount of units of the good at a given price. The respondent, who either accepts or rejects the offer, represents the demand side. One of the most crucial issues in this kind of method is to be precise in the description of the market, and yet simple and clear enough for people to understand it. This is important, because biological and landscape diversity are among those goods for which it is difficult to simulate a clear, credible, precise and understandable market in a poll process.

The best-known SP method is contingent valuation (CV) (Mitchell and Carson, 1989), where individuals state their willingness to pay for a good or their willingness to accept payment for something that is taken away from them. CV or similar methods (see below) are currently among the most used techniques for the valuation of environmental goods. One important reason for this is because only SP methods like CV can elicit the monetary valuation of the non-use values, which typically leave no 'behavioural market trace'. Furthermore CV allows environmental changes to be valued even if they have not yet occurred (i.e., ex ante valuation). It allows the specification of hypothetical policy scenarios or states of nature that lie outside the current or past institutional arrangements or levels of provision. Finally CV allows one to enrich the information base by submitting the process of value formation to public discussion. Against this is the criticism that the values are hypothetical (payments are not actually made or cash paid out) and that the method is subject to many biases. Over the last decade and a half[6], however, there has been greater agreement

[6] After the NOAA Panel - in the wake of the Exxon Valdez disaster - reviewed the methodologies for CV studies and recommended good practice guidelines (Arrow et al. 1993)

on what constitutes a credible CV study, what protocols have to be carried out to meet the good practice standard and what tests for biases need to be conducted. It is fair to say that many of the studies that value different ecosystem services, carried out in that period, would meet these protocols.

Other tools similar to CV have now been developed and form part of the toolkit of stated preference techniques. These include conjoint choice or choice experiments (CE), where information on values is obtained by asking individuals to choose between alternatives; conjoint ranking, where individuals rank alternatives in order of preference and conjoint rating, which indicates their strength of preference on a cardinal scale. Conjoint choice is the most used of the three in environmental valuation, and the relative merits of this against contingent valuation are much discussed in the literature. The primary difference between CE and CV is that the former involves trade-off among choices, while in the latter respondents express their WTP based on a proposed environmental change. The use of substitute goods is more pronounced in the CE than the CV method because the multiple levels of attributes per choice offer various alternatives. (Alberini et al, 2005). Presently a number of economists are tending to favour CE as a method of elicitation on the grounds that marginal values of goods and services are easier to measure, it is more informative as it offers individuals multiple choices, it reduces response problems and some biases associated with CV and it is relatively less expensive to conduct (Hanley et al. 2001; Louveire et al, 2000).

In spite of the progress made in the use of stated preference methods there remains some doubt as to the validity of the results, which are considered to give too high values. This has been addressed in a number of studies that have used both revealed preference and stated preference methods to elicit the values associated with environmental goods. Carson et al. (1996) compared stated and revealed preference estimates from 83 studies conducted from 1966 to 1994. In general, they found that CVM estimates are lower than their revealed preference counterparts. In particular, the CVM estimates are about 30 percent lower than the estimates from multi-site travel cost models. Recent studies that have addressed this issue covered fisheries (Whitehead, 2006), water (Urama and Hodge, 2006; Hanley et al., 2003), recreation (Earnhart, 2004; Park et al, 2002), forestry (Adamowicz et al, 2004), animal husbandry (Scarpa et al, 2001) and cultural artefacts (Boxall et al, 2003). By and large the two methods yield consistent estimates with SP based values not out of line with RP values (a 30% difference is within the bounds of uncertainty for such studies). This should

provide some comfort to those who believe SP methods yield exaggerated and unreliable results (See also Markandya and Richardson, 1992).

7. Tools to Evaluate Biodiversity Targets and Policies

7.1 Cost Effectiveness Analysis

From the Call for Evidence it emerges that, in order to evaluate policy actions, two methods of assessment are available: Cost Effectiveness and Benefit Cost Analysis. The easier of the two is cost effectiveness analysis, in which different actions are evaluated in terms of the cost per unit of improvement in one or a set of indicators. Measures are then ranked in terms of cost per unit of indicator value achieved[7]. Recent work in the US has shown that many ecosystem conservation policies can achieve the same improvements at very different costs. A US study has shown for example that one can achieve the same level of protection for species at ⅓ to ½ of the costs that would be incurred if one based the selection of sites on biological richness alone (Ando et al., 1998). Along a similar vein Csuti and others have shown how it is possible to derive an 'efficiency frontier' which identifies the maximum number of species that can be sustained in a region (e.g. the Willamette Basin watershed in the US) for a given financial outlay (Csuti et al., 1997). This expenditure is used to define land use for different parcels of land, usually in a way that differs from present or planned use. In the same line of reasoning, Meyers and Russell (2000) attempt to address the issue of how can we support the most species at the least cost by exploring the concept of "hotspots". According to the authors, as many as 44% of all species of vascular plants and 35% of all species in four vertebrate groups are confined to 25 hotspots comprising only 1.4% of the land surface of the Earth. This opens the way for a "silver bullet" strategy on the part of conservation planners, focusing on these hotspots in proportion to their share of the world's species at risk.

For the EU, Ecologic (2006), quotes evidence to suggest that it pays to implement targeted measures rather than spread the funds evenly over a geographical area. An investigation from Whitby and Saunders cited in the Call for Evidence shows that the potential savings associated with spatially differentiated measures can outweigh the higher transaction costs. They compared two

[7] Complications arise when the measures address more than one indicator, in which case a weighted average of the indicators has to be used to determine cost-effectiveness. The issue of course is in determining the weights. This can be done by expert agreement or public consultation, as is the case for multi-criteria analysis.

payment schemes in England. In Environmentally Sensitive Areas (ESAs), an equal amount of compensation is paid to all land-users for a defined conservation measure whereas for Sites of Specific Scientific Interest (SSSI), individual payments are negotiated with the land-users based on their costs. The strategy under the SSSI sites requires less public expenditure than the ESA procedure and achieves equal or better results.

Thus, while there is an awareness of the value of undertaking some cost-effectiveness analysis prior to designing policies, and some general assessments have been made of cost effectiveness, the tools that would help achieve such cost effectiveness have not been used extensively or systematically to determine land use allocations with respect to conservation objectives in the EU. There is, however, some ongoing effort in this area although not many results have been reported.

Some useful data is being collected on the cost side, which would be valuable for future cost-effectiveness studies. For example, the Call for Evidence presents a study by GHK Consulting (2006, 2007) that estimates the costs of delivering the UK Biodiversity Action Plan, for the UK Government. A detailed assessment of the costs of delivering species and habitat action plans in the UK estimated the total annual cost of delivery of the UK BAP at £677 million per annum (2005/06), increasing to £753 million per annum in 2010/11. The largest costs relate to the delivery of Habitat Action Plans, and actions for widespread species (such as farmland birds) at the landscape scale. The estimated costs significantly exceeded current and projected expenditure levels in the UK, estimated at £388 million in 2005/06 rising to £587 million in 2010/11. The major funding gap relates to actions at the landscape scale to reverse the declines of widespread species, especially through agri-environment schemes.

7.2 Benefit Cost Analysis

The other method of assessment available is benefit cost analysis, where the benefits of different measures that improve one or more of the indicators are measured in money terms and assessed against the costs. Described below are the main methods for estimating such benefits and how they have been applied to the valuation of eco-system services. A paper by Balmford et al. (2002) reviews five case studies that compare the values derived from ecosystems with those derived from conversion to alternative land uses. All five studies find that total economic values are lower under

conversion than under conservation (approximately 50 percent lower). The authors use this information, combined with the ecosystem values from Costanza and others (1997) and estimates of the rates of change in six biomes to estimate the net loss in value from ecosystem conversion. The authors conclude that for $50 billion a year we could protect natural services worth about $5 trillion a year. This means that the benefit-cost ratio of a globally effective network of terrestrial conservation areas would be 100:1.

Another paper submitted to the Call, by Spurgeon et al. (2005), reports on an assessment of the economic costs and benefits of the Scottish Natura 2000 sites commissioned by the Scottish Executive Environment and Rural Affairs Department (SEERAD). Current full conservation protection of all 300 N2K sites in Scotland has an overall benefit cost ratio (BCR) of around 7:1 over a 25-year period. This is based on annual benefits of £213 million and annual costs of £27 million. Around 99% of this benefit (£211 million per year) relates to non-use values, divided fairly equally between the Scottish public and visitors to Scotland. Only around £1.6 million (1%) of the benefits relate to use values (e.g. enjoyment from visiting the sites). The low estimates of visitor values are attributed to possible methodological biases, as well as genuine reasons such as low visitor numbers at many sites, the many substitute sites, and the weak link between conservation measures and visitor enjoyment at some sites. In addition to the quantified benefits, continued protection of the sites provides significant social, cultural, educational, research, environmental services and health values. These are not quantified, although part of these values is thought to be included in the use and non-use value estimates. Furthermore, there are additional intrinsic, non-anthropocentric values. The estimated marginal benefit cost ratio of N2K designation, over and above other conservation measures, is estimated at 12:1. The sites are also estimated to account for a total expenditures of £150 million in the Scottish economy, supporting incomes of £70 million and employment of 4,800 full time equivalent (FTE) jobs.

A series of case study sites are all found to have a positive benefit cost ratio and to provide positive economic impacts. The case studies demonstrate a distance decay function for public non-use WTP values for N2K sites. Provision of detailed information increased WTP values by 9%, suggesting that a public awareness campaign to provide information on N2K sites is likely to yield significant benefits, but also that other WTP surveys may overestimate environmental values where significant new information is provided to respondents as part of the survey. Differences in WTP by habitat were relatively small.

8. Application of the Valuation of Ecosystem Services

The reply to the Call presents a wide range of contributions that report the use of a wide range of economic valuation techniques to value biodiversity benefits. We classify the valuation estimates according to the nature of the biodiversity benefits being considered. Therefore, we refer to market and non-market biodiversity values. Against this background, we divide our comments between valuations based on market data and valuations based on the non-market methods of revealed and stated preference and refer wherever possible to positions taken on valuation by those who have made submissions to the Call.

8.1 Market biodiversity values and market-based valuation methods

The market-based methods attract little attention from environmental economists, perhaps because they are considered straightforward and do not pose interesting methodological challenges. They are, however, of considerable importance and a good part of the value of ecosystems is in fact represented by commercial and financial gains and losses. In turn such methods can be divided into two classes: those that estimate the value of the loss or gain of ecosystem services and those that estimate the costs of restoring the services in the case of loss. The first is a proper valuation relevant to decision-making in the framework of designing policies to improve services or prevent further deterioration. The second provides useful information but is not a damage valuation and clearly cannot be used to decide whether restoration is justified in the first place. Nevertheless such estimates are sometimes included in studies of the overall damages arising from pollution. They are sometimes referred to as the lower bound of the damage, but that is not correct unless it can be established that the damages are in fact greater than the restoration costs.

Table 3 shows the main market-based value studies submitted to the call. A further set of recent European market-based studies of biodiversity value and the value of ecological services not submitted to the call but of relevance to the report is presented in Box I. In addition we include in Table 4 submissions based on stated value approaches that estimate the value of various economic activities to biodiversity and of conservation more generally. A number of points should be noted about these:

i. Estimates of market values are partial and generally not comparable. Sometimes the figures are given as net income, sometimes as gross income. Some report gains in terms of employment or increased local economic activity, which are not necessarily economic benefits or at least not in full (that depends on what alternative employment opportunities exist and what alternative economic activities are possible). With the current state of the art, however, it is possible to carry out proper valuations based on economy-wide impacts of biodiversity loss or conservation and some studies have done that.

ii. In some cases estimates are based on the costs of restoring lost services. While useful, such estimates could be higher or lower than the market value that is lost. Indeed one of the purposes of valuing loss of biodiversity is to see if replacement or restoration is justified. Using the latter as a measure of value does not allow you to answer that question.

iii. Underlying the market-based approach are scientific studies linking the estimated impacts on biodiversity to certain causes (e.g. the effect of pests on forests, of forests on air pollution etc.). We should recognize that there are still considerable uncertainties regarding these links, which should be reflected in the reported benefits.

iv. The majority of studies refer to marginal changes in local areas. At the same time there are a few that value the broad scale of services provided globally. The numbers from these latter studies are extremely large.

v. The purpose of many of the studies was to show that the services provided by nature are significant and either merit protection (where biodiversity is threatened) or merit expansion (where there is potential for that). Estimates of the 'opportunity cost' of land – i.e. what it would be worth if it were not conserved - are often much lower than the value of the biodiversity services provided if it was conserved.

Table 3: Submissions on the Market Value of Biodiversity and Biological Services

Submission By	Service	Region	Comment
S.M. Gautier	Forest ecosystems	Canada	Mountain Beetle
	Commercial harvest losses	US/Canada	Pest/Invasive species
Sanderson & Prendergast	Commercial use of wild plants	England	Valuation in terms of livelihoods supported.
Kälberer	Beech Trees (*)	Germany	Measures replacement cost
Worm et al.	Marine ecosystem (*)	Global	Measures restoration value
Conservation Int. William Marthy	Bird Keeping	Indonesia	Biodiversity losses traded against economic benefits.
RSPB UK	Employment, tourism, health, economy-wide	UK	Quantifies socio-economic benefits
Lilian Spijkerman	Forest land services	Brazil	Opportunity cost of agricultural development
Williams et al.	All ecosystem services	Scotland	Based on Costanza's et al. Methodology.
BirdLife/RSPB	Values of 'natural services'	Global	
Willis et al	Forest services	GB	Carbon and health benefits
LIFE Priolo Project	Value of the Priolo (Azorean Bullfinch)	Azores	Values in terms of tourism and associated benefits.
CLIBIO	Climate related losses in forest services	Europe	Ecosystem function loss valued using market data
Maryanne Grieg-Gran (IIED)	Hydrological functions of ecosystems	Various	Losses due to soil erosion
Hoppichler et al.	Alpine ecosystem services (**)	Austria	Tourism, replacement costs
Kälberer	Value of nature overall	Netherlands	Tourism, water management, nature itself
Bernstein	Forest values as a carbon store	Tropical	Relative to opportunity cost
Brotherton	Blanket peat as a carbon store	England	Other services also noted
English Nature	Salt marshes Hedgerows	England	Flood protection Fruits harvested Reed beds for thatch reed
Brotherton	Nutrient sinks in the Danube floodplains	Various	Based on benefit transfer
Graham	Forest services	UK	Health benefits of air pollution absorbed
Woodward & Wui	Wetlands	UK	Flood defence functions
Willis	Forest services	UK	Replacement and mitigation costs of water supply
Farber	Coastal wetlands	US	Values loss in terms of damages from storms
Ten Kate and Laird	Pharmaceutical services	Global	Net value of genetic material
Webber et al	Geodiversity	UK	Tourism value
Van den Hove and Moreau	Deep-sea life	Global	Total benefits of food production, oil and gas and nutrient recycling
Costanza et al.	17 ecosystem services across 16 Biomes	Global	Total values assuming all is lost.
Daan Wensing	Values of landscapes through auctions	Netherlands	Ooijpolder nature area landscapes were 'sold'

(*) Indicates valuations are in terms of physical replacement units or changes in productivity.
(**) Also includes some non-market valuations

Box I: European Studies of Ecosystem Service Value Based on Market Data

A recent study (Kettunen and ten Brink, 2006) has provided a number of case studies based on market valuation of services lost due to a resource being misused in various ways or to external pressures.

1. In the coastal waters of several European countries there is a notable loss of crayfish populations (*A Pallipes, A. Astacus, A. Torrentium*) because of pollution, habitat loss, overfishing and the introduction of alien species (mainly N. American). Services lost include food (domestic varieties fetch twice the price of non-native varieties), regulating services (trophic effects on prey and predators), recreation and cultural services. Although estimates of the loss are not made, estimate of costs of restoration are. They indicate modest costs (around €225,000 per stream over 5 years in France) that would be well below the value of recovered crayfish populations.
2. In Germany and Romania the Danube has lost a number of ecosystem services due to dam construction. These include wetlands that have been permanently flooded, a reduction in biodiversity due to lost fauna (including populations of a number of fish species) and poorer water quality.. Estimates of the annual values of these services in market terms are around $16 million for the fisheries, $131 million for the increased cost of water treatment to obtain drinking water, and $16 million from the tourism services the wetland could provide.
3. In Greece, Lake Karla, which was a wetland site, has gradually been transformed as a result of human intervention that dates back to 1936 and is now drained agricultural land. Partial restoration is now under way at a cost of around €152 million. Estimates of the benefits, however, are not available, although the main services that will be restored have been identified – commercial fisheries and farming. Farmers are finding that current land use is unsustainable.
4. Overfishing in the North Sea is a major threat to its biodiversity and ecosystem health and stocks of a number of fish are now under stress. Estimates of the benefits of recovery plans that would increase populations are about €600 million a year. This excludes benefits from fish processing and recreational fisheries.
5. Peat bogs in the UK are being lost as a result of intensive livestock farming. The result is a loss of carbon sequestration services, potable water services and habitat for species. The additional costs of water treatment as a result of the loss are estimated at €1.8 to €3.6 million a year. Other benefits, including carbon sequestration or tourism have not been estimated.
6. Plantation of non-native monocultural forests (eucalyptus and pine) in Portugal has resulted in a loss of biodiversity and an increased risk of fire as these species are more fire prone compared to the oaks they substituted. Other services lost include soil protection, water provisioning, game, non-timber forest products, all of which are less well provided in monocultural forests of this type. The cost of fires alone in 2001 was €137 million, although we do not know how much of this was due to the expansion of monocultural afforestation. The annual value of forest ecosystem services is estimated at €1.33 billion.
7. Eutrophication of coastal marine ecosystems in Sweden is well known and studied. Services lost as a result of eutrophication include provisioning for commercial fishery species and reduced efficiency in regulating services such as cycling and depositing nutrients. In addition there is a loss of cultural services, notably recreation. The value of the loss of regulating services is estimated at €6-€52 million a year for the Stockholm archipelago (for a one meter improvement in summer *secci* depth (depth to which water can be seen with the naked eye)) while the value of provisioning services is estimated at €6-€8 million a year for the Kattegat and Skagerrak fishery areas. This is based on a reduction in the output of *plaice* juveniles as a result of eutrophication. Finally the loss of cultural services is based on the costs of removing algae, which is estimated at €7,000 for the Swedish West Coast.
8. The Osprey is a highly valued bird that experienced a sharp decline in the UK in the 19th century. The restoration that has taken place since the 1950s has generated benefits of €4.8 million to the local economies in Scotland in the areas where the birds nest.
9. Clam fishing in the lagoon of Venice, Italy is a highly profitable activity but it is currently carried out using a technology (vibrating rake) that damages the resilience of the ecosystem. If the present system continues yields will decline rapidly. A shift to a manual collecting system would result in a lower income for the fisherman immediately but would decline more slowly over time. Depending on the discount rate a fisheman may adopt the manual system. Alternatively the calculations show how much compensation we would have to give the fisherman to adopt the less damaging system.

Table 4 summarises the submissions made by stakeholders emphasising their contribution to biodiversity conservation in Europe. Most make their case in quantitative terms emphasising the value of their activities in terms of jobs and incomes in the conservation sector. It is important to recognize the importance of a range of economic activities to conservation. Quantitative estimates of these values are useful when deciding on support policies for those activities. However, it is also important to note that a full analysis needs to establish what would happen to the biological resources in the absence of the activities under consideration. This 'counterfactual' is not always defined or elaborated.

Table 4: Values and Impacts of Associated Activities on Biodiversity Conservation

Submission By	Region	Comment
British Association for Shooting & Conservation	UK	Claims that it aids conservation. (NQ)
National Farmers Union	UK	Examples of conservation value of farming. (NQ).
Swamninathan Research Foundation	India	Value of rice growing to biodiversity (Q)
European Cork Foundation WWF	Europe	Value of cork trees to industry (Q) and to ecological services (NQ)
Scottish Natural Heritage	Scotland	Values of protection and conservation activities to the economy especially in terms of jobs and incomes.
National Trust	Wales	
GFA RACE	England	
RSPB	UK	
Danby	UK	Expenditure by hunters on conservation (Q)
Graham	UK	Contribution of farming to landscape management (Q)

(Q): Quantified
(NQ): Not quantified.

8.2 Non-market biodiversity values and revealed preference valuation methods

There is a large body of empirical studies on the values attached to different ecosystem services. Nijkamp et al., 2008 list some 75 biodiversity studies that had been carried out in Europe from 1981 to 1997, and doubtless there have been many more since. The EVRI[8] database of environmental valuation studies using non-market methods had about 460 records for European studies in June of this year, with a heavy dominance of UK research (37 percent of the total). Just under half of the

[8] www.evri.ec.gc.ca/EVRI, accessed November 23 2007.

total Market-based methods were based on revealed preference (47%) and just over half were based on stated preference. Topics covered included: biodiversity loss, wildlife, national parks and nature reserves, water courses (non-fishing use), recreational fisheries, landscape, endangered species, wetlands, and woodlands.

The Call contains a small number of contributions that are empirical studies on the non-market biodiversity values exploring the use of revealed preference valuation methods. According to the nature of the studies received, we can distinguish two types of biodiversity values. The first type are values elicited using a travel cost model and are mainly associated to the recreational values provided by the conservation of areas rich in biodiversity, including natural parks, see Moons and others (2000) – see Table 5. The second type are biodiversity values elicited by the use of hedonic price models, see Garrod and Willis (1994) and Ruijgrok, (2004a) – see Table 5. In this context, the biodiversity benefits are estimated by assessing the impact of neighbourhood characteristics, including nature/biodiversity ones, on the housing price. For example, Garrod and Willis (2001) studied the value of a waterside location using property sale prices for Greater London and the Midlands over a five-year period (1985-1989). The estimations rendered for properties located on the waterside a premium of £2,689 for Greater London and £2,238 for the Midlands.

A number of points should be noted about these:

i. It requires good quality data on each transaction and information on how to map environmental quality onto the market demand functions.
ii. Multiple demand equation estimation is data demanding and may be difficult.
iii. Use values can only be elicited by these methods.

8.3 Non-market biodiversity values and stated preference valuation methods

The Call is, by far, most populated by stated preference valuation studies. This is in accordance to the EVRI database of environmental valuation studies – where more than half of the 2003 records refer to non-use or passive use values estimates, which are only possible to elicit using stated preference valuation studies – typically with the use of contingent valuation and stated choice

surveys. Christie and others (2006) note that there have been a lot of studies (mostly in the US using stated preference techniques) looking at valuing particular species – see Nunes and van den Bergh (2001). Valuations per species range from $5 to $126 per household per year and for multiple species from $18 to $194 per household per year. In the UK, Macmillan et al. (2002) looked at wild geese conservation in Scotland and White and others (1997, 2001), looked at four mammals – otters, water voles, red squirrels and brown hare. Macmillan and others (2001) look at the reintroduction of species (beaver and wolf) in the native forests of Scotland. They also note that there have been a range of studies on habitats – using either recreation/tourist value approaches or valuation using stated preference methods (e.g. CV). Work includes Garrod and Willis (1994), and Hanley and Craig (1991) on upland heaths in Scotland, and Macmillan and Duff on restoring pinewood forests in Scotland. Willis and others (2003) extend this work to examine public values for biodiversity across a range of UK woodland types. Other studies have assessed public WTP to prevent a decline in biodiversity. For example, Macmillan and others (1996) measure public WTP to prevent biodiversity loss associated with acid rain; while Pouta and others (2000) estimate the value of increasing biodiversity protection in Finland through implementing the Natura 2000 programme. White and others (1997, 2001) examine the influence of species characteristics on WTP. They conclude that charismatic and flagship species such as the otter attract significantly higher WTP values than less charismatic species such as the brown hare. For the remaining non-market biodiversity values that are estimated with the use of stated preference valuation methods, a number of points should be noted about these:

i. Topics covered included: wildlife, national parks and nature reserves, water courses (non-fishing use), recreational fisheries, landscape, endangered species, wetlands, and woodlands. The following question thus emerges: are we valuing environmental resources (including biological resources) in the name of biodiversity (the diversity of biological resources)?
ii. Overall, we find a heavy dominance of studies from the UK or parts of the UK (England, Wales, Scotland), with particular emphasis on significant countryside habitats, forested areas or charismatic and flagship species. Another emerging question: how reliably can we use these estimates for policy, especially when we use the value transfer methods to other sites and countries, which are not characterized by the same flag species?

The diversity of the object under valuation as well as the variety of the economic valuation methodologies does not allow for a direct comparison across the estimate values.

Table 5: Submissions on the Non-Market Value of Biodiversity and Biological Services

Submission By	Service	Region	Comment
M. Grieg-Gran	Various aspects of biodiversity values at local and global scales	Worldwide	Case1: carbon storage benefits of conserving forests in the Cardamom Mountains in Cambodia. Case 2: costs of hydropower developments due to increases in sedimentation in Costa Rica. Valuation methods are not specified
A.L. Notte	Total economic value of biodiversity	Italy	Valuation of biodiversity in Cansiglio forest and St. Erasmo area in terms of biodiversity zoning and spatial stratification. SP Method
T. Cerulus (study author: Moons and others)	Forest valuation	Belgium	Three categories of values considered: the recreational value, the non-use value and the indirect use value. RP, SP and Value Transfer methods are used.
T. Cerulus (Bogaert *et al*)	Valuation of the recreational, hatching and regulating services of nature and landscape as a result of a nature restoration project	Belgium	The study includes a cost-benefit analysis, a cost-effectiveness analysis and a financial analysis. Valuation methods like contingent hierarchy and benefit transfer are used.
T. Cerulus (Liekens *et al.*)	Valuation of Flemish public parks	Belgium	Recreational and aesthetic value of the parks RP and SP
D. Azqueta	Ecosystem services such as: biomass production, water provision, recreational services, residential amenity, prevention of soil erosion, waste treatment, carbon fixation, biological control of production, natural risk regulation, conservation of biodiversity	Spain	VANE project designs ad hoc methodologies and guidelines for the spatial representation of economic values. Analysis regarding aggregation and commensurability of results, treatment of inter-temporal valuations and loss of ecosystem services as a result of land-use changes
F. Watzold	Species protection	Germany	Cost-effective and ecologically effective compensation payments for species protection.
L. Spijkerman	Ecosystem services of protected natural areas	Worldwide	Valuing ecosystem goods and services provided by protected areas at various scales.

Table 5: Submissions on the Non-Market Value of Biodiversity and Biological Services (cont).

Submission By	Service	Region	Comment
L. Spijkerman (Study author: Chomitz *et al.*)	Atlantic forest land, biodiversity 'hotspot areas'	Brazil	Analysis of the opportunity costs for maintaining forest cover against pressure of agriculture conversion.
L. Spijkerman (Study author: Pattanayak and Wenland)	Ecosystem functions and services	Indonesia	Focus on the link between the conservation of biodiversity and the livelihoods of rural people living close-by the protected areas.
Christie *et al*	Changes in biodiversity in the UK countryside	UK	Recommending the use of contingent valuation method for the valuation of biodiversity programmes and the choice experiment method for biodiversity attributes. Benefit transfer method is not advocated.
RSPB	Ecosystem services provided by natural environment, including: life-support services, economic activity support, health and quality of human life, etc.	UK	Reversing wildlife declines and restoring degraded landscapes/ ecosystems will deliver significant benefits for society and the economy.
Defra	Ecosystem services	UK	Development of an introductory guide to valuing ecosystem services with an emphasis on the value of changes in the services provided by the natural environment.
Eftec	Ecosystem services	England and Wales	Development of guidance to value habitats within the context of flood and coastal erosion risk management projects and strategies, involving a full scale benefits transfer process.
	Ecosystem Goods and Services	Worldwide	A literature review of the economic, social and ecological value of ecosystem services in the context of global change and ecosystem degradation. Two case studies in Indonesia and Uganda.
Williams *et al.*	Scotland's ecosystem services and natural capital	Scotland	Costanza methodology

Table 5: Submissions on the Non-Market Value of Biodiversity and Biological Services (cont.)

Submission By	Service	Region	Comment
Murray and Simcox	Commercialized wild living resources in the UK	UK	The wild living resources include: the commercial fish species, the game animals, the marine mammals and birds, and hardwoods.
Baumgärtner	Biodiversity	Worldwide	Insurance value of biodiversity again the uncertain provision of ecosystem services. Natural resource modelling.
Quaas and Baumgärtner	Biodiversity	Worldwide	Conceptual ecological-economic model on biodiversity and insurance. Examples of coffee plantation and rainforest.
Baumgärtner and Quaas	Agro-biodiversity	Worldwide	External benefits of agro-ecosystem and agro-biodiversity by employing a conceptual ecological-economic model.
RSPB	Welfare benefits enhancement due to nature conservation	Worldwide	Nature conservation can help to enhance human health, contribute to economic development, etc.
RSPB	Wildlife protection related various welfare benefits	Worldwide	Nature conservation improves the quality of people's life in terms of sustaining and enhancing human health, offering education opportunities and contributing to sustainable communities and economic activities.
RSPB	Biodiversity	UK	Review the social benefits provided by biodiversity.
BirdLife International	Biodiversity	EU	Presenting 26 case studies of the contribution of wildlife to wellbeing in EU, covering the following countries: Spain, UK, England, Wales, Poland, Romania, Austria, Portugal, Scotland, France, Germany, Mediterranean, Turkey, Denmark, Belgium, Slovakia and Czech Rep.

Table 5: Submissions on the Non-Market Value of Biodiversity and Biological Services (cont.)

Submission By	Service	Region	Comment
BirdLife International	Biodiversity conservation	Worldwide	9 case studies regarding the role of nature conservation in improving livelihoods and fighting poverty in South Africa, Kenya, Uganda, Brazil, Burkina Faso, Ecuador and Peru, Jordan, Indonesia, and Cambodia.
National Trust	Economic impact of the natural environment in Wales	Wales	Contribution of the Welsh environment to the economic growth and quality of life in Wales.
GHK and GFA RACE	Economic impacts of England's natural environment	England	The study identifies the activities responsible for building and maintaining the stock of natural capital and activities that benefit from the quality of the natural environment.
GHK and S. Wilson	Marine environment in the UK	UK	Investigating the potential benefits for economic activities in the UK of a system of marine spatial planning.
Rayment & Dickie and RSPB	Impacts of nature conservation on local economies in the UK	UK	12 case studies regarding Nature conservation benefits to the rural economies.
Shiel, Rayment and Burton	Impact of RSPB nature reserves on local economies in the UK	UK	Covering tourism and direct employment.
Dickie	Economic impact of spectacular bird species in the UK	UK	Economic sector: wildlife tourism. Involves the following bird species: white-tailed eagles, ospreys, red kites, bee-eaters, choughs, peregrines, capercaillies, Montagu's harriers, hen harriers and seabirds.
Sanderson and Prendergast	The commercial uses of wild plants in England and Scotland	England and Scotland	Concerning two most important habitats for supporting livelihoods and activities in the area: woodlands and hedgerows, and wetlands.

Table 5: Submissions on the Non-Market Value of Biodiversity and Biological Services (cont.)

Submission By	Service	Region	Comment
Hanley *et al.*	Value of biodiversity in UK forests	UK	A review of studies on valuing biodiversity across all types of woodland in the UK. SP methods are used to estimate the WTP for various aspects of biodiversity value.
Willis *et al.*	The social and environmental benefits of forestry in Great Britain.	GB	Empirical estimates of marginal benefits of various social and environmental benefits and total value across forests and woodlands in Great Britain.
Beaumont	Services provided by marine biodiversity	UK	The report provides estimates of the annual economic value of a range of goods and services in the UK, including provision of food and raw materials, recreation, nutrient cycling, gas and climate regulation, disturbance prevention, cognitive values and non-use values. It includes two case studies: the North Sea and Skomer Island.
Van Beukering *et al.*	Valuing the environment in small islands	UK overseas territories in the Caribbean	The study provides guidance on how the value of the environment on small islands can be estimated and incorporated into planning and development decisions (EEWOC project). Economic valuation studies and monetary damage estimates are included.
Waliczky	Ecosystem functions	Turkey	Total economic value derived from the ecosystem functions in Tuz Gölü specially protected area in Turkey.
LIFE Priolo project	Economic benefits and impact of a conservation project	Priolo, Italy	RP method is performed, considering a range of ecosystem services like water quality, protection against landslides and floods, carbon sequestration, leisure and tourism, educational and scientific services, in addition to ecotourism.

Table 5: Submissions on the Non-Market Value of Biodiversity and Biological Services (cont.)

Submission By	Service	Region	Comment
Dickie	Economic benefits and impact of the LIFE Priolo project	Priolo, Italy	Ecosystem services are particularly important in helping to offset market costs. Significant services from the SPA relating to water resources, flood/landslide protection, carbon storage, conservation, educational, resilience and scientific services.
Asociación Guyra Paraguay and WWF	Conservation value of forests	Paraguay	Definition of the High Conservation Value forests (HCVs) method in Paraguay.
MacMillan *et al.*	Wild geese in Scotland	Scotland	Economic costs and benefits of wild geese in Scotland. RP methods is use to estimate total annual WTP for alternative goose management policies.
Carraro *et al.*	Economic benefits of biodiversity	EU	CLIBIO project aiming at assessing the economic impacts of climate change on biodiversity and human wellbeing. Its first year's report presents data for the total economic value of ecosystem goods and services produced by European forests.
Ruijgrok *et al*	Socio-economic valuation of nature, water, soil and landscape	The Netherlands	Providing an overview of physical interventions, ecosystem functions, changes in physical conditions and their socio-economic effects, as well as a valuation methodology to include economic ecosystem valuation in SCBA.

Table 5: Submissions on the Non-Market Value of Biodiversity and Biological Services (cont.)

Submission By	Service	Region	Comment
Ruijgrok *et al*	Socio-economic valuation of nature, water, soil and landscape	The Netherlands	Providing more than 400 values designed to calculate the welfare effects of changes in biodiversity and ecosystem functions.
Witteveen and Bos	Various aspects of the natural environment in the Netherlands	The Netherlands	Studies cover the value of cultural heritage (RP and SP), the existence value of natural river and canal banks (SP), the value of the effects of acidification measures on nature (SP), the benefits of water quality improvement (SCBA), various, economic evaluation of dike management, and the application of the Dutch national guideline for monetarising ecosystem values.
Martin-Lopez *et al*	Specific ecosystem services provided by biodiversity	Spain	Estimating the influence of individuals' environmental behaviour and knowledge on their WTP for sustaining specific ecosystem services provided by biodiversity, with a case study in the Donana National and Natural Park, Spain. (RP)
Martin-Lopez *et al*	Species conservation	Spain	Estimating the WTP for biodiversity conservation of 15 selected species in the Donana National Park (RP).
Christie *et al*	Diversity of biodiversity	UK	Focusing on biodiversity conservation and enhancement on farmland in English with two case studies: Cambridgeshire and Northumberland.
Christie *et al*	Valuing particular species	Worldwide	List of literatures containing values of various species in UK, Scotland, EU, and Finland, looking at different aspects of the species, including their own estimations. (SP)

Table 5: Submissions on the Non-Market Value of Biodiversity and Biological Services (cont.)

Submission By	Service	Region	Comment
Hoppichler *et al*	Austrian Alps	Austria	Valuation studies cover main issues, including tourism, the regulating functions of forest, a number of national parks, and the exploration of Alpine water resources (RP and SP)
Pearce	The economic value of biodiversity	Worldwide	Demonstrating the fundamental role of measuring biodiversity value in introducing incentives for resource conservation.
Kälberer	Economic benefits derived from nature	The Netherlands	Concerning a number of ecosystem services, including tourism and recreation, water management, real estate auctions, production and products, regulating services and other intrinsic values of nature.
Bernstein	Biological goods and services	Worldwide	Regulating services provided by tropical forests; economic contribution by world's ecosystems; and agriculture-related services providing sustainable livelihoods for people.
English Nature	Provisioning services and regulating services provided by various English ecosystems	UK	Including the value of salt marshes in flood defence, tourism benefits from visits to the country, and commercial harvesting of fruits and reedbeds.
Brotherton (Study author: Crowle)	Blanket peat in the English uplands	GB	Estimating the important role of blanket peat in agricultural, grouse management, recreation, culture, water catchments and carbon storage.
Brotherton (Study author: Fisher *et al.*)	Insurance value of biodiversity	Jamaica	Increasing biodiversity is important to insure a supply of ecosystem services.

Table 5: Submissions on the Non-Market Value of Biodiversity and Biological Services (cont.)

Submission By	Service	Region	Comment
Brotherton (Study author: Christie *et al.*)	Value of biodiversity enhancement in Cambridgeshire and Northumberland	UK	(1) Estimating the WTP for a number of policies that would avoid or reduce biodiversity decline. (SP) (2) Assessing the value of four attributes of biodiversity: familiar species of wildlife, rare unfamiliar species of wildlife, species interactions within a habitat and ecosystem services. (SP)
Brotherton (Study author: Grarrod and Wills)	Biodiversity benefits of woodlands	UK	The results provide WTP for four different forest management standards for achieving different levels of biodiversity. (SP)
Brotherton (Study author: Powe and Willis)	Mortality and morbidity benefits of air pollution absorption by woodland	GB	Valuing in terms of forgone net pollution costs or net benefits of having trees.
Brotherton (Study author: Gren)	Value of the Danube floodplains as a nutrient sink	UK	Benefits transfer
Brotherton (Study author: Clarkson and Deyes)	Cost of soil erosion in the UK	UK	Soil erosion caused by dredging of stream channels, sediments washing onto roads, etc. (NS)
Brotherton (Study author: RPA)	Cost of flooding	UK	Estimates the mean WTP to avoid the final losses of flooding. (SP)
Brotherton (Study author: Woodward and Wui)	The value of individual wetland services	UK	Concerning wetland services: flood defence, storm defence and recreational functions. (meta-analysis)
Brotherton (Study author: Brouwer *et al.*)	Wetland service	UK	WTP for wetland flood control function (meta-analysis)
Brotherton (Study author: Klein and Bateman.)	Total Benefits of avoiding flood damage in intertidal habitats and wetlands	UK	Case study of the Cley Marshes in Norfolk (SP)
Brotherton (Study author: Bateman *et al.*)	Benefits of avoiding further damage to habitats from coastal flooding	UK	Case study of the Norfolk Broads (SP)
Brotherton (Study author: Farber)	Wind storm protection of costal wetlands	US	Estimating the incremental effect of wetlands using the impact-pathway approach.

Table 5: Submissions on the Non-Market Value of Biodiversity and Biological Services

Submission By	Service	Region	Comment
Brotherton (Study author: Scarpa)	Recreational function of woodlands in the UK	UK	The study is based on data from the most extensive valuation study of woodland recreation, including 6 woodland sites across England. (RP + Market Price)
Brotherton (Study author: Rayment and Dickie)	Recreational value of RSPB reserves	UK	RP
Brotherton (Study author: Garrod)	Value of the wooded landscape	England	Different geographical settings are considered (SP)
Brotherton (Study author: Garrod and Willis)	Value of a waterside location on housing prices	UK	Two locations are studied: Greater London and the Midlands (RP).
Webber *et al.*	Value of knowledge about geodiversity	UK	Four geological locations are studied: the whole site at Wren's Nest NNR, the Seven Sisters cavern within the NNR, the Jurassic Coast WHS, and the Isle of Wight (NS, but likely RP).
Danby	Recreational values from hunting	UK	Shooting benefits and cost of biodiversity management and conservation.
Van den Hove and Moreau	Deep-sea habitats and ecosystems	Worldwide	Concerning 13 deep-sea habitats and ecosystems and 9 related goods and services, e.g. food production, deep-sea oil and gas wells, nutrient cycling from the oceans, etc.
Costanza *et al.*	17 ecosystem services across 16 biomes	worldwide	Provide an estimate of the current global economic value of ecosystem services.
	Biodiversity related primary production	North America	Estimating the impact of increase in biodiversity on the value of ecosystem services in warmer climates
Sutton and Costanza	Ecosystem services	Worldwide	Concerning global spatial distribution of marketed and non-marketed economic value.

Table 5: Submissions on the Non-Market Value of Biodiversity and Biological Services

Submission By	Service	Region	Comment
Balmford *et al.*	Valuing the conservation of ecosystems and natural capital	Worldwide	Estimation of the rates of change in the extent of six biomes to estimate the net loss in value from ecosystem conversion.
Boumand *et al.*	Dynamics and values of ecosystem services	Worldwide	GUMBO model
Brotherton (Study author: Bishop)	Landscape, wildlife, and recreational amenities of woodlands	England	Two woodland sites are studied: Derwent Walk and Whippendell Wood in England (SP).

(RP) Revealed preferences methods; (SP) Stated preferences methods
(NS) Valuation method has not been specified

8.4 Non-monetary valuation and sustainability

A key component of non-monetary valuation of biodiversity and ecosystem services is the concept of sustainability. The notion is used define rates of use of ecosystems that are consistent with permanent provision of services, and then measure the difference between actual rates of use and sustainable rates. Other non-monetary valuations of ecosystem services focus on social aspects, such as the provision of jobs, preservation of communities etc. These, too can be seen as contributing to sustainable development, but the links are not always clear and neither are they brought out in the submissions.

A submission by the Royal Society for the Protection of Birds argues that the natural environment should be protected because of its intrinsic value, its contribution to our quality of life and to bestow a healthy, sustainable planet to future generations. In the UK, one of the few studies presented on this matter, the RSPB argues that reversing wildlife declines and restoring degraded landscapes/ecosystems will deliver significant benefits for society and the economy: a high quality natural environment is a powerful positive projection of a high quality of life for overseas visitors, tourists and investors; it contributes to our health, with recent research underlining the strong links between good physical health, good mental health and the natural environment; people enjoy experiencing nature (e.g. four million viewers of the BBC's spring watch, millions visit the countryside annually, a 2004 MORI survey found that 81 percent of the British population regard visiting the countryside as being important to their quality of life); it tells us about the state of our

planet (the impact on wildlife is a key test of the extent to which society is living sustainable – recognized by Government through the 'populations of wild birds' indicator of sustainable development); and, the natural environment also supports economic activity directly, in nature conservation and indirectly through tourism, contributing 500,000 jobs overall.

A paper by WWF (2006) shows sustainable extraction of bark is important for maintaining rural economies, supporting 27,500 direct jobs and an estimated 65,000 indirect jobs. Another paper submitted to the Call refers to the Scottish Natural Heritage reports (2004). This paper examines the role of natural heritage in generating and supporting employment opportunities in Scotland. Activity relating to the protection, management, conservation, maintenance, enhancement, awareness, interpretation and enjoyment of Scotland's biodiversity and natural landscapes is estimated to support almost 93,000 full time equivalent (FTE) jobs. This represents 3.9% of Scotland's total employment. Of these, 69,000 FTE jobs are estimated to be supported by activities that depend upon the quality of natural heritage (especially tourism). The report from the National Trust suggests that the Welsh environment is increasingly being recognised as a major asset, which makes a significant contribution to economic growth and the quality of life in Wales. The study estimates that more than 117,000 jobs can be directly attributed to the management and use of the Welsh environment. A submission to the Call by Hoppichler et al. (2002), at the Austrian Economic Research Institute, presents a discussion about the approaches taken so far to the valuation of national parks, and then assesses the effects on employment on the basis of the input-output tables for 1990. The total effect on employment is said to be the creation of 322 jobs.

GHK and GFA RACE (2004) compiled a report for Defra on the economic impacts of England's natural environment, estimating that the management of the natural environment supports 299,000 full time equivalent (FTE) jobs in England. Shiel, Rayment and Burton (2002) examine the impacts of RSPB nature reserves on local economies in the UK. The RSPB's 176 reserves, covering 121,000 hectares, are estimated to support a combined total of 1,000 FTE jobs, with the largest impacts coming from visitor spending and direct employment. The report presents case studies from 12 reserves around the UK, which are estimated to support a combined total of 320 FTE jobs.

The LIFE Priolo Project (2007) reports the economic benefits and costs of a project to conserve the Priolo (Azorean Bullfinch) and its Laurel Forest habitat in an SPA on Sao Miguel Island. The project was estimated to support 13.5 full time equivalent jobs between November 2006 and April 2007, and provided training for local people, especially young people. The project has also received more than 2000 visits. The project offers potential for ecotourism, and contributes to a variety of ecosystem services, including water quality, protection against landslides and floods, carbon sequestration, leisure and tourism, educational and scientific services. The value of services provided by the SPA is estimated at €7.3m per year.

Finally, a multiplier analysis study was also undertaken to provide an estimate of the local economic impacts associated with geodiversity on the Isle of Wight. Tourism on the Isle of Wight was estimated to be worth £352 million for the tourism year 2004/2005 (Isle of Wight Council, 2006). Geodiversity was therefore estimated to account for approximately £11 million of this value. Applying income and employment multiplier coefficients, it is argued that geodiversity generates between £2.6 million and £4.9 million in local income and supports between 324 and 441 full time equivalent local jobs.

9. Critical discussion of the valuation studies

9.1 Biodiversity, neo-classical economics valuation and methodologies

Biodiversity is a complex, abstract concept. It can be associated with multiple, widely ranging benefits to the human society, most of them still poorly understood. From the economic valuation studies submitted to the Call it is clear that the assessment of biodiversity values does not provide an unequivocal, unambiguous monetary indicator. As a matter of fact, the practical and effective design of any valuation exercise involves crucial choices with respect to: (a) the level of life diversity; (b) the biodiversity value category; (c) the most appropriate valuation method, and, most importantly the (d) the overall perspective on biodiversity value. Independently of the (a)-(d) choices made, one should always keep in mind that economic valuation of biodiversity values does not pursue total value assessment of biodiversity, but of biodiversity changes. Therefore, it is nonsense to try to value extremely large changes in biodiversity, and certainly a waste of time to examine extreme changes like to a situation in which there is no natural living world. Economists

have assessed the economic value of biodiversity through tradeoffs between money and changes in biodiversity at the different levels of life diversity, including genetic, species, ecosystem and functional diversity. Most of the time, there are no market valuation mechanisms that price biodiversity values. Therefore, valuing biodiversity requires the use of special valuation tools. The choice of the valuation tool will, in turn, depend upon the biodiversity value category under consideration. For example, it will be hard to set a contingent valuation survey to elicit the economic value of changes in biodiversity related to changes in ecosystem functions and ecological services that are far removed from human perceptions, such as CO_2 storage or groundwater purification processes. On the contrary, the contingent valuation method is the most appropriate method whenever one focus on the monetary valuation of the biodiversity non-use values. Having said this, we strongly believe that (neo-classical) economic valuation of biodiversity does make sense. Nevertheless, it is important to mention that economic valuation studies have arrived at an important crossroad. On the one hand, one may opt for combining contingent and non-contingent valuation strategies so as to assess the complexity involved at multiple life organization levels in more detail. This strategy signals the need for a multidisciplinary approach that seeks a clear perspective on the direct and indirect effects of changes in biodiversity on human welfare. This would contribute to more robust economic value estimates that could serve to guide biodiversity policy. On the other hand, researchers can continue to work on creating more sophisticated versions and applications of the non-market valuation methods.

9.2 Biodiversity and the Millennium Ecosystem Framework

As noted earlier, the Millennium Ecosystem Assessment has fundamentally altered the way we conceptualise the value of ecosystems. Ecosystem services offer benefit streams that may be used to estimate the value of the underlying ecological assets. The Millennium Ecosystem Assessment (MA) distinguishes four broad categories of benefit: provisioning services, cultural services, regulating services and supporting services. The valuation - in monetary terms - of ecosystem services remains a difficult issue. Although the welfare-theoretic approach is by now well developed, applications do not always follow the theoretical framework. It is not always clear whether this is because of lack of data; or because of a lack of understanding of the basic theoretical framework. Today, more than ever, we are in a position to feedback this process, retrieving and validating data in the light of this path-breaking theoretical framework. All in all, the MA is now

recognized as a key reference for assessing the economics of biodiversity loss and is referred to in many papers, but its application is inconsistent in the submissions reviewed. In other words, there is some ongoing effort in this area although not many results have been reported. A recent attempt at operating the MA for economic valuation is the study of Nunes and others (2008), in which the authors explore the potential of an Environmental Economics Outlook of the Climate Change Impact on Forest Biodiversity and Human Wellbeing providing valuation estimation results from an MA application to Europe.

10. Gaps in Knowledge, and Suggestions for Future Research

The submissions made the following points with respect to the gaps in knowledge:

(1) The value of indigenous knowledge in the conservation of biodiversity is under-researched (Development Alternatives, India)

(2) Likewise, the biodiversity value of marine resources - especially deep sea resources - is an under-researched topic (van den Hove and Moreau, Netherlands; Moran, UK; Beaumont et al, UK)

(3) There are still major gaps in the science and economics of the valuation of ecosystem services, including the definition of ecosystem boundaries, the need to improve environmental understanding and the effective valuation of genetic material. (DEFRA, UK).

(4) Others have noted the gap in studies that consider marginal effects in a proper way (rather than assuming they are equal to the average impact) (Brotherton, UK; Natural England, UK)

(5) We still have not properly integrated our knowledge of ecosystem dynamics into an economic assessment of land–use options. Most of the economic evidence available concentrates on a single use of a single good of a given ecosystem, while most ecosystems provide multiple services that are interrelated in complex ways (Eftec, UK, Tschirhart, USA, van den Hove and Moreau, Netherlands). Also relevant to ecosystem dynamics, any review of the costs of biodiversity must factor in climate change: both the impacts of climate change on biodiversity and the feedback effects of biodiversity loss on climate change (Martin Dietrich SCB-ES, Germany)

(6) There are gaps in the public's understanding and awareness of biodiversity. By improving information and awareness we may achieve significant gains in conservation at a modest cost (DEFRA, UK, Christie et al, UK)

(7) Valuation topics covered included: wildlife, national parks and nature reserves, water courses (non-fishing use), recreational fisheries, landscape, endangered species, wetlands, and woodlands. There is poor distinction between the valuation of biological resources for their biodiversity and for their contributions as biological resources in themselves. More work is needed to provide the keys for an accurate interpretation of the difference between the two. (Moran, Nunes)

(8) As noted above we find a heavy dominance of UK studies, with particular emphasis on significant countryside habitats, forested areas or charismatic and flagship species. It is unclear how reliable these estimates may be for policy, especially when we transfer the value to other sites and countries, which are not characterized by the same flagship species. (White and others)

(9) There is a fundamental uncertainty regarding the minimum level of ecosystem structure needed to provide a continual flow of services (Brotherton, UK). Related to this is the importance of recognizing the discontinuities in the biophysical relationships that govern ecosystem service provision and that are critical to a valuation of their loss.

(10) Present valuation systems based on individualistic and reductionist approaches are inadequate and what is needed is a different paradigm. One suggestion is to focus on valuing the limitations imposed on the development of human societies by ecological constraints, such as the "Steady State Economy" model of Hermann Daly (Martin Dietrich SCB-ES, Germany). Another is to adapt a valuation system based on 'fairness' and collective values. (Hopplicher et al., Austria)

(11) Primary valuation studies are still lacking for ecosystem services provided by deserts, tundra, ice/rock and cropland (Costanza et al. USA)

(12) There are few studies on the value of changes in the delivery of goods and services arising from conversion of natural habitat. In particular few suitable studies were found for 10 of the natural biomes, including rangelands, temperate forests, rivers and lakes and most marine systems (Balmford et al., UK)

(13) Methods are needed to identify priority areas for biodiversity conservation that minimize conflict with agricultural productivity (Spijkerman, Conservation International, USA).

A similar point has been made by Ando, Polasky and others, who note that protecting the largest area within an ecosystem does not equate to the greatest protection for its biodiversity.

(14) Related to the above, we need to know more about how to identify the extent to which the goals of safeguarding biodiversity and securing ecosystem services are consistent, and at what point there is a trade-off between the two. (Spijkerman, Conservation International, USA)

(15) More accurate information is needed on the populations who stand to gain or lose from changes in biodiversity and ecological services. An example is given about the benefits of woodlands, where it is difficult to identify the populations for which the different categories of social and environmental benefits are to be aggregated. (Willis et al. UK)

(16) Most of the valuations address the issue of biological resources rather than biodiversity *per se*. We are all diminished by a world that is increasingly homogenized, but there is as yet no credible estimation of the cost of diversity loss. This is arguably an important research question. Only a few agricultural studies demonstrate true farm system costs for the loss of genetic diversity in land races and domestic breeds. Costs associated with the loss of naturally occurring diversity are uncertain (Moran, UK)

With regard to suggestions for future research one can obviously note the need to fill the gaps identified in the previous list. In addition submissions made the following points:

(1) Closing the gap between ecological economics and other areas of economics using experimental approaches and models of behavioural economics. (K.N. Ninan, India).

(2) The greater use of auctions as a means of eliciting values and determining the demands for conservation (Markus Groth, Germany). Such an approach was applied in the Netherlands and is reported in the market research by Daan Wensing.

(3) One of the emerging issues is how the depletion of biological resources may heighten global insecurity and conflict. Hardly any research is available on this. (Moran, UK: Heikkilä, Finland).

(4) Future research in relation to ecosystem services should consider a range of interdependent ecological functions, uses and economic benefits at a given site; or track changes in site values across different states of ecological disturbance. Future research

should investigate the necessary conditions for incentive measures and their relative merits in relation to different locations, ecosystems and types of ecosystem stress. (Eftec, UK).

(5) The present analysis is static (Concerning the global spatial distribution of marketed and non-marketed economic value). It needs to be extended to a dynamic analysis in order to provide more useful information on the trends in the value of ecosystem services and sustainability (Sutton and Costanza, USA).

(6) Most economic valuation exercises miss a common platform of biodiversity analysis. According to the ecosystem approach, one needs to provide a detailed catalogue of ecosystem services and address the value of ecosystems and ecosystem services, as the basis for understanding the value of the biodiversity that underpins those services (Barbier et al, USA).

(7) Ecosystem management options should be evaluated by coupling service change assessments with valuations of these changes (Farber et al., USA)

From the above, and from the review of the valuation literature, we conclude that while methods have been developed and used widely for some environmental values (especially market values as well as recreation and amenity), there are still several gaps in the literature. Notable among these are the valuation of loss of species other than headline species; marine ecosystems; cultural and spiritual values; and the dynamic aspect of all ecosystems and values – changes over time are at the core of all ecosystems.

Equally important (a point not made in the submissions), information on the values to be attached to improvements in the indicators that form the basis of the EU's biodiversity strategy is still patchy. In some cases local values are available (e.g. changes in forest cover and products, measures of water quality, species on the red list, changes in land use to facilitate certain recreational activities, and changes in levels of commercial fisheries). These values tend to be site and species specific. Transfers to other species and locations are difficult and often not credible. In other cases values are currently not available (e.g. change in abundance of some species, status of species, changes in diversity of species that are important ecologically but not from a human point of view, critical loads of some pollutants being exceeded). Based on the submissions and our work we would argue that the following issues need to be addressed urgently:

i. Incremental value. To be useful the valuation of the service has to be an incremental one. There is little advantage in knowing the total value of an ecosystem unless there is a threat to eliminate it or a policy or reconstruct it in its entirety, which is rarely the case. Yet many valuation studies provide estimates of the total costs of whole systems and there is even one of the value of the whole world's ecosystems (Costanza et al., 1997). Carrying out an incremental analysis (which may entail estimating significant non-marginal changes in ecosystems), however, is not as easy as it might sound. If one is using revealed preference methods, a link has to be established between a change in the environmental attribute and the demand for a visit to a site or the value of a property. If one is carrying out a SP analysis the respondent has to understand the nature of the incremental change, which is more difficult than asking for the value of access to a site or use of a particular recreational facility. Incremental analysis under SP is perhaps a little easier with choice experiments (CE) rather than contingent value (CV).

ii. Addressing the multiple services and the 'adding up' problem. Many ecosystem services that individuals receive are multidimensional and there is an adding up problem. The value attached to one forest area for recreational or other use is not independent of whether another forest nearby is conserved or not. The implication is that studies need to be undertaken allowing for substitution effects, which makes them more specific to a particular application and less capable of being transferred to other applications.

iii. Benefit transfer. The question of the extent to which ecosystem values can be transferred from one site to another and from one type of service to another is a controversial one. Economists have devoted a great deal of effort to see how far such transfers are possible, given that full valuation studies are expensive to conduct. The most comprehensive way to carry out transfers is to use a 'meta analysis', which takes all existing studies and estimates a relationship which gives changes in the benefit values as a function of site characteristics, attributes and size of the population affected, type of statistical method used etc. in the sample of existing studies. This is then transferred to the policy site in a procedure referred to as value transfer, which can provide a single value for the policy site or a 'value function', which gives a range of values depending on the characteristics of the object of valuation. Meta analyses are available for urban pollution, recreational benefits, recreational fishing, water quality, wetlands, visibility improvement, price

elasticity of demand and travel cost, valuation of life and valuation of morbidity (Nijkamp et al. 2008)[9]. These provide the best method of transfer, although we should note that many values are very location specific and the transfer can never be perfect.

Although use is made of meta analyses and value transfers in estimating costs we do not have an idea of the extent of such use. Transfers of estimates are unlikely to enter databases such as EVRI, because they do not involve original estimation. It would be helpful to know how many policy-related studies have indeed used proper meta analyses to derive environmental values in a policy-making context. Recent discussions on the subject seem to suggest that while value transfer is easier for some ecosystem services it is less easy for others. It should be possible, for example, to derive estimates of some categories of recreational benefits (including recreational fishing), improvements in water quality, carbon sequestration and perhaps visibility. It is more difficult to carry out credible benefit transfer, except in a much localised way (e.g. estimates for one landscape or land use pattern to another that is close by) for some other categories of value such as for example coastal protection. As noted under the 'adding up problem', different combinations of benefits cannot be valued by adding up the individual benefits of ecosystem services.

Notwithstanding such difficulties the international community urgently seeks estimates of the foregone benefits from biodiversity at the EU and global level. The current initiative on the Economics of Biodiversity Loss explicitly states that it will seek to estimate the 'economic significance of the global loss of biodiversity'[10]. Given that there are thousands of ecosystems and sites of importance within the EU, let alone the whole world it is impossible to conduct individual studies to obtain the relevant information in a timely way[11]. Hence some kind of benefit transfer will be essential if the goal of obtaining national, regional and global estimates of the damages from biodiversity loss in the absence of any action is to be obtained. The same

[9] Nijkamp et al. (2008) also refer to other methods of making a transfer such as rough set analysis, fuzzy set analysis and content analysis. Since there is no assessment of their application to biodiversity and ecosystems one cannot comment on how useful they might be.

[10] Background Paper for the Working Group, 1st Meeting on the Review of the Economics of Biodiversity Loss, European Commission, Brussels, 21st November 2007.

[11] Taking the Nature 2000 sites in Europe and dividing them into the 27 habitats we have over 75,000 ecosystems whose services need to be valued.

applies, *a fortiori*, to estimating the reductions in such damages when some actions to protect the ecosystems are implemented.

The answer to this problem consists of working in parallel at two levels. The first is to develop rules of thumb for acceptable estimates of the overall costs of biodiversity loss and the second is to improve the application of benefit transfer for specific evaluations of ecosystems service benefits.

To tackle the first, rules of thumb will be needed, based on rough values, for all the ecosystems under threat. The COPI project that is just being started has this as its objective. It cannot be expected that this project will arrive at a real scientific assessment of the costs of inaction but it may be able to provide credible orders of magnitude, based significantly on the market-based losses of services from the expected degradation of ecosystems. Coverage of non-market costs will be much less complete. Whatever estimates are obtained should be subjected to as much scrutiny from the scientific community as possible and revised in the light of responses to provide some headline figures that are broadly correct. The exercise will necessarily ignore many of the guidelines for benefit transfer. In the light of that it will need some way of deriving approximations in the right ballpark and further work in this area will almost certainly be required.

To tackle the second approach we need to establish a clear set of guidelines about which kinds of benefit transfer are possible. Such guidelines need to stipulate not only the kind of ecosystem services but the areas and countries where the transfer can be carried out given the available set of valuation studies. Secondly, further research should be carried out on how 'packages' of ecosystem services may be valued without undertaking whole new studies. It may be possible to develop approximations for adding up benefits that can be individually transferred but where there is an adding up problem. Third, where transfer is not possible we should develop toolkits that can be used to carry out location specific studies. Given the large database of existing studies, these can help simplify and demystify the process of valuation so it can be conducted more routinely and more cheaply. Finally, an inventory of all major ecosystems should be drawn up and the loss of services expected under different scenarios should be prepared. Some of this is underway for some ecosystems but not for all the important ones.

iv. Gaps that remain. After all the work on valuation, there still remain areas where credible and reliable economic values are not available. As noted these include many species, marine ecosystems, cultural and spiritual values and dynamic dimensions of all values. They also include damages to ecosystems from air and water pollution (Ecolas, 2007). In all cases further work on valuation is worthwhile, using innovative combinations of market and non-market techniques. For damages from air and water pollution Ecolas has already made a number of recommendations for such studies. In other cases a similar list should be drawn up to fill the gaps that have been referred to in this paper. But it is only realistic to assume that it will be some time before a comprehensive set of estimates is available. In the interim we need to rely more on cost effectiveness tools, and to focus the development of these tools around the indicators for the Biodiversity Strategy for the EU, as reflected in the set of indicators drawn up by the EEA (see Annex II). Not all those indicators are amenable to such an analysis but many are. It should be a matter of urgency to develop these tools and make them available to decision-makers responsible for allocating funds and introducing and implementing conservation policies.

11. Conclusions

This report has critically reviewed the set of articles put forward to the Call. The main message is that we are witnessing a progressive loss of biodiversity. This is the cause of significant welfare damages. Secondly, one can also conclude that the economic valuation of changes of biodiversity can make sense. This requires, inter alia, that a clear diversity level is chosen, that a concrete biodiversity change scenario is formulated, that changes are within certain boundaries, and that the particular perspective on biodiversity value is made explicit. So far, relatively few valuation studies have met these requirements. As a matter of fact, most studies lack a uniform, clear perspective on biodiversity as a distinct, unequivocal concept. Against this background, the Millennium Ecosystem Assessment is now recognized as a key reference for assessing the economics of biodiversity loss. However, to the present date, we have insufficient knowledge about, for example, how the functioning of ecosystems relates to the production of ecosystem goods and services and what is the underlying role of biological diversity within this complex relationship, so that for this reason alone it is very difficult, if not factually impossible, to assess the total economic value of biodiversity. Even if we admit that could place a value on a set of goods and services represented to by all

ecosystems, and remember that at present scientists still do not have sufficient knowledge to map and calculate the full range of ecosystem goods and services (across all the different types of world ecosystems), we would be still unable to answer to the question "what is the value of biodiversity?" To answer this question, we would also have to include: (a) the role of genetic variation within species across populations and its impact on the provision of ecosystem goods and services, (b) the role of the variety of interrelationships in which species exist in different ecosystems on the provision of ecosystem goods and services, and (c) the role of functions among ecosystems on the overall level of provision of ecosystem goods and services. Without any doubt, a full monetary assessment will be impossible or subject to much debate. An important reason for the latter is that global level values are difficult to compare due to an equal international income distribution. All in all, the available economic valuation estimates should be considered at best as a lower bound to an unknown value of biodiversity, and always contingent upon the available scientific information as well as the global socio-economic context.

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Annex I: Brief Overview of Evidence Received

The Call has received contributions from 55 participants/experts. The total number of contributions is 116 and they are distributed the following way:

57 Position statements prepared especially for this review
34 Articles (not published)
27 Journal articles (published)
2 Book chapters
16 Personal/Organization reports (specifically prepared for the call)
16 Further references listed (books, articles, webpages)
18 Project reports

Contributors and their contributions were as follows (in parenthesis the organization responsible for the review):

1. Azqueta (FEEM)
   1 position statement prepared especially for this review
   7 further references listed

2. Baumgartner (GHK)
   3 journal articles
   1 book chapter

3. Bearzi (ECOLOGIC)
   1 position statement prepared especially for this review
   4 further references listed

4. Bernstein (ECOLOGIC)
   1 position statement prepared especially for this review
   1 personal report

5. Bozzi (FEEM)
   1 position statement prepared especially for this review
   1 article

6. Brander (FEEM)
   1 position statement prepared especially for this review
   1 journal article

7. Brotherton (ECOLOGIC)
   1 position statement prepared especially for this review
   1 personal report
   3 articles
   3 project reports

8. Carraro (GHK)
   1 article

9. Cerulus (FEEM)
   5 position statements prepared especially for this review
   11 further reference listed

10. Christie (IEEP)
    1 position statement prepared especially for this review
    1 journal article

11. Cobra (GHK)
    1 position statement prepared especially for this review
    3 articles

12. Costanza (IVM)
    7 journal articles

13. Danby (ECOLOGIC)
    1 position statement prepared especially for this review
    1 personal report

14. De Corte (GHK)
    1 position statement prepared especially for this review
    1 personal report
    1 further reference listed (webpage)

15. Dieterich (FEEM)
    1 position statement prepared especially for this review
    1 personal report

16. Farooquee (IVM)
    1 position statement prepared especially for this review

17. Gautier (FEEM)
    4 articles
    1 project report

18. Gast (ECOLOGIC)
    1 personal report
    5 further references listed (webpage)

19. Gibby (GHK)
    1 position statement prepared especially for this review
    10 further references listed

20. Gokhale (FEEM)
    1 position statement prepared especially for this review

21. Graham (ECOLOGIC)
    1 position statement prepared especially for this review
    1 personal report

22. Grieg-Gran (FEEM)
    1 position statement prepared especially for this review
    5 further references listed
    4 articles
    1 project report

23. Groth (FEEM)
    1 position statement prepared especially for this review
    1 further reference listed

24. Hauser (GHK)
    1 position statement prepared especially for this review
    27 references listed

25. Heikkila (GHK)
    1 position statement prepared especially for this review
    1 article

26. Henson Webb (GHK)
    1 position statement prepared especially for this review
    1 article

27. Hoppichler (IEEP)
    1 position statement prepared especially for this review
    1 personal report
    1 article
    1 further reference listed

28. Kadekodi (FEEM)
    1 further reference listed (book)

29. Kalberer (ECOLOGIC)
    1 article

30. Kirchholtes (GHK)
    1 position statement prepared especially for this review
    3 articles
    4 project reports
    1 journal article

31. Kumar (FEEM)
    1 position statement prepared especially for this review

32. La Notte (FEEM)
    1 position statement prepared especially for this review
    1 article

33. Lueber (GHK)
    1 position statement prepared especially for this review
    1 further reference listed (webpage)

34. Marthy (FEEM)
    1 position statement prepared especially for this review

35. Martin-Lopez (IEEP)
    2 position statements prepared especially for this review
    2 journal articles

36. Michalowski (IVM)
    1 position statement prepared especially for this review
    1 personal report

37. Moran (FEEM)
    1 position statement prepared especially for this review
    1 personal report
    1 project report

38. Mowat (GHK)
    1 position statement providing a co-ordinated response from UK Government, in four sections
    1 article
    4 project reports

39. Myers (FEEM)
    1 position statement prepared especially for this review
    1 further reference listed (book)

40. Ninan (FEEM)
    1 position statement prepared especially for this review
    1 journal article
    1 further reference listed (book)

41. Perrings (IVM)
    2 position statements prepared especially for this review
    2 articles
    3 further references listed (books)

42. Smale (FEEM)
    1 position statement prepared especially for this review
    1 further reference listed (webpage)

43. Spijkerman (FEEM)
    9 position statements prepared especially for this review
    2 articles
    5 journal articles
    1 book chapter

44. Sud (FEEM)
    1 position statement prepared especially for this review
    1 article

45. Tschirhart (FEEM)
    2 journal articles

46. Vaissiere (FEEM)
    1 journal article

47. Van Beukering (IVM)
    20 further references listed (webpage)

48. Van Den Hove (ECOLOGIC)
    1 position statement prepared especially for this review
    1 project report

49. Van Ham (FEEM)
    1 article

50. Walicsky (GHK)
    1 position statement prepared especially for this review, providing links to 12 further papers
    2 personal reports
    2 project report

51. Watzold (FEEM)
    1 position statement prepared especially for this review
    1 personal report

52. Wensing (FEEM)
    1 position statement prepared especially for this review
    1 personal report

53. White (IVM)
    1 position statement prepared especially for this review
    1 project report

54. Wossink (IVM)
    1 position statement prepared especially for this review
    3 journal articles

55. Yessekin (FEEM)
    3 articles

Annex II: List of Key Indicators to Measure Progress in Meeting the Target of Halting Biodiversity Loss.

1. Trends in the abundance of common birds and butterflies over time across their European ranges.
2. Red List Index shows trends in the overall threat status of European species. Specifically the index relates to the proportion of species expected to become extinct in the near future in the absence of additional conservation action.
3. Changes in the conservation status of species of European interest. This indicator is currently based on data collected under the obligations for monitoring under Article 11 of the EU Habitats Directive (92/43/EEC).
4. Proportional and absolute change in extent and turnover of land cover categories aggregated to relate to main ecosystem types in Europe from 1990 to 2000. The 13 ecosystem types discussed represent forests, cropland, semi natural vegetation, wetlands, inland water systems, glaciers, permanent snow and urban/constructed/industrial /artificial areas.
5. Conservation status of habitats of European interest. This indicator is based on data collected under the reporting obligations of Article 17 of the EU Habitats Directive (92/43/EEC).
6. The population share ratio of breeding females between introduced and native breed species (namely, cattle and sheep) per country, as a proxy to assess the genetic diversity of these species.
7. The rate of growth in the number and total area of nationally protected areas over time. This indicator can be disaggregated by IUCN category, biogeographic region and country.
8. The current status of implementation of the Habitats (92/43/EEC) and Birds Directives (79/409/EEC) by EU Member States, (a) showing trends in spatial coverage of proposals of sites and (b) by calculating a sufficiency index based on those proposals.
9. Critical loads for nitrogen deposition being exceeded indicating the risk of biodiversity loss in semi-natural ecosystems.
10. 'Invasive alien species in Europe'. This indicator comprises two elements: 'Cumulative number of alien species in Europe since 1900', which shows trends in species that can potentially become invasive alien species, and 'Worst invasive alien species threatening biodiversity in Europe', a list of invasive species with demonstrated negative impacts.
11. Changes in occurrence of species that are mainly sensitive to temperature (changes)
12. Trends in mean trophic levels of fisheries landings per European sea.
13. Change in average size of patches of natural and semi natural areas, on the basis of land cover maps produced by photo interpretation of satellite imagery.
14. Fragmentation in spatial and quantitative terms due to the presence of artificial structures that a) may affect the passage of migratory fish and so restrict their range and/or abundance and b) substantially change the natural habitat distribution within rivers and modify their ecological capacity.

15. Trends in, and concentrations of, winter nitrates and phosphates (microgram/l), as well as Nitrogen/Phosphorous ratio in the seas of Europe.
16. Annual median concentrations in rivers of Biological Oxygen Demand (BOD) and ammonium (NH4). Trends in concentrations of orthophosphate and nitrate in rivers, total phosphorus and nitrate in lakes, and nitrate in groundwater bodies.
17. Change in stocks of forests and other wooded land, classified by forest type and by availability for wood supply, and the balance between net annual increment and annual felling of wood in forests available for wood supply.
18. Volume of standing and lying deadwood in forest and other wooded land, classified by forest type.
19. 'Gross nitrogen balance', which estimates the potential surplus of nitrogen on agricultural land.
20. Trends in area (as proportion of the total utilised area) of three (not mutually exclusive) categories of agricultural land: a. High nature value farmland area. b. Area under organic farming. c. Area under biodiversity supportive agri-environment schemes. Looks at land under management practices potentially supporting biodiversity.
21. Annual change of proportion of commercial fish stocks within safe biological limits (SBL) in European Seas and per fisheries management unit.
22. Annual trend in release of nutrients into the marine environment as a result of aquaculture practices.

23. The amount of biologically productive land and water area that Europe requires to produce all the biological resources it consumes and to absorb the waste it generates, using prevailing technology and management. This area could be located anywhere in the world. (Ecological footprint for Europe).
24. The share of European patent applications that are based on genetic resources.
25. The value for the specific types of expenditure for biodiversity from the EU budget.
26. Eurobarometer survey on biodiversity to provide information on public attitudes to biodiversity.

Part II:

International expert workshop on The Economics of the Global Loss of Biological Diversity

The workshop program was jointly defined by FEEM (Paulo A.L.D. Nunes and Anil Markandya) and the European Commission (Aude Neuville), with the assistance of Ecologic

Contributors:
Ingo Bräuer (ECOLOGIC), Patrick ten Brink (IEEP), Onno Kuik (IVM), Matt Rayment (GHK), Paulo A.L.D. Nunes (FEEM) and Anil Markandya (FEEM)

1. Introduction

The workshop on the Review of the Economics of the Global Loss of Biological Diversity was organised by the European Commission's DG Environment and the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)[12]. The event brought together more than 80 experts in economics and ecology as well as contributing parties from the call for evidence from more than 20 countries to explore approaches for estimating the economic significance of the loss of biodiversity and related ecosystem services. The workshop developed recommendations on the way forward for the Review. The Review will be conducted in two phases, with a preparatory phase running up to the Ninth Conference of the Parties of the Convention on Biological Diversity (CBD COP9) in May 2008, and a more substantial phase that will run until 2010, under the responsibility of the recently appointed Review leader, Pavan Sukhdev.

This chapter will first present the workshop programme and afterwards analyse and synthesise the workshop outputs.

The Economics of the Global Loss of Biological Diversity
5-6 March 2008, Brussels, Belgium

Program: DAY 1

9:30	• Opening by BMU (Elsa Nickel, deputy Director General) and the European Commission (Ladislav Miko, Director, DG Environment) • Background and purpose of the study and of the workshop (Peter Carl, Director General, European Commission, DG Environment) • Brief overview of on-going reports (Patrick Murphy) • Participants' background and expectations (Heidi Wittmer) • Introduction to the workshop, structure and dynamics (Paulo A.L.D. Nunes) • Discussion
10:30	*Coffee*

[12] With support from FEEM, Ecologic, IEEP, GHK, IVM & UFZ.

11:00-12:30	A1: Setting the scene: from biodiversity to human welfare -– what do we know about the links and what are the priorities for future research in ecological science? (Kerry Turner) *An assessment of the economic significance of biodiversity loss requires an understanding of how changes in biodiversity affect the provision of ecosystem goods and services. Some of these links are well understood, many others much less so. This session should explore the links between biodiversity and human welfare, addressing for various types of benefits, what the state of ecological knowledge is, where the main research gaps are, and what the priorities for future work in the timeframe of the Review could be.* A2: What types of biodiversity benefits should be prioritised in an economic assessment? (Pushpam Kumar) *The different types of benefits derived from biodiversity (e.g., food, water, recreation, non-use values) vary in their economic importance. What is the relative importance of these benefits and in particular which are likely to make a large difference to the quantitative assessment of the economics of biodiversity loss? What are typical ranges of values from available estimates? Given the potential and limits of economic valuation tools to assess the importance of biodiversity to people, what are the main types of benefits on which work could be focused in the timeframe of the Review and what could be priorities for future research?* A3: Integrated socio-economic scenarios of environmental change to highlight and compare alternative, future development trajectories. (Ben ten Brink) *Scenarios are necessary for exploring future trends of biodiversity loss and changes in ecosystem services. They are used to analyse the effects of socio-economic trends on pressures on ecosystem functions (state), and the ability of ecosystems to sustain the above goods and services (impacts). The possible feedbacks of changes in impacts on policies (drivers) will also be explored.*
12:30	*Lunch break*

14:00	B1: Measuring benefits from ecosystem services in monetary terms – using market and non-market based methods (Alistair McVittie) *This session should include an evaluation of economic techniques for assessing the importance of biodiversity to people. What is common practice and what are promising developments? This session will also explore the potential use of quantitative socio-economic models in combination with case study based approaches to evaluate the welfare changes associated with different scenarios. What are the methodological challenges ahead in making an efficient, policy relevant evaluation of ecosystem goods and services?* B2: Measuring benefits from ecosystem services – integrating monetary and non-monetary estimates (Patrick ten Brink) *In practice it is often the case that only part of the services provided by ecosystems can be assessed in monetary terms, while for some other services only measures in biophysical terms are available. This session should evaluate the economic and non-economic techniques for assessing the importance of biodiversity benefits and how to combine information in biophysical terms with monetary estimates.* B3: The aggregation challenge: how to go from small changes and individual case studies to the big picture (Stale Navrud) *How to use values from case studies for large scale assessments? An efficient use of the benefit transfer tool is a great challenge for natural scientists and economists so as to deliver value estimates of policy relevance. The difficulties include not only how to transfer values which are site-specific but also how to take into account the cumulative effects of small changes in ecosystems when estimating the consequences of large changes, and how economic values can vary accordingly. What are the informational and methodological needs to deliver such estimates*?
15:30	*Coffee break*
16:00-18:00	• Report to the Plenary A1 to A3, B1 to B3 • Discussion

DAY 2

9:00	Costs of biodiversity loss - contributions / case studies: • Ecosystem accounting applied to wetland case studies by EEA (Jean-Louis Weber) 20mn • Forest study by IUCN (Katrina Mullan) 20mn • Marine Bill valuation study made for DEFRA (Salman Hussain) 20mn • Discussion 30 mn
10:30	*Coffee break*
11:00- 12:30	C1: The costs of actions necessary for the conservation and sustainable use of biodiversity (Joshua Bishop) *What are the main drivers of biodiversity loss? What information do we have concerning the type of actions and their associated costs – including opportunity costs - which will be necessary to prevent the loss of ecosystem goods and services? What are the most promising attempts/examples for market creation?* C2: Trade-offs across EGS (Anantha Duraiappah) *This session should explore how to make best use of the experience of the MA with particular attention on the mapping of the relationship between the production of ecosystem services and the beneficiaries. How can we deal with trade-offs across ecosystem goods and services, taking into account distributional effects?* C3: Policy needs and science challenges (Anil Markandya) *What are the different challenges for economic valuation if we are to respond efficiently the questions raised by policy makers at different levels? Which kinds of figures/analyses are appropriate with a view of incorporation in scenarios and policy design?*
12:30	*Lunch break*

14:00	• Report to the Plenary C1 to C3 • Discussion
15:00	• Roadmaps for the way forward: research agenda • Round table discussion
15:45	*Coffee break*
16:15	• Policy, synthesis and way forward to Bonn and beyond • What are the lessons learned from the workshop? (Pavan Sukhdev)
16:45-17:00	• EC: Closure and thank you (Ladislav Miko)

The present program was jointly defined by FEEM (Fondazione Eni Enrico Mattei) and the European Commission, DG Environment, with the assistance of ECOLOGIC.

The Economics of the Global Loss of Biological Diversity

International Experts Workshop

5-6 March 2008, Brussels, Belgium

Session 1

Welcome and Introduction

Opening by

Elsa Nickel, deputy Director General, BMU and Ladislav Miko, Director, DG Environment of the European Commission

Ladislav Miko (Director, DG Environment, European Commission) opened the workshop, noting that the launch of a review of the economics of biodiversity loss took place at Potsdam at the G8+5 meeting of environment ministers and has the support of German Minister Gabriel and of Commissioner Dimas.

He underlined the complexity of the problem, from both an ecological and economic perspective, and said that it is essential to combine inputs from these two disciplines. It is important that we try to better understand the links between biodiversity, ecosystems, and the benefits we derive from them. He stressed that cost-benefit analysis has a role to play, but we need to be realistic that this is not the only approach to be used. There should be a strong focus on risks, as well as on ethics, including intergenerational equity. We also need to bear in mind the links to policy – not just nature conservation, but also to other sectoral policies, and assess policy costs. He underlined the vital benefits of forests and of marine ecosystems.

Elsa Nickel (deputy Director General, BMU, German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety) recalled that biodiversity is dwindling at an unprecedented rate; many species are becoming extinct without scientists being able to study them, or to ascertain how they might be used by humans. They "*take their secrets to the grave*". She underlined that we need to show respect to nature, and to attach a value to it; economic value is part of that value. She added that economic valuation should not be a substitute for ethical considerations, but one component, one that is essential and convincing.

She underlined that COP9 is the next milestone in the international process regarding the conservation of nature. A slot in the high-level political segment in the last 2 days has been reserved and the ambition is to present some first results from the current work. They will be presented to ministers by Commissioner Dimas, Minister Gabriel, and Pavan Sukhdev, the newly assigned *Study Leader*, whom she introduced to the workshop. Pavan Sukhdev is an economist with long-standing experience in the commercial sector (14 years at the Deutsche Bank), and also a founding member and chairman of GIST (Green Indian States Trust), India, working, *inter alia*, on green accounts for Indian States.

When speaking of the work to be done in the Review, she expressed the hope that the results will contribute to future claims to protect biodiversity. She underlined that a lesson learnt from the Stern

Review was that economic arguments can be a good foundation for policy action. She also noted that economics is not enough, and quoted the German Philosopher, Immanuel Kant.

In the kingdom of ends everything either has a price or a dignity. What has a price can be replaced by something else as its equivalent; what on the other hand is raised above all price and therefore admits no equivalent has a dignity… That which constitutes the condition under which alone something can be an end in itself has not merely a relative worth, that is a price, but an inner worth, that is, a dignity."

Immanuel Kant

Nature has no equivalent and does not have a price. Nature and biodiversity have dignity, ethical and moral value, which are beyond economic aspects. However, economic arguments can be a strong support.

Elsa Nickel finished by underlining that it is essential to look for global collaboration, as the issue is a global one, and thanked the European Commission for taking leadership.

Mogens Peter Carl, (Director General, DG Environment, European Commission) noted that warnings about biodiversity loss made over many years have often fallen on deaf ears and that there is a big gulf between grand discourse and action on the ground. This is perhaps understandable in a world where population is predicted to rise to 9 billion within the next 25 years and where land and natural resources are being consumed at increasingly high rates. He stressed that three quarters of humanity live under conditions that are very different from those in Europe, and that the developed world has a large share of responsibility in wiping out much of biodiversity.

Peter Carl underlined the importance of the Millennium Ecosystem Assessment (MA) – noting the large impact that this initiative has had in changing the way we look at the relationship between human populations and their environment. It provides a conceptual framework for examining the goods and services provided by the natural environment. And it focuses attention on their economic value. The challenge now is to build on the foundations of the MA and refine and strengthen our methodology, in particular to forge better links between ecology and economics.

He noted that, day after day, despite growing awareness and major efforts, little by little, we have been losing the battle to halt biodiversity loss. The argument that we should be driven by higher moral or ethical purposes and that humanity has a duty to protect the environment is fine in principle, but for many reasons it is necessary to also use economics. In societies where economic considerations are paramount, we need to demonstrate the economic importance of biodiversity and associated ecosystem services and to explore how to ensure that they are duly taken into account in decision-making.

The economic arguments need to be credible, and need to be free from green spectacles. Work on biodiversity is still more challenging than climate change work.

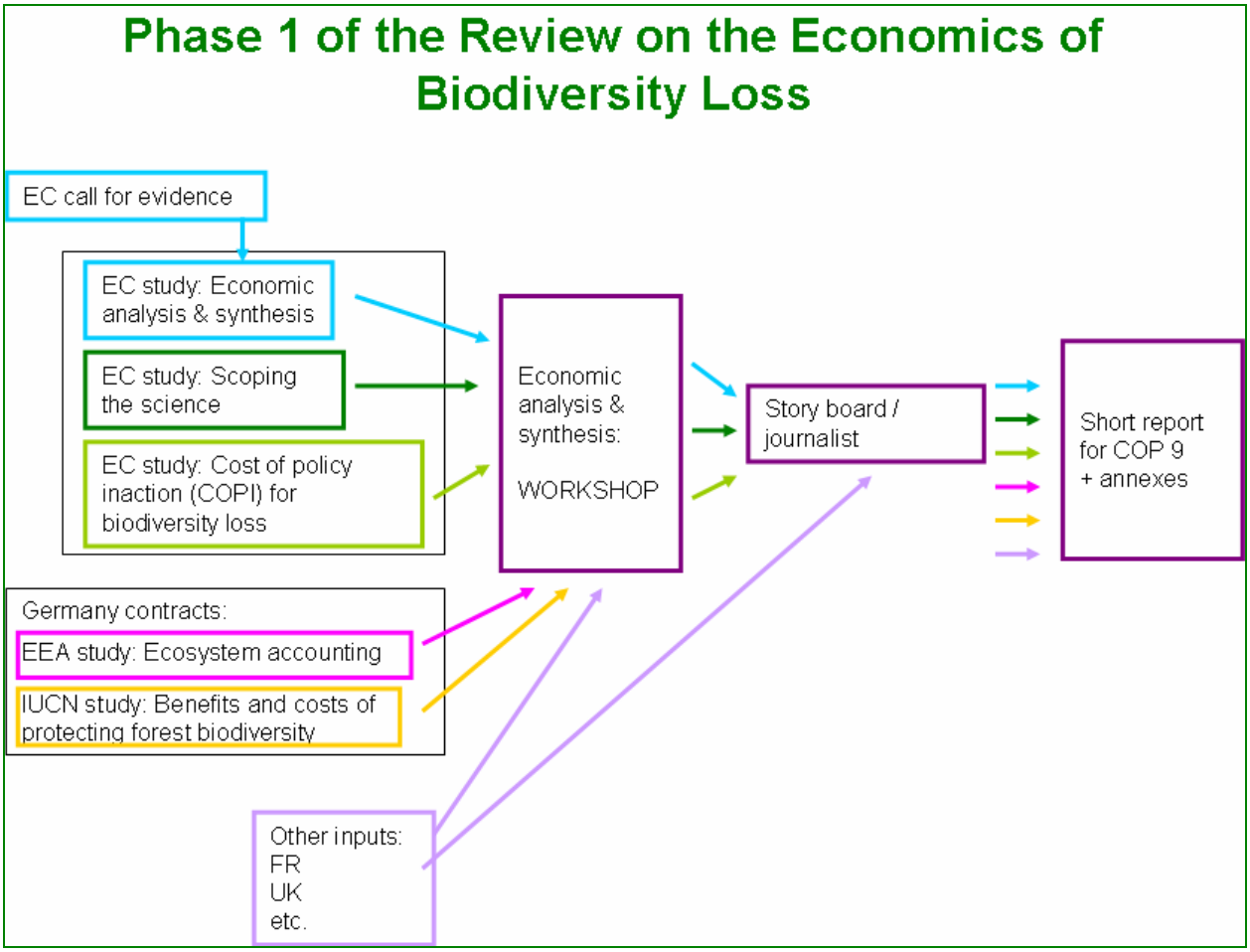
Pavan Sukhdev (appointed Review Study Leader, Deutsche Bank and Chairman of GIST, Green Indian States Trust) presented his vision and the purpose of the review. When speaking of his vision, he noted that society must urgently replace its defective economic compass if it is to preserve biodiversity; it is not only possible, but necessary to change metrics and this should be done at the state level, population level, corporate level and individual level. On the purpose of the

Review, he sees biodiversity evaluation not as an end in itself, but as preparing a valuation toolkit, tailored for successful end use, to help engage end users, with the end goal of achieving biodiversity conservation. He cited an example of the end users - the Supreme Court of India. Their call for evidence led to "floor values" being integrated into law for use in development decisions. This led to a fund created for the purpose of reforestation.

Patrick Murphy (Head of Unit, DG Environment, European Commission) gave a brief overview of the call for evidence organised by the European Commission at the end of 2007 and the other ongoing reports feeding into Phase 1 of the review (see Figure 1). He underlined that the aim of the call for evidence and the workshop was not just to create a literature review and a good debate, but to help tackle the challenge together. The outputs will be an input to a 50-60 page report that goes to COP9. This will cover ecology and economics and be accessible to policy makers. Phase 2 will last 2 years and go to COP10. The short term objective is COP9.

Heidi Wittmer (UFZ) canvassed participants' backgrounds and expectations for the workshop, including their key hopes and fears. She noted with satisfaction the global reach of the workshop attendents.

Paulo A.L.D. Nunes (Professor at University of Venice and FEEM) introduced the structure of the two days, the approach and speakers. He also thanked all those who contributed to the call for evidence for the review.


Phase 1 of the Review on the Economics of Biodiversity Loss
EC call for evidence
EC study: Economic analysis & synthesis
EC study: Scoping the science
EC study: Cost of policy inaction (COPI) for biodiversity loss
Economic analysis & synthesis:
WORKSHOP
Story board / journalist
Short report for COP 9 + annexes
Germany contracts:
EEA study: Ecosystem accounting
IUCN study: Benefits and costs of protecting forest biodiversity
Other inputs:
FR
UK
etc.

Sessions 2 to 4

This involved three parallel sessions (A1 to A3) from 11:00-12:30; a further three (B1 to B3) from 14:00 to 15:30;
Presentations were made to the plenary in the afternoon. These are presented in turn below.

Session 2: 11:00 to 12:30

A1 Setting the scene: from biodiversity to human welfare - what do we know about the links and what are the priorities for future research in ecological science?

Session Leader: Kerry Turner (UEA)

Session Participants: Diego Azqueta, Giovanni Bearzi, Pierluigi Bozzi, Leon Braat, Mike Christie, Roberto M. Constantino, Martin Dieterich, Yogesh Gokhale, Maryanne Grieg-Gran, Haripriya Gundimeda, John Hanks, Salman Hussain, Marianne Kettunen, Anil Markandya, Emily McKenzie, Shaun Mowat, Karachepone Ninan, Matt Rayment, Ana Rodrigues, Melinda Smale, Isabel Sousa Pinto, Ridhima Sud, Patrick ten Brink, Rob Tinch, Kerry Turner, Bernard Vaissiere, Wouter van Reeth, Matt Walpole, John Ward, Frank Wätzold, Ada Wossink.

A2 What types of biodiversity benefits should be prioritised in an economic assessment?

Session Leader: Pushpam Kumar (University of Liverpool)

Session Participants: Stefan Baumgärtner, Aline Chiabai, Zoe Cokeliss, Denis Couvet, Pierre Devillers, Anantha Duraiappah, Katia Karousakis, Anil Kumar, Pushpam Kumar, Markus Lehmann, Alistair McVittie, Bedrich Moldan, Paul Morling, Katrina Mullan, Stale Navrud, Patrizia Poggi, Rosimeiry Portela, Alice Ruhweza, Guillaume Sainteny, Daan Wensing, Bulat Yessekin.

A3 Integrated socio-economic scenarios of environmental change to highlight and compare alternative, future development trajectories.

Session Leader: Ben ten Brink (MNP)

Session Participants: Joshua Bishop, Pascal Blanquet, Leon Braat, Ingo Bräuer, Laura Dietzsch, Gustavo Fonseca, Roy H. Haines-Young, Mark Hayden, Nick King, Sigrid Lüber, Christoph Schröter-Schlaack, Ben ten Brink, Francis Turkelboom, Sybille van den Hove, Carlos Young.

A1 Setting the scene: from biodiversity to human welfare - what do we know about the links and what are the priorities for future research in ecological science?

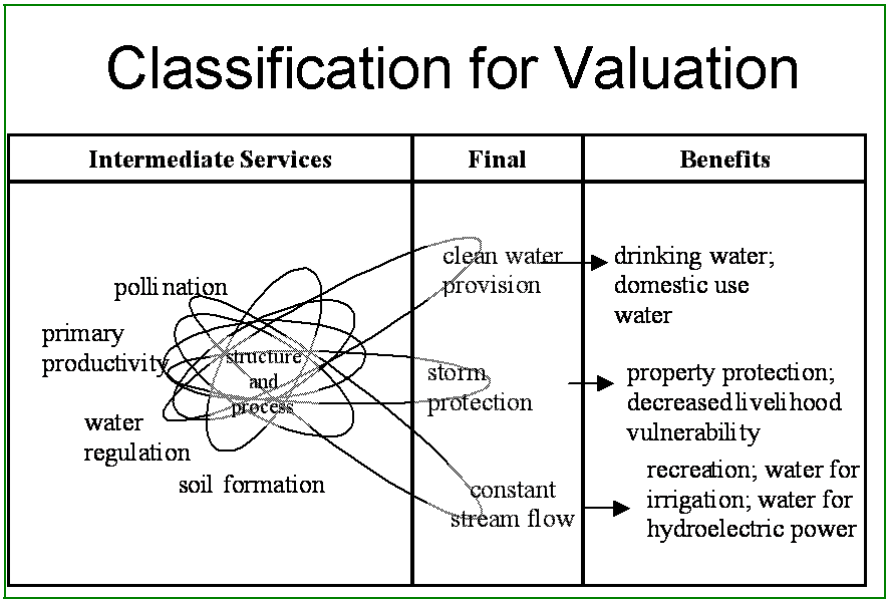
Session Leader: Kerry Turner (UEA)

Session Moderator: Patrick ten Brink (IEEP)

Session Note taker: Matt Rayment (GHK)

Session issues: *an assessment of the economic significance of biodiversity loss requires an understanding of how changes in biodiversity affect the provision of ecosystem goods and services. Some of these links are well understood, many others much less so. This session should explore the links between biodiversity and human welfare, addressing, for various types of benefits, what the state of ecological knowledge is, where the main research gaps are, and what the priorities for future work in the timeframe of the Review could be.*

Kerry Turner[13] gave the introductory presentation, noting that to value the benefits provided by biodiversity, we need a classification system linking biodiversity to ecosystem services and changes in human welfare. This needs to distinguish between "intermediate" services and "final" services that provide benefits to people - see figure bellow.



Classification for Valuation

There are several definitions and classification systems for ecosystem services (ES). Among these, the Millennium Ecosystem Assessment (MA) is widely acknowledged and cited, in particular in the context of international and EU policy-making. However, the MA approach is not ideally suited to valuation because it includes intermediate services as well as others which directly provide end-user benefits. This may lead to a double counting problem. Ultimately, we are interested in the value of biodiversity to society; the production function is needed only to understand what the benefits are.

Biodiversity is multifaceted and we need to understand which aspects (e.g. biomass, species diversity) are important for the provision of services to people. There may be aspects of the system that are redundant from a human welfare perspective.

Economists deal with marginal changes. Attempting to assess the total value of the services provided by biodiversity and ecosystems is pointless – it can be argued that it is infinite since we could not exist without them. Thus MA is a very useful assessment framework but we need to adapt it for the purpose of economic valuation.

[13] Kerry Turner is Professor at the University of East Anglia's School of Environmental Sciences, and director for CSERGE.

Key points from the discussion:

- There was agreement that the MA provides an excellent platform with which to take forward interdisciplinary dialogue on links between biodiversity change, ecosystem services and human welfare.
- It was agreed that the MA could be adapted and re-oriented to focus more on the requirements of economic valuation: (1) we need a classification system distinguishing "intermediate/core" services from "final" or "beneficial" services which provide benefits directly (i.e. are components of human welfare); (2) we can adapt the MA with little loss of functionality and mitigate the problem of double counting
- The approach should encompass the concept of a production function with inputs and outputs. The information used should be valid, functional and legitimate. A multidisciplinary approach is required to achieve this.
- The focus should be on the information requirements of this approach: At the front end, what are the implications of biodiversity loss for ecosystem services? We need to systematically review the existing science base and think more about which aspects of biodiversity loss (diversity and/or amounts) influence service delivery.
- Scale was thought to be a crucial issue: (1) Local contexts – indigenous knowledge, symbolic and cultural values; and (2) Global scale – tipping points
- Non linearity and threshold effects – what is the current state of knowledge, how to take forward a precautionary approach?
- At the benefit end of the production function, we need to: be aware of the limitations of economic valuation; (1) consider the intrinsic value of biodiversity; and (2) recognise that total ecosystem value > total marginal economic value.
- While there was some debate about intrinsic values, it was recognised that evidence of impacts of biodiversity on human welfare may be more influential with finance ministries and other decision makers. However, it was also agreed that there are limitations to what we can value.
- There is also a need to consider the costs of action. Much of the attention following the Stern report was focussed on the relatively low costs of action. Given the difficulties in valueing the non-market benefits in a notable way, demonstrating that there are areas where costs are low could be influential.
- There are significant gaps in scientific knowledge and these are greater for some taxa (e.g. invertebrates, marine organisms) than others (vertebrates, flowering plants). To a large extent we do not yet know what there is, let alone the consequences of losing it. This calls for adopting an ecosystem approach and applying the precautionary principle. Protecting flagship species can have a role if it conserves their wider habitats, but should not be the only approach.
- There are key scientific questions about the implications of biodiversity loss for ecosystem services. We need to consider what we know, what gaps there are, what questions we may be able to answer in the short to medium term and which ones we will never answer. The "scoping the science" work is important to identify the framework and gaps and should underpin the economic analysis. However, we do not need to know everything about ecosystems and biodiversity to understand the benefits they provide and begin to value them.
- We are losing key services which are economically important but not fully understood. In Africa key issues are disruption of water cycles including loss of tree cover, soil genesis and erosion, and pollination services. We also risk the loss of important marine services but there are big gaps in knowledge about these.

Main recommendations for the Review

Sort-term priorities (Phase 1 and COP9 report)

- Summarise what we know about the value of ecosystem services and about the contribution of biodiversity to these, basing the assessment on the MA.
- Set an agenda for taking forward an assessment of the economic value of biodiversity in the second phase of the Review, building on and adapting the MA for valuation purposes.

Priorities for 2008-2009: Phase 2 of the Review

- Adapt and take forward the MA to facilitate the valuation of ecosystem services and the role of biodiversity, to provide the tools for decision-makers to make arguments for conservation.
- The scope for additional pure research is limited – we need to use what we have – a multidisciplinary, systematic review of existing evidence is needed. We can develop existing valuation databases and combine them with scientific evidence and the development of appropriate analytical tools.
- Recognise that there are huge uncertainties and that the answer is unlikely to be a single big number.
- Examine the costs as well as the benefits of biodiversity conservation, to understand the full picture while recognising the difficulties in valuing benefits.

A2 What types of biodiversity benefits should be prioritised in an economic assessment?

Session Leader: Pushpam Kumar

Session Moderator: Paulo A.L.D. Nunes (FEEM)

Session Note taker: Aline Chiabai (FEEM)

Session issues: *the different types of benefits derived from biodiversity (e.g. food, water, recreation, non-use values) vary in their economic importance. What is the relative importance of these benefits and, in particular, which are likely to make a large difference to the quantitative assessment of the economics of biodiversity loss? What are typical ranges of values from available estimates? Given the potential and limits of economic valuation tools to assess the importance of biodiversity to people, what are the main types of benefits on which work could be focused in the timeframe of the Review, and what could be priorities for future research?*

Pushpam Kumar[14] pointed out the importance of economic assessment to help decision-makers facing trade-offs and choices. Every economic valuation exercise has to be associated with scenario building, including a business-as-usual (BAU) scenario.
Approaches to valuation can be based on:

- biodiversity, or
- ecosystem functions

Economic valuation will influence human actions (intervention), which will in turn influence ecosystems /resilience. Hence it can be argued that it is preferable to focus on ecological functions.

In principle, each assessment would need a detailed analysis of full costs and risks. Nevertheless, the different benefits associated with biodiversity conservation are more or less difficult to capture - like spiritual and religious values for example. Thus it should be decided which ones it is essential to try to capture.

Taxonomy of valuation methods
Useful approaches to valuation are the following:

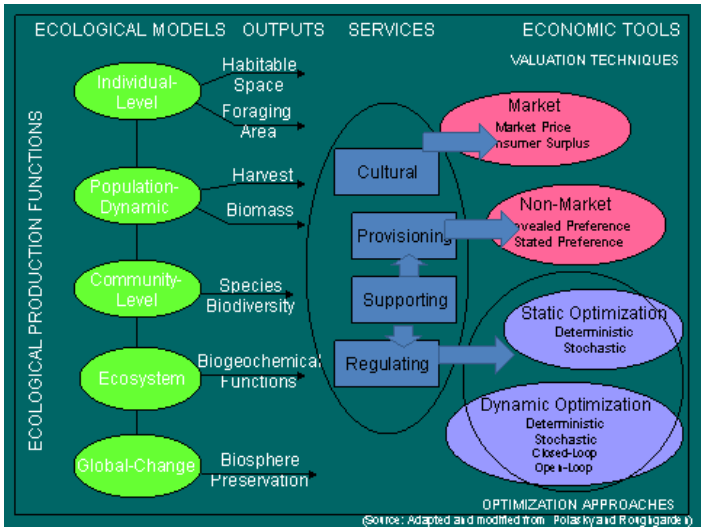
- Consumptive benefits should be valued based on consumer's preference, demand and location.
- Productive benefits can be valued by following a maintenance-cost approach/ restoration-cost approach / replacement-cost approach / cost-of-shadow-project approach.

Whichever approach is used, the integration of ecology and economics is essential. The output from ecological models can be analysed in terms of provision of the four main categories of ES used in the MA. Mr Kumar presented an example of ES valuation following a maintenance-cost approach from SEEA's Green Accounting Framework (2003) – see figure bellow.

Key messages for valuation exercises:

- Valuation has to be context-specific.
- The focus should be on marginal changes rather than the total value of biodiversity
- The assumptions that have been made about ecosystem conditions must be made explicit.
- Sensitivity analysis is important for policy-makers because of uncertainty.

[14] Pushpam Kumar is Lecturer at the University of Liverpool's Department of Geography



Ecosystem services (ES)

Key points from the Discussion:

- There are elements that are easy to value and others that are difficult. For the latter, it is important to determine how important the gaps are.
- Why should policy-makers care? Most developing countries have other priorities.
- One challenge is to demonstrate the link between biodiversity and ES. How does biodiversity contribute to resilience? Regulating services have not been sufficiently addressed by research, although they are essential.
- Biodiversity indicators could be very useful. Five indicators of ES are suggested, from local to national scales. These indicators represent how ecologists and economists can meet on common ground. But it is the economists who will value ES. Indicators and criteria are good, but they should be used to know what is happening. Indicators give the possibility of comparing regions. Indicators of biodiversity / ES can be used to describe how the provision of ecosystem goods and services changes over time/space. Indicators are good in the first part of the assessment (the biophysical one).
- Valuation of ES on a global scale is useful, but it is also important to address specific regional issues. Different levels of assessment (global to local scale) are needed.
- ES valuation can help to answer the following questions: what ecosystems should we save for global sustainability? How to prioritise conservation? What type of biodiversity should we focus on? There is a need for common objectives for the CBD.
- It was recommended not to use replacement costs as a general methodology since they can be different from the value for society (as measured by willingness-to-pay).
- For the setting of priorities it is important to capture some services, such as regulating services (unfortunately there is still no consensus.)
- It is important to value services from a welfare perspective. For this reason, we anchor the valuation in an incremental perspective, linking economic values to incremental changes (or avoidance) in the provision of ecosystem goods and services
- There is no amortisation of natural capital. It is not a measure of total value, but a flow; the cost that should be reinvested in the system in order to maintain life. Economic valuation has to be

careful about its objectives. The focus should be on flows and changes.

- Convention concerned with restoration (CMS). Focus on ES valuation. Here, the guide should be replaceability, i.e. which values are easier to replace. This then raises the question: what is easy to evaluate and what is replaceable?
- Valuation cannot address all relevant issues, because it cannot capture resilience, for instance. How much do we need to maintain and preserve resilience?
- Global economy and human life depend on biodiversity. It should be addressed in a global political summit, not only at the COPs. Not only an economic assessment is important, but also a physical one (because of the limitations of economic tools).
- It is important to focus on beneficiaries, not only on ES themselves. Cultural services and regulating services are sometimes global, sometimes local, etc. For setting priorities, we need to look at who are the beneficiaries at the different scales (to create a matrix of a general picture).
- Understanding the relationship between biodiversity and ES is difficult. There is a new approach which links functional biodiversity to functional groups.
- Analysis of forest biodiversity case studies shows a wide variation in values that does not only reflect different locations and forest types, but maybe also different methodological approaches. It is necessary to check if marginal changes or the value of existing stocks have been measured.
- Similar ES across the world are often valued in different ways. We should identify some criteria and provide some guidance for valuation – a valuation protocol is needed.
- Once we have an agreement on a valuation protocol, for both primary and value transfer exercises, we will have to use the existing studies to upscale the valuation exercise, and to address areas where there is a lack of original studies.
- Regarding benefit transfer, it would be useful to have some common guidelines for transfeing values from boreal forests to tropical forests, for example. COPI is addressing this point on how to value in a systematic way.
- Another question is how to translate values per hectare into net values. This will require information on the sector in question, including profit margins.

Final conclusion:

We have too much information, fragmented studies, and data. There is an urgent need for guidance on how to set up valuation studies for each ES, for each ecosystem (biome), and for different beneficiaries (local and global).

Main recommendations for the Review

Short term priorities (Phase 1 and COP9 report)

- Valuation of ES rather than biodiversity should be the preferred approach
- Valuation of provisioning services (food, fibre, etc) is easily doable and a number of studies and the necessary data exist. Efforts should focus more on regulating and cultural services.
- Economic valuation of biodiversity / ES must be done with a purpose - CBA, Accounting, Payment, Evaluation of action /inaction, etc.
- Valuation of ecosystem services must be associated with the condition / state (BAU / Alternate Scenario).

Priorities for 2008-2010: Phase 2 of the Review

- Develop an evidence base for ecosystem relationships and ecosystem services (localised SGAs).
- How much biodiversity do we need to maintain ecosystem services?
- Designing criteria and guidance for transfer of estimates for ecosystem services (e.g. per ha value of carbon, bioprospecting and water-flow).
- Greater attention to the valuation of regulating services.
- Identifying the thresholds, the point of non linearity and resilience for a variety of ecosystems.

A3 Integrated socio-economic scenarios of environmental change to highlight and compare alternative, future development trajectories.

Session Leader: Ben ten Brink (MNP)

Session Moderator: Leon Braat (Alterra)

Session Note taker: Christoph Schröter-Schlaack (UFZ)

Session issues: *scenarios are necessary for exploring future trends of biodiversity loss and changes in ecosystem services. They are used to analyse the effects of socio-economic trends on pressures to ecosystem functions (state), and the ability of ecosystems to sustain goods and services (impacts). The possible feedbacks of changes in impacts on policies (drivers) will also be explored.*

Ben ten Brink[15] started his introductory presentation by giving an example of the continual loss of biodiversity – metaphorically speaking; humankind is fishing down the food web. The overall available biomass may stay the same, but species composition changes dramatically as big species are declining and the share of short-living and highly productive species increases. This trend is reflected in a decline of the Mean Species Abundance (MSA)-indicator, which is frequently used in modelling approaches. As humans strive for maximising the output of some specific ecosystem services, this intensification of specific uses comes along with high pressure on natural systems and MSA decreases accordingly. Ben ten Brink identified some drivers of biodiversity loss and stressed the threat that societies may plunge into lose-lose situations between degrading ecosystems and increasing social vulnerability. This prediction holds for prosperous societies, too.

Ben ten Brink then presented some results of the GLOBIO-modelling approach (developed in cooperation with UNEP-WCMC), by showing possible scenarios of population, income and energy consumption growth between 2000 and 2050. Since the economy may grow by four times over that period, MSA may drop from the current value of 70% to 63% in 2050. Although this seems to be a moderate decline, this 7 % loss would correspond to reducing the whole United States of America from its natural state to asphalt. Overall, the main argument holds that the higher economic growth is, the higher the loss in MSA. Taking a look back at economic development from 1700 on, biodiversity loss accelerates over time and especially richer (and more valuable) ecosystems face the highest levels of degradation. The lesser loss in poorer ecosystems should be seen as just a time lag, these marginal ecosystems werebrought into use by humankind more recently, but will soon face a corresponding threat.

Illustrations were shown of the on-going loss of biodiversity as measured by MSA. The combination of the GLOBIO-model with Google Earth maps allows zooming from global to national, regional and local scales.

Key points from the discussion:

- The kind of information that is fed into models such as IMAGE-GLOBIO was discussed. Current models assume an infinite resource base and do not include feedback loops between loss of biodiversity / natural ecosystems and GDP. This is quite unrealistic, particularly over the long term, and undermines the credibility of the results of modelling exercises. The necessity to

[15] Ben ten Brink is Project Leader at MNP

find ways of including such feedbacks between ecosystem service supply and economic growth in modelling was stressed. However, this task is challenging. The "beyond GDP" movement was seen as a stimulating discussion in that respect.

- The question was raised whether there are successful cases of decoupling economic growth from ecosystem degradation. Some examples were mentioned for air quality and land use. However, they have to be handled with caution, e.g. even the successful case of Costa Rica's increase in MSA in recent years comes along with some higher losses in nearby regions (Nicaragua). In biodiversity conservation, there is the threat of focussing efforts on the last percentages of biodiversity in developed countries, whereas at the same time much more is lost in the developing world.
- How to integrate already fragmented (and near to extinction) species in the modelling? It may be difficult to demonstrate their economic value.
- There was substantial discussion on whether MSA is the right measure, especially for the provision of ecosystem services. With regard to a possible win-lose relationship between MSA and GDP (i.e. trade-offs), is there a stable path involving low MSA accompanied by a growing GDP? Are there turning points? How robust are predictions (sensitivity analysis)?
- As GDP is a dynamic concept, a map of conservation per dollars spent should be used for distribution of conservation efforts. Furthermore, it is important to consider what social stratum is touched by a redistribution of GDP. In the Indian case – 70% of the people make up around 20% of GDP – even marginal changes may have huge impacts on this group. The traditional definition of GDP needs to be challenged for these reasons*;* the growth paradigm must be questioned.
- Focussing on the global level tends to underestimate impacts; some regions will lose 40-50% of ecosystem services by 2050.
- Modelling raises awareness – but should we put more energy into deciding how to change development? When there is no escape mechanism, society has to evolve a solution. Energy analysis seems to be promising in this regard, as every solution for substituting ecosystem services so far has been accompanied by an increase in energy consumption.
- To avoid intensification of natural resource use and degradation of ecosystems in developing countries, developed countries have to pay for part of the foregone opportunities.

Main recommendations for the Review

Short term priorities (Phase 1 and COP9 report)

- Raise awareness and demonstrate the urgency of the problem (and assess alternatives).
- Consider feasible (technically and politically) solutions (factor 10 club; global compensation mechanism safeguarding biodiversity?). However, even with the development of market solutions, governmental regulation will remain necessary (to address social dilemma).
- To limit the maximum conversion of ecosystems is a political choice, but insights into the contribution of ecosystem services to economic value can help.
- There is a need for a new economic paradigm based on carrying capacity of ecological systems (a new type of GDP).

Priorities for 2008-2009: Phase 2 of the Review

- Measure and model all CBD-indicators, including goods and services
- Run scenarios on sustainable ecosystem use (major & minor users)
- The absence of feedback loops between loss of biodiversity / ecosystems and economic growth in models is unrealistic and undermines the credibility of results. Need to find ways of including feedbacks between supply of natural resources and economic growth in the modelling.
- Develop maps of best conservation opportunities
- Address the role of the red list indicator in the Total Economic Value framework
- Pay particular attention to quantifying trade-offs between provisioning and regulating services.

Session 3: 14:00 to 15:30

B1 Measuring benefits from ecosystem services in monetary terms – using market and non-market based methods

Session Leader: Alistair McVittie

Session Participants: Aline Chiabai, Zoe Cokeliss, Deighton Conder, Roberto M. Constantino, Martin Dieterich, Anantha Duraiappah, Maryanne Grieg-Gran, Haripriya Gundimeda, Mark Hayden, Salman Hussain, Alistair McVittie, Paul Morling, Shaun Mowat, Ana Rodrigues, Alice Ruhweza, Christoph Schröter-Schlaack, Melinda Smale, Ridhima Sud, Kerry Turner, Bernard Vaissiere, Wouter van Reeth, Daan Wensing.

B2 Measuring benefits from ecosystem services – integrating monetary and non-monetary estimates

Session Leader: Patrick ten Brink (IEEP)

Session Participants: Stefan Baumgärtner, Pascal Blanquet, Pierluigi Bozzi, Mike Christie, Denis Couvet, Pierre De Villers, Laura Dietzsch, Yogesh Gokhale, Roy H. Haines-Young, John Hanks, Nick King, Pushpam Kumar, Berta Martin-Lopez, Bedrich Moldan, Stale Navrud, Karachepone Ninan, Rosimeiry Portela, Matt Rayment, Isabel Sousa Pinto, Patrick ten Brink, Sybille van den Hove, Matt Walpole, Ada Wossink.

B3 The aggregation challenge: how to go from small changes and individual case studies to the big picture

Session Leader: Ståle Navrud (Norwegian University of Life Sciences)

Session Participants: Diego Azqueta, Giovanni Bearzi, Joshua Bishop, Leon Braat, Ingo Bräuer, Gustavo Fonseca, Katia Karousakis, Marianne Kettunen, Anil Kumar, Marius Lazdinis, Markus Lehmann, Sigrid Lüber, Emily McKenzie, Katrina Mullan, Elsa Nickel, Guillaume Sainteny, Ben ten Brink, Rob Tinch, Francis Turkelboom, Hans Vos, John Ward, Frank Wätzold, Jean-Louis Weber, Bulat Yessekin, Carlos Young.

B1 Measuring benefits from ecosystem services in monetary terms – using market and non-market based methods

Session Leader: Alistair McVittie

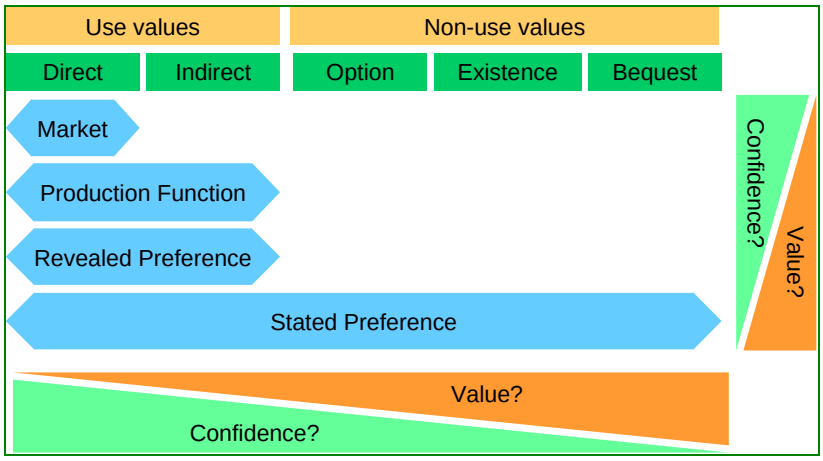
Session Moderator: Paulo A.L.D. Nunes (FEEM)

Session Note taker: Aline Chiabai (FEEM)

Session issues: *this session should include an evaluation of economic techniques for assessing the importance of biodiversity to people. What is common practice and what are promising developments? This session will also explore the potential use of quantitative socio-economic models in combination with case study based approaches to evaluate the welfare changes associated with different scenarios. What are the methodological challenges ahead in making an efficient, policy relevant evaluation of ecosystem goods and services?*

Alistair McVittie[16] presented an evaluation of economic techniques for assessing the importance of biodiversity to people. Evaluation is generally based on the Total Economic Value framework, exploring both the magnitude and the degree of confidence of each value estimate.

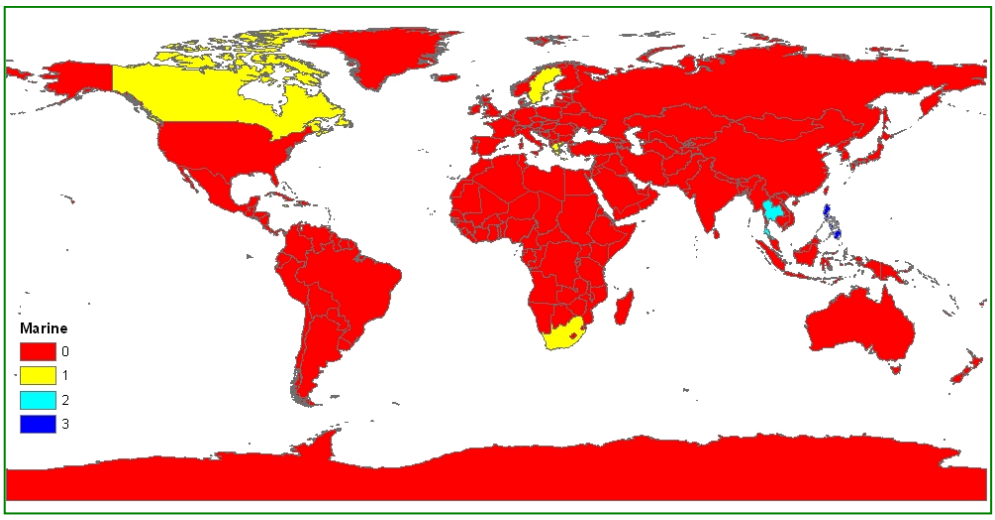
Information on opportunity costs can provide a first benchmark. Next to cost figures, direct use values from market-based information have a high confidence. Indirect uses are more difficult to estimate but for climate change, the shadow price of carbon and carbon trading can be used – see figure below-



Information, value and confidence

To facilitate economic valuation studies, several databases have been set up, e.g. EVRI. The EVRI database provides a dataset on both market and non-market valuation studies. The categories and the structure of this dataset do not correspond to the MA categories. Nor is it very heavily populated, especially with regard to marine studies – see figure below.

[16] Alistair McVittie is researcher at the Scottish Agricultural College.



Mapping of marine valuation studies

The use of quantitative socio-economic models was explored to see how they could be combined with case study based approaches, in order to evaluate the welfare changes associated with different scenarios.

The lack of production functions was stressed: there is a need for substantial work in this area. In the context of marine ecosystems, several questions were raised. What is the link between conserved areas and fish productivity? What is the link between resilience and resistance?

It is important to come to an agreement about the mapping of ecosystem goods and services as a result of a nature production function. The nature production function is dependent on ecosystem conditions, including both the state of biodiversity quality and the range and complexity of the natural processes involved. However, there is currently limited knowledge about the forms of production functions that link ecological and economic scales, processes and values.

Key points from the discussion:

The MA and other ecosystem goods and services approaches have focused on processes, functions and services. Ecosystem services, or more generally biodiversity benefits, are recognised by economists as being a platform for welfare changes.

All in all, knowledge from economic valuation studies remains fragmented. Some datasets, such as EVRI, aim at providing a compilation of worldwide valuation studies. There is an urgent need to merge this dataset with other ones (including those from Scandinavian countries, from the Wageningen University, and from the school of Bob Costanza) into a single one, thus forming a meta-data basis.

Having reached that stage, one would have a more complete picture of the existing work on case study based economic valuation. Then it would be possible to proceed with more efficient up-

scaling. Furthermore, up-scaling may be followed by additional primary valuation studies where needed – the meta-data basis will signal where additional investments are necessary.

When planning to invest in additional valuation studies (primary valuation), one should explore the potential for wider levels of analysis, including the role of participatory approaches, recognising cultural sensitivities, and ways of embedding the structure of preferences of the local, rural communities, NGOs, and other stakeholders in the valuation exercise.

Areas with rich biodiversity, the so-called hot spots, are often inadequately covered by valuation studies. The studies generally take place in areas for which researchers have received financial support, which are not necessarily the most relevant ones from a biodiversity protection perspective.

Additional efforts are needed to map and evaluate option or insurance values (which can be interpreted as an insurance premium to avoid disruption to the flow of ES).

Finally, the group discussed whether targeting policy-makers on the issue of biodiversity loss is the only way to proceed in terms of creating instruments for conservation policy. Would it be more efficient to explore the idea that protection of biodiversity could provide some significant business opportunities for the private sector? Would the private sector deliver biodiversity protection in a more efficient way? One could explore leaving some protection effort to the private sector, with a complementary effort by policy-makers, mainly on the provision of the public benefits of biodiversity.

Short-term priorities (Phase 1 and COP9 report)

- Use existing data bases.
- Try to demonstrate that protection of biodiversity could also provide significant business opportunities for the private sector.
- Stress the importance of insurance values even though more work will be needed to assess them properly.

Priorities for 2008-2009: Phase 2 of the Review

- Compile datasets from worldwide valuation studies in order to form a meta-data basis.
- Explore the potential for broadening the approach of valuation studies, including the role of participatory approaches, cultural sensitivities and ways of embedding local communities' preference structures.
- Make additional efforts to map and evaluate option (insurance) values.

B2 Measuring benefits from ecosystem services – integrating monetary and non-monetary estimates

Session Leader: Patrick ten Brink (IEEP)

Session Moderator: Matt Rayment (GHK)

Session Note taker: Onno Kuik (IVM)

Session issues: *in practice it is often the case that only part of the services provided by ecosystems can be assessed in monetary terms, while for some other services only measures in biophysical terms are available. This session should evaluate the economic and non-economic techniques for assessing the importance of biodiversity benefits and how to combine information in biophysical terms with monetary estimates.*

Patrick ten Brink[17] presented the different levels at which the benefits from ecosystem services can be categorised – the monetary, quantitative and qualitative levels – using a benefits pyramid to underline that fewer facts can be represented at the monetary level than at the quantitative or qualitative level (see figure).

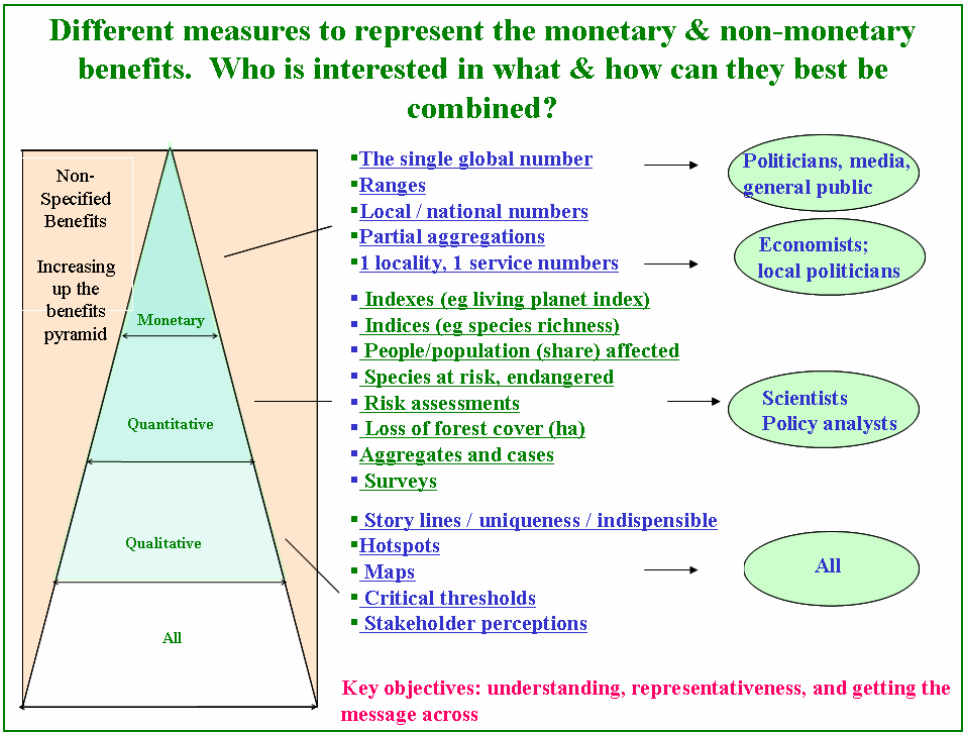


Figure 4: ???

Information pyramid: of the full range of ecosystem services, we can assess only a part qualitatively, assess only a smaller part quantitatively, and assess an even smaller part in monetary terms. The monetary values we have are not likely to be representative of the full range of services, nor are they likely to be representative from a geographical point of view.

[17] Patrick ten Brink is Senior Fellow and Head of the Brussels Office of the Institute for European Environmental Policy (IEEP). ptenbrink@ieep.eu

There is a disconnection between supply of information (mostly quantitative / qualitative) and demand for information (most interest in monetary assessment). There is therefore a tension between the level of interest and the data availability – many people are interested in the "single global number for the value of biodiversity", for which there is less information, while there is generally less interest at the non-monetary levels, where there is more information.

We need to integrate monetary assessments (from local to global) with other information/assessments such as indices, storylines, etc. For communication of biodiversity loss to COP9/10 we need to find an appropriate balance of information.

Patrick ten Brink underlined that the challenge for the 50-60 page report for COP9, the wider review and the general question of the cost of policy inaction (equivalent to the loss value of ecosystem services, from loss of biodiversity) is to present an honest and representative picture, that gets the messages across in a form that reaches the range of interested parties – politicians, media, economists, scientists, policy analysts and general public. He underlined that a mixture of the different levels will be important – monetary figures are useful, essential even for certain audiences; quantitative facts about areas lost, or the share of populations affected will work for some; while headlines, maps, and insights on hotspots will be important for others.

Key points from the discussion:

- Even where a single number is obtained it will never be representative of the full value of biodiversity loss.
- Bio-physical issues and monetary measures are in some cases two very different things; in other cases monetary estimates can represent bio-physical reality.
- There are some problems with non-commensurability and non-substitutability – e.g. one cannot always substitute one service or one benefit with another.
- There was agreement that we need both quantitative and monetary assessments to ensure a representative picture.
- It was recommended that we use a number of different indicators (three to four) to convey the message. It is also important to make the link between biodiversity and cultural and social assets.
- A range of measures are needed to get the messages across to different parties
- We need to understand which information "sticks" to different audiences (including business), and which is useful for different decision making tools
- New measures including the ecological footprint (EF, HANNP et al.) are worth considering in order to reach certain audiences
- The EF, while supported by some, was doubted by others, noting that EF has disadvantages – it can be distracting from ecological services per se, and is potentially confrontational in North-South debates.
- There was also some debate on the role of happiness indicators (some participants recommended indices as the Happy Planet Index), since biodiversity leads to wellbeing and hence the need for appropriate indicators. Some thought that this would be distracting, others thought helpful.

- This led to the question as to whether the indices should be more focussed on biodiversity. Suggestions raised for measures that would be potentially highly visible and that could help with communication included “fun per ton” and “happiness per hectare”.
- Other measures are also valuable – e.g. uniqueness
- There was disagreement about the relative merits of energy analysis/thermodynamics in valuation. It was not recommended to try this before COP10.
- Other tools thought to be useful included “vulnerability assessments”.
- When selecting the indicators, it was underlined that it is important to ensure that different stakeholder interests/attention to indicators are factored in – we need to check what information is needed to get the message across.
- Remember the different communication power of different measures – e.g. power of maps, national hotspots.
- To be useful to policy makers, the information of biodiversity loss needs to be repackaged to the national level. Especially for African countries, national information is the key – global information is less relevant.
- Indices should convey a sense of urgency.
- There was a question on how non-monetary indices should be aggregated; the use of geographical maps was recommended as a good heuristic device.

Main recommendations for the Review

Short-term priorities (Phase 1 and COP9)

- Use a mix of qualitative, quantitative, and monetary indices in the report – be careful about the balance between them to ensure that the main issues are represented and the messages are communicated effectively.
- Include country-level information.
- Make use of maps.
- Look to build on existing indicators and initiatives as far as possible

Priorities for 2008-2009: Phase 2 of the Review

- For Phase 2, the recommendations are similar to those for for Phase 1, but also look at decision-making processes, evaluation tools and information needs to check what information is needed to get the message into processes that have impacts. Keep in mind the end-game of getting practical changes.

B3 The aggregation challenge: how to go from small changes and individual case studies to the big picture

Session Leader: Ståle Navrud (Norwegian University of Life Sciences)

Session Moderator: Ingo Bräuer (Ecologic)

Session Note taker: Aude Neuville (DGENV)

Session issues: *how to use values from case studies for large scale assessments? An efficient use of the benefit transfer tool is a great challenge for natural scientists and economists so as to deliver value estimates of policy relevance. The difficulties include not only how to transfer values which are site-specific but also how to take into account the cumulative effects of small changes in ecosystems when estimating the consequences of large changes, and how economic values can vary accordingly. What are the informational and methodological needs to deliver such estimates*?

Stale Navrud[18] introduced the session by explaining that benefit transfer (BT) involves transferring an economic value of a public good estimated from a study site (primary valuation study) to a policy site; both benefits and costs can be transferred ("value transfer"). Increased use of cost-benefit analysis (CBA) and lack of time and money to do new primary studies justify the use of BT. Case studies can be drawn from a number of international and national databases of valuation case studies. The web-based database EVRI (www.evri.ca) is the most comprehensive one and is continually updated and extended.

However, BT implies increased errors. How can we limit them? Quality assessment of primary valuation studies is important. BT methods include unit value transfer (naïve or with adjustments) and function transfer (benefit functions and meta-analyses). Criteria for BT include scientific soundness, relevance, and richness in detail. Protocols can be defined. What transfer errors are acceptable? It depends on policy use (e.g. higher accuracy needed if directly used for compensation payment). Studies suggest that willingness-to-pay (WTP) does not always vary with the size of ecosystem area, therefore transfers and aggregation using value per hectare may be biased.

General question for discussion: what are the difficulties/challenges in benefit transfer of biodiversity values, from ecological and economic points of view?

Specific issues for discussion:

- requirements for benefit transfer, especially access to EVRI database and coverage of EVRI for biodiversity studies;
- level of valuation/transfer: species, habitats, ecosystem services and functions;
- use vs. non-use values;
- reliability of use and non-use values (hypothetical vs. actual WTP, e.g. Veisten & Navrud 2006);

[18] Dr Ståle Navrud, Department of Economics and Resource Management, Norwegian University of Life Sciences, Ås, Norway.

- site-specific values: different baseline conditions?
- transfer methods: unit transfer, function transfer, meta analysis;
- BT protocol for biodiversity;
- double counting issues (e.g. different methods estimate partly overlapping value components);
- how to deal with uncertainty and risks;
- what are acceptable transfer errors for which purpose;
- aggregation issues (aggregating over areas, species, habitats, affected households, etc.);
- cumulative effects;
- for BT, only new primary valuation studies using state-of-the art methodology should be used;
- new primary studies should be constructed and reported with BT in already mind;
- there is a need for a protocol for new primary valuation studies for biodiversity.

Key points from the discussion:

- For the purpose of the Review, there is a need for both transfer and aggregation.

How to implement benefit transfer?

Basic requirements for valid BT are:

(i) access to valuation databases
(ii) best practice criteria for assessing quality of valuation studies, and
(iii) best practice criteria for benefit transfer techniques (unit value transfer, benefit function transfer and meta analysis)

(i) The accessibility of databases, in particular of EVRI, should be improved. Many studies are unpublished/unavailable on databases. Valuation studies are distributed unevenly for type of ecosystem (e.g. abundance of forest studies) and for geographical location. In EVRI there is still a large representation of North American studies, although many studies have been added over recent years.
(ii) The quality of studies is quite heterogeneous; there has been significant progress since the 1990s. The methodology is often not reported in enough detail in databases. There is a need for common criteria for quality assessment.
(iii) At the case study level, transfer is defensible (the review suggests average errors of 25 to 40% in national and international transfers; also for ecosystem goods and services) Try to take into account the quality of the resource and its relative scarcity (if not, higher uncertainty).

How to undertake aggregation?

- Aggregation is a huge challenge: uncertainties increase with higher levels of aggregation - and so does distrust in valuation! There is no easy solution.
- The units of valuation needed for policy making (ha of ecosystem) are not the same as those that are directly meaningful to ecologists or the public: e.g. some services are available whatever the size of the ecosystem, while for others a minimum size is needed. The units are not the same either as those actually used in valuation studies, which reflect how people think about biodiversity and ecosystem services. It is a challenge to use per ha values. There is a need to refer to the population concerned and to take into account how WTP changes with distance from the resource (depends on the ecosystem service).

- The acceptable size of transfer and aggregation error depends on policy use: higher level of accuracy required for cost-benefit analysis (CBA) vs. Green National Accounting (order of magnitude may be acceptable) vs. Externality valuation vs. Natural Resource Damage Assessment (NRDA)).

Research agenda

- Test validity and reliability of transfer and aggregation within and between (developed and developing) countries, by conducting similar valuation studies in multiple countries.
- Develop studies and methods to reduce uncertainty of economic valuation of biodiversity when aggregated on a larger scale (which is needed to move from a CBA of preservation projects - case studies - to assessing e.g. EU-wide and worldwide policies).
- Further develop valuation methods for biodiversity; including contributions from deliberative methods to address the heterogeneity in preferences
- Research needed on temporal transfer – New studies on how economic values of biodiversity change over time
- Research needed on non-monetary units, e.g. NRDA techniques of habitat equivalence analysis (HEA)

Main recommendations for the Review

Short-term priorities (Phase 1 and COP9)

- Aim for valuation of biodiversity / ecosystem service rather than of single species as people have more well-defined and stable preferences for ecosystems.
- GDP per capita adjustments of economic values (i.e. unit transfer with income correction) can be used as a first approach in international transfers to overcome the lack of studies in some parts of the world.
- Communicating some good case studies can already be influential.
- Need to take into account the appropriate scale for policy relevance.
- Need to recognise limits to transfer and in particular to aggregation: valuation studies typically value discrete changes, which are converted to marginal values and then scaled up, not taking into account non-linearity, thresholds/critical limits, changes in economic conditions etc.. Avoid a new Costanza et al. exercise.
- Draw from a continuum of case studies (from small to large scale)

Priorities for 2008-2009: Phase 2 of the Review

- More work needed in Phase 2 to determine how far we can go in aggregation without undermining credibility.
- It is preferable to use several assessment approaches (not only CBA); however, even with assessment in non monetary terms, the problem is to determine the weightings.
- Convey the need for more primary valuation studies constructed for transfer and aggregation.
- EU and other countries should subscribe to EVRI database and populate the database with existing primary valuation studies on biodiversity.
- Best practice guidelines for benefit transfer exist, but should be adapted to biodiversity valuation.

Session 4

Reporting back to the Plenary

The 6 speakers reported back to the plenary (key points as in above sections[19]), with subsequent discussions. Points from the plenary discussion include:

A1: Kerry Turner

Kerry Turner suggested an ecosystem services classification, such as the one in Turner 2008 (and in Scoping the Science), in which a production function is employed solely for the benefits production. The non-linearity and threshold effects need to be studied further. It is important that one does not try to oversell economic valuation.

A2: Pushpam Kumar

Pushpam Kumar emphasised the relationship between ecosystems and ecosystem services. The benefits of biodiversity should be measured at a variety of ecosystem service levels. A priority is to design criteria and guidance for benefit transfer of estimates for ecosystem services. Greater attention should be given to regulating services. Furthermore, it is necessary to identify thresholds, points of non-linearity and ecosystem resilience. He also stressed the point that any economic valuation of biodiversity and ecosystem services should be done with a purpose- CBA, Accounting, Payment, Evaluation of action /inaction etc. Valuation of ecosystem services must be associated with the condition /state (BAU / Alternate Scenario).

A3: Ben ten Brink

Ben ten Brink outlined what the priorities for 2008-2010 are. Scenarios on sustainable ecosystem use must be run, distinguishing between major & minor factors. Maps of best conservation opportunities must be developed. The importance of incorporating the red list species in the Total Economic Value framework was stressed. Another priority is developing strategies on how to block human escapes to overcome ecosystem depletion (tunneling through). The trade-off between direct land use (goods) and regulating services must be quantified.

[19] See also the reporting back slides on http://www.ecologic-events.de/eco-loss-biodiv/index.htm

Discussion A1 to A3

- There is a risk of losing sight of the relationship with biodiversity, when focusing valuation on ecosystem services only. The main function of biodiversity is to preserve the adaptability of ecosystems in the short and long terms – a fact that did not show up in the valuation. The relationship between biodiversity, ecosystem functions and ecosystem goods is very complex.
- Ecosystem services are not the same as biodiversity: services are replaceable and could be bought. The concept of ecosystem services is a useful tool, especially for the review on the economic consequences of biodiversity loss. Losing biodiversity means losing welfare. Ecosystem services can be seen as an intermediate. Hence the CBD suggests that the sustainable use of components of biodiversity, such as genes, species and ecosystems, can be a bridge for an introduction of the ecosystem service-term.
- The framework used in the first group was specifically to illustrate the relationship between biodiversity, ecosystem services and benefits – scaling up knowledge about resilience from plot-scale to real-world scales, at the very front-end.
- It is necessary to look at a wide range of different groups in society, which makes it plain that the relationship between ecosystem services and biodiversity is inescapable.
- Umbrella / flagship species can be used as a tool to see the relationship between biodiversity and ecosystem services.
- The costs of quasi-extinction, such as species recovery plans, must be considered. In the case where only a few remnants of a species are left, ecosystem services evaluations make less sense. There is no value in it from the beginning - except for the intrinsic value.
- An economic valuation should be assisted by physical valuations and the incorporation of possible enforcement mechanisms. Cost Benefit Analysis is not the answer to the policy question; it is a framework that should be used inclusively and not exclusively.
- Goods production is the very cause of deterioration for ecosystems.
- Stern's strategic masterpiece was to present climate change not as an environmental, but as a development issue. The benefit of this is that one can use the momentum brought up by the Millennium Assessment and bring in the issue of equity, especially in scenario usage with poverty levels and other equity indicators.

B1: Alistair McVittie

Alistair McVittie focused on the need to scale up from existing studies, but also emphasised the difficulties in getting reliable data. New studies need to focus where biodiversity is policy relevant and make valuation more robust. In addition, it would be beneficial to explore the potential for wider analysis:

- the role of participatory approaches
- cultural sensitivities
- ways of embedding local communities' preference structures.

Furthermore, the option, or insurance, value should be estimated. It is important to determine what the area, especially floor level, of valuation should be: the object is to avoid any interruption of the service flow. Policy makers are only one of many target groups. Also local communities, NGOs, civil stakeholders and politicians should be considered.

B2: Patrick ten Brink

Patrick ten Brink explained how the overall aim of a presentation is to be representative of the facts and engage the interest of a range of key audiences. There is a pyramid of information available in all categories – qualitative, quantitative and monetary. The pyramid can be seen as a large toolkit with different groups being interested at different stages of the pyramid. One should look at the information or function provided by different measures. The global number is a tool, but it has to be used very carefully. There is agreement that both quantitative and qualitative measures are needed to ensure a representative picture. Another possible tool is vulnerability assessments. As to the type of stakeholder that one aims to reach, each should be tackled with their specific information or data requirements. The second phase should be to look at the decision making process and information needs, and check what information is needed, in order to get the message into those processes that have an impact.

B3: Ståle Navrud

Ståle Navrud said that benefit transfer is necessary but asked whether benefit transfer at case study level is defensible, with average errors being between 25 and 40%. In addition he pointed out that the discussion ended with the recommendation to be careful with upscaling exercises. The reason for this is that the units of valuation needed for policy-making (e.g. ha of ecosystem to be conserved) are not the same as those that can be considered to be ecologically meaningful or useful for valuation. The basic requirements for a valid benefit transfer are access to the valuation database and a set of best practice criteria for assessing the quality of primary valuation studies and the benefit transfer techniques, in order to minimise transfer errors. GDP per capita adjustments can be used in calculating willingness-to-pay for benefit transfers. Nevertheless there are limitations to upscaling: more primary valuation studies are needed as well as best practice guidelines for benefit transfer. The validity and reliability of transfer and aggregation must be tested (i.e. by conducting similar studies in different regions).

- There are a number of case studies in the EVRI database that are relevant to biodiversity – although not written specifically on that issue. There are many case studies on valuation of land uses, even if these do not involve the term ecosystem services. The difficulty of finding these is increased by the complicated structure of the database.
- One should be aware that the database is not comprehensive, and many studies are not included for different reasons (e.g. not published, etc.). In addition it is primarily focused on Europe. There are publications for Africa in the grey literature.
- There is a limited number of studies from developing countries (approximately 200 studies of the overall 2000) – and these studies are not accessible to policymakers in those countries.
- There is unease with regard to the acceptability of different valuation methods, especially with transfer benefits methods.
- Transfer seems to work better than we could ever have hoped for. But it has to be kept in mind that there is a lot of uncertainty in primary studies also, e.g. the difference between hypothetical and real WTP.
- The costs of conservation are much easier to determine than the benefits. Empirical data shows that costs are very low and that should be a strong political argument.
- It is possible to adopt various angles – i.e. reactive vs. proactive approach, reactive being far more costly.
- A priority list of ecosystems should be used. The COPI study considers this by looking at different biomes. Grassland is facing the heaviest impacts. There are many systems of conservation priorities available and they are not coherent. In addition they are totally blind to the economics side – not taking into account costs and benefits. For most of the affected ecosystems valuation studies have not yet been developed.
- The marine environment should be considered as a top priority area to conduct additional primary studies, since the discrepancy between importance and available knowledge is high.

Session 5

Costs of biodiversity loss - contributions / case studies

This session included the following presentations, with key points presented in order thereafter. Each is a useful input to the biodiversity review process.

- **Ecosystem accounting applied to wetland case studies by EEA**

Jean-Louis Weber

- **Forest study by IUCN**

Katrina Mullan

- **Marine Bill valuation study made for DEFRA**

Salman Hussain

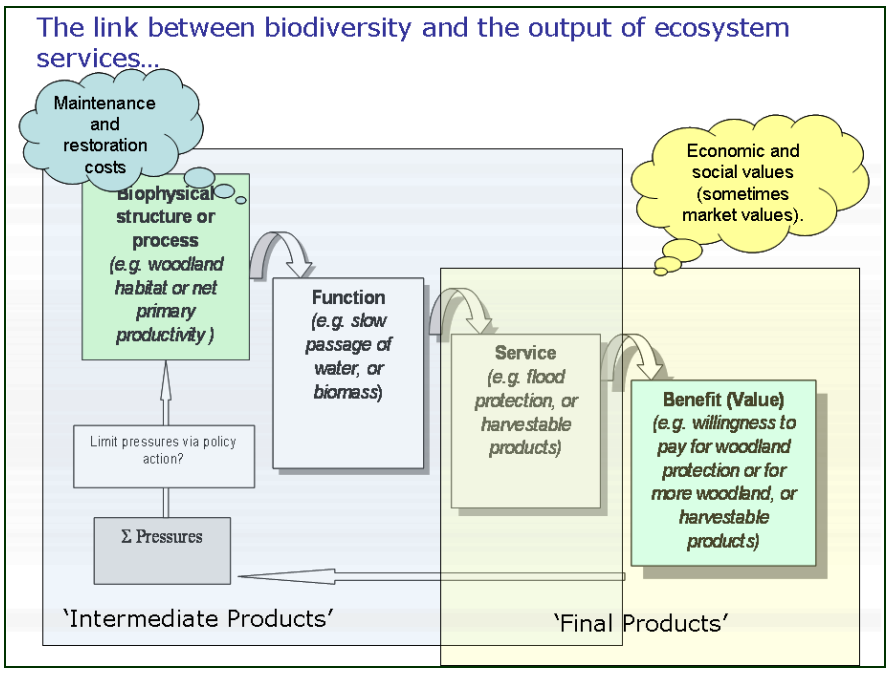
EEA – Jean-Louis Weber
Ecological truth and market prices in GDP

Jean-Louis Weber[20] started by noting that the unsustainable use of living natural capital is ignored, that no allowance is made for maintaining ecosystems and their functions and services in economic accounting (natural capital is not amortised), that ecosystem degradation in the production of a product is not included in the price, that the actual value for people of free ecosystem services is not accounted, and that GDP does not directly reflect the value of ecosystem services.

He spoke about EEA's work on ecosystem accounting (part A of the presentation) and also about the case study on Mediterranean wetlands (part B).

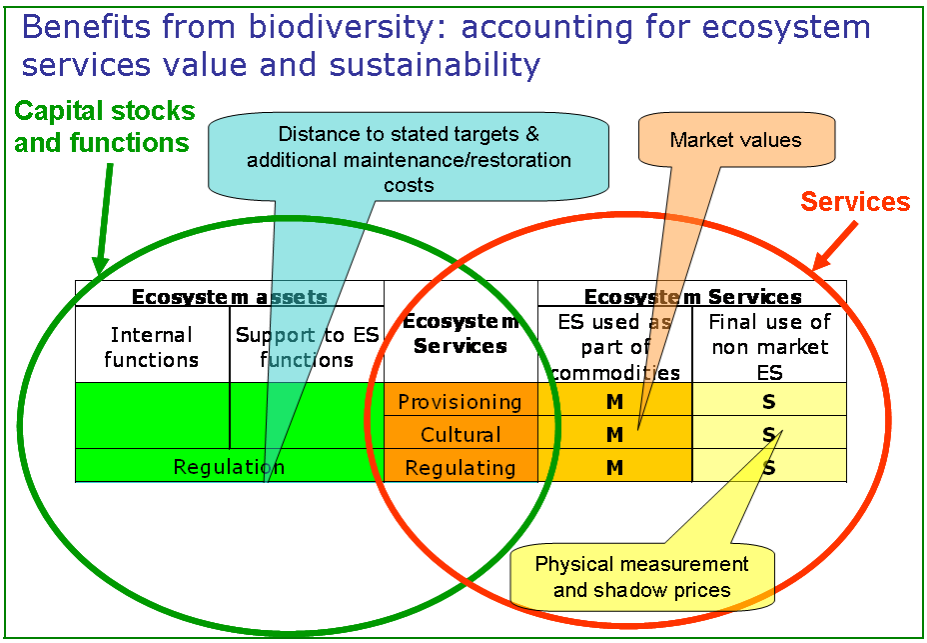
He noted that ecosystem accounting is a useful tool that helps provide a systematic look at the link between biodiversity and the output of ecosystem services - see Figure bellow.

[20] Jean-Louis Weber is project manager at the European Environment Agency.



The links from biophysical structure to function to service and benefit

Ecosystem assets, services (some market products, others not); also ecosystem maintenance and restoration costs are all part of ecosystem accounting (see Figure 6), and the accounts contain both physical units such as on ecosystem assets integrity (stocks, flows, resilience) and monetary units, e.g. for maintenance costs and for ecosystem services. He underlined that there are different levels of services from different land uses – in some areas they are very significant, in others marginal, and in others non-existent - see Figure ,

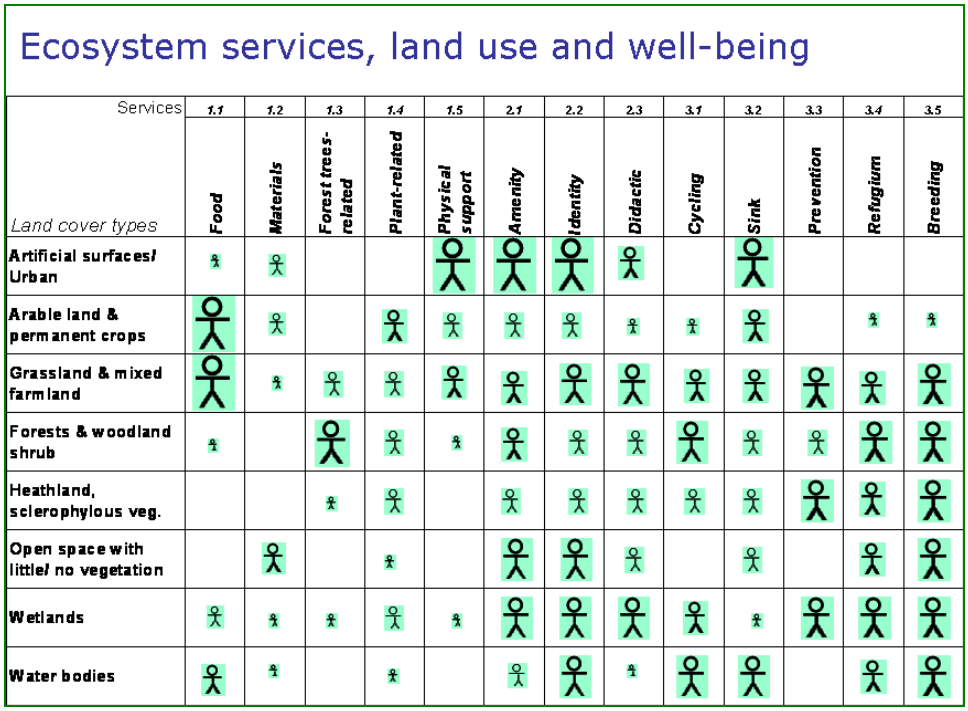


On the Mediterranean wetlands work, which is one of the inputs to the report for COP9, Jean-Louis noted the value of a global mapping system that allows mapping wetland socio ecological systems. These build on land cover and change accounts and use the ecological potential concept. Data on land cover accounts are available on the EEA website.

The work responds to the call for action and needs - as noted in the high level international conference *"Beyond GDP"* [21] held last November in the European Parliament – as well as the next Millennium Ecosystem Assessment (MA2) in 2015, and COP10.

Katrina Mullan, University of Cambridge
Benefits and costs of protecting forest biodiversity – IUCN

Katrina Mullan[22], introduced the ongoing IUCN work (for the EEA), noting that they are looking at both the costs and benefits and that they use the Total Economic Value (TEV) framework. Benefits covered include: direct use values, some indirect use values, non-use and option values. Options values are the main gap, and there is a focus on biodiversity related benefits – see figure



Ecosystems services, land use and wellbeing

Data is good on the use values, but she noted that option value data was weaker.

[21] See www.beyond-gdp.eu
[22] Katrina Mullan works at University of Cambridge's Department of Land Economy

One issue that came up was whether to focus on the benefits from biodiversity, or benefits of biological assets – they chose to focus more on the diversity aspects and hence looked less at, for example, the timber value of plantation forests.

Their work was to find and collate existing studies. Some studies were found to give marginal values, others give values for flows of services. All are being assessed to see how these can be compared. Types of cost information available include opportunity cost and implementation costs.

Examples of benefits numbers include:

Direct use values - non timber forest products (NTFPS). Mostly in developing countries; values are not so high per hectare. The majority of values are less than $100/ha/year, many less than $10/ha/year in terms of flow of values. These figures were obtained from an analysis of 40 studies.

Direct use values - Recreation and tourism both from developing and developed countries: different lengths of visits – in developed countries day visits vs. several day visits in developing countries. In tropical countries: high variation in the values for visits. These values are difficult to transfer into per hectare values. In developed countries, when transferred to per hectare values, values are usually rather high.

Developed world

- $5/visit or $10 to $62/person per year
- Wide variation in per hectare values:. $7582/ha/year in the southern Appalachians (Kramer et al 2003) and 2290$/ha/year in the UK (Batemen et al)

Developing world

- $10-50/visit for foreign tourists, lower for domestic tourists

Bioprospecting

- Here we find a very high range ($20 – $9000/ha/year).

Indirect use values

- not directly related to biodiversity but the existence of the forest ecosystem as a whole, some pollination examples etc.

Non use values – temperate forests. Mainly from developed countries, per hectare values differ – higher values when forests contain charismatic species

- e.g. $1000/ha/year

Tropical forests – fewer studies

- Opportunity costs – sometimes using land prices, sometimes modelled land values, sometimes household surveys. Opportunity costs vary highly - more than benefits results do - and include external costs and management costs.

There are fewer studies on management costs.

Values are very location specific. Some issues are difficult to transfer – notably non-use or recreation values. An important question arose as to whether or how to use area based values since aggregation / extrapolation can be difficult.

Salman Hussain, SAC / University of Liverpool
Marine nature conservation proposals – valuing the benefits

Salman Hussain[23] noted that very little information exists on the value of the marine environment. There is the Constanza study that says that two thirds of global ecosystem service value comes from the marine environment, yet this is based on little evidence, and much more analysis on marine environments is needed.

- One problem is how to disaggregate values down to specific areas / services (as these are often aggregates), and then re-aggregate them for different landscapes and habitats. In practice this has been based on an expert scoring system for services.
- The work was an *ex-ante* assessment: looking at the difference between a bottom line business-as-usual scenario and a scenario in which where conservation efforts are made. Different values were used, including some from the Beaumont study[24] - but for some values those were considered too high for realistic impact assessment (e.g. nutrient cycling)
- Benefits estimate is 2x as high as costs – which is an underestimate since non-use values are not included
- Marine nature benefits show a present value between £2.2billion and £4.7billion. Mean annual undiscounted benefits between £0.9 billion and £1.9billion, twice the estimated costs.

Plenary Discussion on the three presentations - key points:

- There are successful national PES (payments for environmental services) systems around, e.g. in Costa Rica which can be regarded as a success case.
- Removing perverse incentives is a high priority – this is a political decision.
- Issues related to governance – highest amount of biodiversity is in countries with high poverty and lacking overall governance. How does / can our exercise help that?
- So, how to target the message to politicians is the key
- Note: politicians are hard to predict, thus targeting messages to them is not maybe the one and only goal. Having good solid arguments is thus also of very high importance.
- Stern was in the end about ethical values and arguments, this should be the case here as well
- How about producers and consumers? What instruments do we have for them?
- How can we avoid that the recommendation in the next COP be "go and produce another report". Could the recommendation be instead for example "focus on how to make PES work well"?
- There is a need to break down the group of policy makers. Different arguments may be needed for policymakers working on environment vs. development issues.
- Aid effectiveness as one entry point for the discussion in the future!
- GEF: international WTP for global biodiversity benefits. GEF projects provide a significant info source relevant for the Stern-like study.

[23] Salman Hussain is Ecological Economics Researcher at the Scottish Agricultural College.
[24] Beaumont N, Townsend M, Mangi M and Austen M C (2006) Marine Biodiversity: An economic valuation. Building the evidence base for the Marine Bill. Report for Defra, London

- It was stressed that it should be the aim to make biodiversity "The Issue", not as one issue to be addressed in the context of other issues (e.g. floods etc.). This is what Stern did for climate change.

Key message should be to demonstrate the political power related to addressing biodiversity issues now.

Session 6

This includes three further breakout sessions:

C1 The costs of actions necessary for the conservation and sustainable use of biodiversity

Session Leader: Joshua Bishop

Session Participants: Stefan Baumgärtner, Giovanni Bearzi, Joshua Bishop, Zoe Cokeliss, Deighton Conder, Laura Dietzsch, Maryanne Grieg-Gran, Haripriya Gundimeda, Salman Hussain, Katia Karousakis, Markus Lehmann, Paul Morling, Shaun Mowat, Katrina Mullan, Karachepone Ninan, Matt Rayment, Ana Rodrigues, Alice Ruhweza, Christoph Schröter-Schlaack, Isabel Sousa Pinto, Wouter van Reeth, Hans Vos, John Ward, Frank Wätzold, Jean-Louis Weber, Daan Wensing, Ada Wossink, Carlos Young

C2 Trade-offs across EGS

Session Leader: Anantha Duraiappah (UNEP)

Session Participants: Denis Couvet, Rudolf de Groot, Yogesh Gokhale, Roy H. Haines-Young, Marianne Kettunen, Berta Martin-Lopez, Bedrich Moldan, Rosimeiry Portela, Guillaume Sainteny, Rob Tinch, Bernard Vaissiere, Matt Walpole

C3 Policy needs and science challenges

Session Leader: Anil Markandya

Session Participants: Diego Azqueta, Pascal Blanquet, Pierluigi Bozzi, Leon Braat, Ingo Bräuer, Aline Chiabai, Mike Christie, Roberto M. Constantino, Pierre De Villens, Martin Dieterich, John Hanks, Mark Hayden, Nick King, Onno Kuik, Anil Kumar, Pushpam Kumar, Marius Lazdinis, Sigrid Lüber, Anil Markandya, Emily McKenzie, Alistair McVittie, Stale Navrud, Patrizia Poggi, Ridhima Sud, Patrick ten Brink, Francis Turkelboom, Kerry Turner, Sybille van den Hove, Bulat Yessekin

C1 The costs of actions necessary for the conservation and sustainable use of biodiversity

Session Leader: Joshua Bishop

Session Moderator: Matt Rayment

Session Note taker: Alexandra Vakrou

Session issues: *what are the main drivers of biodiversity loss? What information do we have concerning the type of actions and their associated costs – including opportunity costs - which will be necessary to prevent the loss of ecosystem goods and services? What are the most promising attempts/examples for market creation?*

Joshua Bishop[25] (JB) introduced the topic by identifying 3 key issues to be addressed during the session; the drivers of biodiversity loss; the type and costs of actions needed to protect and conserve biodiversity; and finally, what have been the most promising attempts to use market based instruments to achieve that. While addressing the drivers that lead to losses like habitat changes and unsustainable use, it was noted that among the drivers suspected to lead to a decline of biodiversity are decisions taken by politicians and others that lead to biodiversity loss, simply because the CBA used for most development projects does not internalise biodiversity values. The participants supported this comment and it was concluded that cultural and political factors need to be taken into account when addressing what drives biodiversity loss.

When introducing the type of actions needed to conserve biodiversity, JB identified widely used strategies like systems of protected areas, as well as initiatives that can be taken by private entities in the productive sectors (farmers, companies, etc) such as adopting low-intensity activities, either to avoid payments for Ecosystem Services (PES) or to building their social profile by avoiding pollution. On this point it was mentioned that there is a growing recognition of the relation between Climate Change and Biodiversity and there is a need to internalise the costs of biodiversity adaptation to Climate Change.

The costs of preservation have been addressed and there is a great diversity in the available studies; this relates largely to the level of ambition attached to the conservation objectives. It is not easy to say what is actually spent on conservation actions; data are very fragmented and frequently are reported together with other actions making it hard to distinguish what is spent on biodiversity preservation and what can be attributed to other environmental goals (i.e. pollution abatement). Costs are also dependent on institutional arrangements made for the implementation of the actions (participants felt that in certain cases the transaction costs of implementing some conservation projects are too high and this results in low response and effectiveness). It was also mentioned that when demand and supply can interact (and thus markets to start be created) then the prices can start to vary and choices can be made.

With respect to market creation for biodiversity, the issue of profile was raised; which markets, how, by whom? There is a variation in the definition of markets, which can be either narrow or broad, while there is also a need to see what will be the advantages of establishing markets. How will markets be developed? Facilitation, taxes, subsidies, or even trade have all been used for this. For instance, corporate investment in biodiversity is increasing through Habitat Banking in the US.

[25] Joshua Bishop is Senior Advisor for Economics at the International Union for Conservation of Nature.

The floor was opened for discussion around the following questions that the participants were asked to focus on (for time horizons COP-9 and COP-10):

- Do we know what we need to do in order to halt biodiversity loss?
- Do we know how much it costs / will cost? Who pays and how can markets help?

Key points from the discussion:

Do we know what we need to do to halt biodiversity loss?

Sometimes we know about the value of biodiversity at the **local level** and the benefits it brings, but we do not explore the alternatives to destruction very well. Local values matter. It is different if we speak about biodiversity services that sustain livelihoods and life, vis-à-vis biodiversity services that can be seen as luxuries or have only option values.

There is a need to define "biodiversity loss". Is it the probability of losing some species, or habitats only? There is a need to avoid extinction, either by establishing protected areas or by keeping IAS out, but also by controlling hunting and pollution. We need to **map these needs**, and tools exist for that (WWF hotspots, etc), but we also need to factor in the opportunity costs of actions for prevention/preservation. And to do that effectively, we need to **set priorities**. If we try to protect all biodiversity we may fail, but many things can be achieved quickly with a modest amount of resources and there can be big benefits and positive impact.

An Australian example was presented in which ecosystem services are auctioned and both absolute and relative costs are used. It is possible to use different metrics for absolute values; however the use of relative costs creates an opportunity to add more and to have a consistent metric. However, a variety of comments on this point stressed the need to go beyond the metrics and to define a matrix of actions (maybe different ones for marine / terrestrial ecosystems) for stopping the loss of biodiversity. The view was not to put so much emphasis on market and absolute values. There would be a lot of problems if we tried to convert CBD to IPCC (and turn everything to metrics). There could be a cap of 1% of the CDM to support REDD and halt deforestation.

Do we know how much it costs?

Land rent and the opportunity cost of land may distort the costs of biodiversity actions if we take them into account. Management costs are easy to grasp and there are published data as well as experience with management; what is very difficult to calculate and allocate in a decision model are the existing opportunity costs, which are also very variable. Some participants felt the need to make a survey of public expenditure and see what every country spends to protect its biodiversity. Some participants suggested that possibly financing targets should be set for all countries.

A consensus developed around the idea that there will be a window of opportunity of 2 years to build more on biodiversity and Climate Change and that there is an urgent need to do so, by bringing the delegates of the different countries to the CBD and IPCC together to discuss at national/regional levels and define common lines. There is an additional opportunity from the IPCC land emissions and this could be used to design market instruments; additional channelling of any available resources could be made to priority biodiversity areas; however, together these may not be

enough to reverse deforestation. Some concern was expressed about REDD, as it is an important action for the reversal of deforestation, however, it can be effective only if the data, inventories and monitoring are in place and functional. These add more costs to the operability of the scheme. At the moment many countries discuss about REDD implementation and try to calculate land values, however, we should be cautious about the links since Climate Change tends to focus on increasing carbon sequestration in the forests and this approach is not good for certain areas and ecosystems such as (for example) savannas.

It was highlighted that the issues are different in different countries. India was mentioned as an example of serious forest degradation rather than deforestation, thus conservation actions need a different focus. There markets may work better, by permitting the preservation of forest resources and their qualities with a view of the medicinal use of plants, etc. Furthermore, it is felt that while conservation actions are advocated, there is a need to speak about and understand how perverse subsidies impact negatively on biodiversity. Simply a switch of these subsidies, or building in triggers for protecting biodiversity can change the picture and can help to make cost savings and direct financing to its preservation.

Suggestion for the Study Leader: ***Put costs of actions for protecting biodiversity as a key issue to be addressed in the 2nd phase of the study.***

Who pays and how can markets help?

Transaction costs are too high most of the time and PES do not work well when this happens (India). It was also mentioned that for some cases like religious forests in India, these areas are ready to enter a PES system and we could potentially see spiritual values acquire a market. It was felt that the opportunity and transaction costs need to be tackled further but still progress can be made on that. If the system develops along the same lines as carbon credits, certification monitoring, and other transactions can "kill" it before it is launched. What needs to be done urgently for biodiversity is to build a political construct equivalent to the Climate Change agenda that will move things forward (Brazil). A need to steer society was expressed, and therefore to have informed people and informed leaders that put biodiversity high on the agenda, as is was for Climate Change.

Also mentioned was the very great uncertainty associated with markets. For instance in many EU agri-environmental schemes for farmers, the support is paid as a cost/Ha, but in many cases this does not correspond to the same value of services (frequently an overcompensation is provided).

It was also mentioned that when designing PES it would be good to look at how much it will cost society and the economy not to provide Ecosystem Services. For example, a study on the services provided by afforestation and re-vegetation found that farmers and society will have multiple benefits (90% more services than before) if they re-vegetate some parts of their land. However, a scheme to achieve this would cost 1.9 Billion $AU in the absence of a carbon market.

It was also mentioned that it will be difficult to create a market for ecosystem services in the marine environment and another approach should be followed. It was pointed out that the discussions have not focused much on genetic diversity (in particular agro-ecosystems). Biological/organic agriculture can capture benefits and bring opportunities for farmers, preserving not only the genes but the traditional knowledge too.

There is a need to think where we can apply market instruments. Wetland banking is very different from old-growth forest banking, and the same applies to marine species. There is also a need to establish not only where ES are produced, but also where they are consumed and appreciated. Then we can discuss who pays for enjoying these services and how compensation can be transferred between countries or even regions. GEF may offer a possible platform to do that. Furthermore, private donations can enter a pool of money available for biodiversity actions globally.

All of the participants felt that there is an urgent need for action. There was consensus that the study should present at COP-9 whatever information is already available on costs of action to preserve biodiversity, alongside a presentation about the costs of policy inaction for biodiversity. Scientific knowledge and experiences are available, even if not perfect, and there is no need to know what exactly is being lost. There is a need to act now, so not to lose opportunities to conserve/preserve what we have.

Participants expressed the need to generate demand for ES in the same way as a demand was generated for carbon. And this demand should be expressed at the global level. The CC debate brought the polluters up front, and the same needs to be done for biodiversity. The Stern-report said why the UK should pay for climate change combating measures. *This report should also say why and how much everyone should pay for biodiversity.*

Main recommendations for the Review

Short-term priorities (Phase 1 and COP9)

- We need to address the costs of actions urgently needed to halt biodiversity loss. It is possible to review conservation targets / indicators at different scales (spatial, temporal, etc). With good mapping, we can identify needs and actions that can be carried out quickly and immediately to alleviate a considerable amount of biodiversity loss.
- Identify cost-reducing conservation actions (e.g. fishing subsidy reforms), with attention to ways to overcome vested interests.
- Present an initial outline assessment of the costs of alternative scenarios of conservation actions – examining the distributional aspects, but also social, ecological and governance scales.

Priorities for 2008-2009: Phase 2 of the Review

- There is a great need to explore and examine in depth the costs of conservation actions and present them for COP-10. Work in this area should advance in parallel with the costs of (biodiversity) policy inaction. This can be done by:
  - identifying categories of conservation actions, using a vulnerability / threat-based approach
  - compiling and analysing data on the cost- effectiveness of conservation actions.
- The policy framework, the instruments available and the institutional arrangements should be examined and efficient ways that will allow payments for ES (PES) at a global level should be examined.
- Explore further ways to attract private investment in conservation of biodiversity. Opportunities to do so in an institutionalised manner may exist under the currently post-Kyoto negotiated CC Mitigation efforts (REDD) and these need to be explored as there are synergies emerging.

C2: Trade-offs across EGS

Session Leader: Anantha Duraiappah (UNEP)

Session Moderator: Ingo Bräuer (Ecologic)

Session Note taker: Aude Neuville (DGENV)

Session issues: *this session should explore how to make best use of the experience of the MA with particular attention on the mapping of the relationship between the production of ecosystem services and the beneficiaries. How can we deal with trade-offs across ecosystem goods and services, taking into account distributional effects?*

Anantha Kumar Duraiappah [26] introduced the session, focusing on the Millennium Ecosystem Assessment (MA). He noted that the MA has shown that: (i) although there have been substantial economic gains from ecosystem conversion, large groups of the population have not benefited, and (ii) ecosystem use has often been unsustainable, which raises the issue of intergenerational equity.

The MA has analysed the links between ecosystem services (ES) and human well-being, but there are knowledge gaps on: interdependencies among ES, their role in contributing to different constituents of well-being, and what are the weightings of these constituents in people's preference functions. Trade-offs between ES and constituents of well-being differ across individuals – they are context specific – as well as between individuals and society. Trade-offs can take place across space and across time. The challenges are to measure the changes in well-being caused by changes in ES, and to establish governance structures which are responsive to these changes across different stakeholders, especially vulnerable and socially excluded groups. Part of the explanation for declining ES is the mismatch in the social, spatial and temporal scales at which the impacts of environmental change occur and at which decisions are made. Effective environmental governance implies that these scales are matched and that there are structures and feedback control mechanisms (prices, regulations, etc) that operate at the appropriate scale.

Key points from the discussion:

- There can be trade-offs between different categories of ES, but also among different regulating services, or provisioning services. Often trade-offs involve food production.
- We need to better understand the relative weight of the different components of welfare deriving from ES, and how much of each component is generated by each ES. In the economic literature on preference functions there have been few papers making the link with ES, in particular regulating and cultural services.
- The individuals or groups who make trade-offs may not have sufficient knowledge of complex ES such as regulating services. Also in some cases people may not be willing to admit that they are making implicit trade-offs.
- The rapid increase in global environmental awareness in recent years (about climate change in particular) might be reflected in changes in the weightings in preference functions and

[26] Dr Anantha Kumar Duraiappah, Chief Ecosystem Services, Economics Unit, UNEP, Nairobi has been a coordinating lead author of the Millennium Ecosystem Assessment (MA) and the co-chair of the Biodiversity and Human Well-Being synthesis report.

how trade-offs are made. People want more information on environmental issues and trade-offs and more control.

- Ethical considerations are part of preference functions and they influence trade-offs. This applies both at individual and at societal levels. The cultural background matters. Preference functions at a societal level (e.g. the concept of national interest) include a variety of considerations, not only economic growth, poverty reduction and equity.
- The analysis of ES should be placed in the broader context of integrated systems where humans play a role. ES may be an input among other inputs.
- The relevant societal levels for trade-offs in ES include the global level (global environmental issues) and the community level (local goods); in particular in rural areas, communities are important. The management of common goods is different from that of public goods.
- There is a frequent mismatch between the scales where the consequences of natural resource management are felt and those where decisions are made. Although the political systems already have multiple scales, often the interests and preferences of some groups are not taken into account, even in the most democratic countries.
- A multi-scale approach from institutions, either formal or informal, is needed to manage: providers / managers of ES, beneficiaries, and those who bear the costs.
- Economic valuation can help to address the mismatch between scales, for example by providing critical information to design compensation mechanisms. The scale of valuation should be appropriate.
- It is important to have criteria for measuring the sustainability of the use of ES.
- Often there is not enough economic evaluation taken into account in the political debate on biodiversity. Need to develop appropriate evaluation to this effect.

Research agenda

- Develop a common metric for evaluating changes in well-being.
- Further research on the values of ES and their role in preference functions
- Further research on the mismatch between ecological scales and governance levels.

Main recommendations for the Review

Short-term priorities (Phase 1 and COP9)

- Part of the explanation for declining ecosystem services is the mismatch in the social, spatial and temporal scales at which the impacts of environmental change occur and at which decisions are made – this should be made clear in the report.
- The analysis of ES should be placed in the broader context of integrated systems where humans play a role.
- Take into account the influence of ethical considerations and increasing global environmental awareness

Priorities for 2008-2009: Phase 2 of the Review

- Contribute to a better understanding of the matching between social, ecological and governance scales
- Contribute to a better understanding of the values of ES and trade-offs among them at different scales
- Develop criteria for measuring the sustainability of the use of ES
- Economic evaluation can provide critical information to design feedback control mechanisms – economic instruments, compensation schemes, regulations, access restrictions, harvest moratoria etc – that operate at the appropriate scale. It can also provide information to help matching the different scales with appropriate institutional structures necessary for effective environmental governance.

C3: Policy needs and science challenges

Session Leader: Anil Markandya (FEEM)

Session Moderator: Onno Kuik (IVM)

Session Note taker: Paulo Nunes (FEEM)

Session issues: *what are the different challenges for economic valuation if we are to respond efficiently to the questions raised by policy makers at different levels? Which kinds of figures/analyses are appropriate with a view of incorporation in scenarios and policy design?*

Anil Markandya[27] introduced the session, starting by looking at the lessons that can be learnt from the Stern Review. Key points are:

The assessment of climate change policies was successful not because of the accuracy of assessing benefits (avoided damage), nor because of the assessment of mitigation costs. The assessment was successful because it made two convincing arguments:

1) benefits (including insurance against risks) are likely to exceed costs; and
2) there is a need for early action.

Other factors contributing to the policy attention for climate change are

1) the scientific work of IPCC,
2) experience with extreme weather-related events, and
3) clever publicity (Al Gore).

What can we learn from the climate change discourse?

1) Do not only report average damages / losses, but also report extremely high risks and confront these with moderate avoidance costs;
2) show likely impacts in physical terms;
3) make the case for early action.

Key points from the discussion:

- There was some disagreement about whether 'scare tactics' would work in the biodiversity debate. Some argued that they wouldn't (there might be some 'environmental fatigue' and an 'emotional' appeal would be more appropriate), while others seemed to support that at least some dramatic risks could be communicated (pointing to the share of wild animals/ plants in human diets to underline their importance; pointing to the risk of the acidification of oceans, which has the potential for dramatic disruption of the food chain).
- One lesson from climate change policies is the power of 'mainstreaming' policy measures into development priority areas such as food and energy. Biodiversity should likewise be 'mainstreamed' and not remain an isolated 'environment' issue. Some promising policy initiatives were mentioned, in South Africa, Uganda and the UK.
- Important for the dynamics of the climate change discussion are the business (and job) opportunities in low or zero carbon technologies (e.g. wind and solar in Germany). It would be

[27] Anil Markandya works at the Fondazione Eni Enrico Mattei and is Professor at University of Bath's Department of Economics and International Development.

very helpful to identify such business opportunities for biodiversity conservation and engage these businesses.

- A key problem for biodiversity conservation is that the (effective) demand is in the North, while most of the assets are in the South. This would suggest a transfer problem. One way of dealing with this is to shift the onus onto the (Northern) consumer, by letting him or her pay for ecologically sound products. An interesting initiative was suggested by President Correa of Ecuador who said that if the international community can compensate the country with half of the forecasted lost revenues of oil extraction, Ecuador will leave the oil in Yasuni National Park undisturbed to protect the park's biodiversity and indigenous peoples living in voluntary isolation.
- One 'advantage' of biodiversity loss over climate change is that nobody doubts the causes and extent of biodiversity loss.
- Biodiversity policy and research need a pro-active approach. At the moment, international negotiators live from meeting to meeting and there is no feedback to national audiences. Continuous research is hampered by the 3-year funding cycles of most international research donors (like the World Bank). In African countries, there are no national champions (like Al Gore) for biodiversity protection.
- A priority area for biodiversity conservation policy should be the removal of perverse subsidies to biodiversity-threatening activities like agriculture, fisheries and mining.
- Convey the message that even if we are wrong about the cost of the loss of biodiversity, the actual cost of preservation is modest and preservation generates important side-benefits.
- Broaden the climate change issue to a global change issue encompassing climate, biodiversity and water.

Main recommendations for the Review

Short-term priorities (Phase 1 and COP9)

- Select case studies of biodiversity loss and practical ways of dealing with it at the country level
- Try to identify business opportunities
- Link biodiversity to climate change

Priorities for 2008-2009: Phase 2 of the Review

- Select case studies of biodiversity loss and practical ways of dealing with it at the country level.
- One lesson from climate change policies is the power of 'mainstreaming' policy measures into development priority areas such as food and energy. Biodiversity protection efforts should do likewise and not let it remain an isolated 'environment' issue.
- Engage businesses that see opportunities; engage consumers.
- Create something like 'biodiversity' IPCC?

Session 7

Report to the Plenary

The 3 speakers reported back to the plenary (key points as in above sections[28]), with subsequent discussions. Points from the plenary discussion include:

C1 : Josh Bishop

Josh Bishop strongly highlighted the importance of looking at the composition and structure of costs. We know what the drivers are, but the complexity of them requires a more systematic approach. Management costs are currently possible to grasp, but there are substantial knowledge gaps regarding opportunity costs and the costs of transaction which still present a challenge.

- A big proposition was presented: halting biodiversity loss can be done relatively rapidly with a not too demanding amount of resources.
- There is a failure to internalise costs. We have good models to internalise biodiversity costs – but distributional effects need to be taken onboard. Hence there is an urgent need to explore how a market demand for biodiversity can be created.
- In addition to looking at costs of action, it is imperative that perverse subsidies / incentives are removed, in order not to support counteractive behaviour.
- A further question of importance is: how can mechanisms that recognise and reward traditional knowledge be developed?
- In relation to COP10 it was stressed that it would be helpful to map the situation and see what can be done quickly. In the context of COP10 and financing, could GEF be used for benefit transfer? How can PES and other arrangements be improved so that transaction costs are not too high? There is a need to clarify the role of REDD in bringing resources for biodiversity conservation.
- The development of a global, spatially aggregated assessment of conservation costs is seen as a high priority – not least in order to form a basis for future decision making.

[28] See also the reporting back slides on www.ecologic.de

C2: Anantha Duraiappah

Anantha Duraiappah's summary points included:

- Looking at an MA follow up, trade-offs and the magnitude of the interdependency between ecosystem services and the components of wellbeing need to be considered. There are different kinds of trade offs:
  - between different services / groups of services
  - between components of wellbeing, i.e. within preference functions
  - between interlinkages.

  It is also important to understand the main levels of trade off:
  - Individual
  - Community
  - Societal

  How do these work and how do they affect trade-offs?
- Governance structures and ecological systems are mismatched. Hence there is a need to develop new approaches to set up institutions, e.g. one authority responsible for the whole Danube basin.
- For COP 10, there is an urgent research need to achieve a better understanding about matching social, ecological and governmental goals.

C3: Anil Markandya

Anil Markandya's summary points included:

- Stern highlighted not costs per se, but the fact that the elements of risk are very high and the importance of incorporating evaluations of equity issues. It would be helpful to adopt the same approach for biodiversity, i.e. incorporating the cost of risks of losses. In addition, the relative effects of loss on poor and vulnerable people should be emphasised – even if the monetary value is small, the importance is great.
- A challenge is overcoming environmental fatigue. In this, links between biodiversity and climate change should be emphasised. A move towards a framework of "global environmental issues" and away from separating biodiversity and climate change etc. should be attempted.
- In the end we want to see biodiversity as a development issue, not an environmental issue.

- The problem was stressed that if one focuses too much on costs it might be that there will be no action at the end. An incorporation of benefit analysis is essential. Both sides of the coin need to be considered to make well founded decisions about investments in nature conservation.
- The costs perspective is a key in communication to COP. People will be referring to this information. So one should not shy away from the exercise.
- Cost-effectiveness-analyses are necessary (what do we get for a dollar spent) – but costs are an important term of the balance sheet.
- The main tools for conservation in Africa are protected area networks. For these the costs are constantly increasing. The figures presented give an idea of the magnitude of necessary investments for conservation in Africa.
- It was also mentioned that from a cost efficiency perspective Africa is a clear candidate for action. But then burden sharing should also be considered, since most of the time, local benefits will not cover local costs. There is a need to compensate the global-level benefits at the local level which on the other hand could act as an added incentive for African governments in addressing the issues.
- It was mentioned that on the topic of underfunding, the crown jewels of biodiversity protection (national parks in Africa) provide an illustration. A very good (or better bad) example of this comes from Angola, where the national parks are heavily underfunded. Much could be done without huge investments. So this is a good example of the low-hanging-fruits argument).
- The idea of biodiversity conservation should be put forward as a development issue. Trade-off analysis can be used as a tool here.
- In COP9 – biofuels will be the main issue there and this is clearly a trade-off issue. EC could address the relevant issues here.
- There are trade-offs not only between different ecosystem services and well-being factors, but also on the temporal scale and even in biodiversity underlying the ES. The costs of inaction are delay costs (the same action in the future will cause much higher costs than early action).
- It was stressed that it may not be advantageous to give an pre-cooked solution to policy makers. Rather, by delivering convincing arguments, let them come to the same conclusion.
- To deliver an idea of the size of the bill is essential (and it seems that it's not that huge).
- It was stressed that Stern brought economics and ethics together – this is what the Biodiversity study should be doing too!

- **Session 8**

Way forward & the policy messages from the studies supporting developments towards COP9

Session Leader: Heidi Wittmer

Session Note taker: Patrick ten Brink (IEEP) / Ingo Bräuer (Ecologic)

Pavan Sukhdev started the round table with his vision of the joint output of the different studies. He intends to present a 50-page report with highly relevant suggestions for politicians and decision-makers. Hence he asked the study leaders to present the policy-relevant messages from their studies. Afterwards he led the series of short conclusions, comments and ideas for roadmaps for the way forward. These included:

- Starting point should be GDP and other metrics to guide decision-making. There is still a healthy dialogue on this and a need to take this concept forward to help us have a more appropriate compass to steer our economies and societies.
- Welfare and wellbeing are a good main focus – particularly for the poor. This is to say the relative importance is high. For poorer countries, absolute terms of GDP correction seem not to be relevant; however, the distribution of rearrangement is highly policy-relevant.
- PES examples are delightful – it is useful to have both a stick (law) and the carrot (financial payment) in order to get the results.
- Local values and local incentives should not be forgotten in the global review.
- He highlighted the need to engage the business world and build on the successes. With regard to business and government partnerships, there are small success stories that have not been scaled yet, and hence provide opportunities.
- Carbon storage and REDD are potential tools for biodiversity (notably forest conservation) – the review work should try to elaborate this more.
- Finally, Pavan Sukhdev recalled the usefulness of the soft metrics as described in the benefit pyramid (session B2), and invited the group to think about new metrics as well as the already mentioned ones like fun per ton, happiness per hectare.

Policy-relevant messages from the studies

COPI study - Leon Braat (Alterra) presented some key points from the perspective of the Cost of Policy Inaction (COPI) on biodiversity loss study (Partners: Alterra, IEEP, Ecologic, FEEM, MNP, GHK, W&B).

He explained that the work builds on the OECD baseline scenario, which has been just released in Oslo.

- The study builds in scenarios of population growth and income growth, with due implications for food-demand and land-use changes. The world population is expected to be 9 billion people in 2050, with a global GDP of several times today's.
- This will put increasing pressure on the world's natural capital. It is not expected that productivity gains alone will address the growing needs. Significant areas of still pristine lands will be converted to agricultural land and to plantation forests to address climate change. Some of the converted lands will be marginal lands, and will require significant input (energy/ fertiliser).
- The overall rate of species extinction will increase (in the COPI-setting) resulting in a loss of biodiversity respectively.

- Grassland and shrub land are most under pressure, in particular those in Africa and parts of Asia. Unfortunately these are also habitats where only very limited information on their economic benefits exist. Hence the team is asking for information on grey literature regarding these habitats.
- To assess the economic value of the losses (a focus in the COPI study), more information is needed on grasslands and on non-European countries, and also more information on marine ecosystems is needed.

IUCN message - Joshua Bishop

The case studies being collected and analysed allow for greater understanding, increasing spatial detail, location-specific insights, and improved reflection of institutional and demographic issues. Insights include:

- compelling evidence on the importance of forest ecosystem services for the poor,
- costs and values are location specific – reflecting a range of factors,
- improving governance can decrease conservation costs,
- guidance on priority setting and budget allocations can help.

Economics of Biodiversity Call and Synthesis study – Paulo Nunes

- Most of studies from the call for evidence refer to non-market biodiversity benefits; hence you have to deal with them in a different way than other goods.
- We must be aware of the risks, benefits and importance of early action.
- Evidence is fragmented so far. While there are many studies on forest habitats, there is less information on marine systems - despite their importance – and this situation needs to be rectified.
- A double-dividend argument can usefully be underlined – halting biodiversity loss will be positive for both the environment and for low income groups. This should lead to stakeholder involvement to endorse politics.
- Important to focus to engage beneficiaries – market-based instruments could be a useful tool here.

Scoping the Science - Ana Rodrigues – sees two key messages of the project

- *Message 1*: The conceptual framework presented is a proposal for the whole review as a tool/framework for comparing, at different spatial scales, the costs and benefits of maintaining biodiversity.
- It is spatially explicit, i.e. it notes where the losers and winners are – which allows one to address the situation and issues of trade-offs and equity.
- Aggregated values have to be spatially underlined (distributed) – to map mismatches between costs and benefits of conservation (equity issue).
- It can also be a tool to set priorities by identifying the "low-hanging fruit" in conservation.
- *Message 2:* Review of ecological science "fit for purpose" – main message: we depend on biodiversity in so many ways that it is important to understand the range and complexity of the linkages between biodiversity and ecosystem-services and well-being.

Ecosystem Accounting Study, EEA - Jock Martin – focused on the benefits of an ecosystem accounting approach. This will have 7 kinds of benefits

- Allows us to talk the right language for some key stakeholders – e.g. speak the language of the finance minister.
- Enables us to relate to welfare and to measure external effects.
- Provides a practical application for addressing the "issue of scales" in a way that makes both up- and down-scaling possible.
- Frameworks are essential to deal with the two first mentioned points. The accounting may be a robust framework to help the political process. The aim of the ecosystem accounting should be to become an equivalent to the GHG-nomenclature. So far nature conservation can look back on 40 years of measuring, but the data is not suitable to assess whether policies have been successful or not.
- Finally, he noted the ecosystem health challenge - to employ private resources for protection.

Marine Study - Salman Hussein – key messages

- The temporal dimension can be measured in costs and benefits very well. This will help to decide whether a decision is beneficial and when it will reach its break-even point.
- Spill-over effects are important to bring benefits - conserving marine ecosystem helps to support food production and health of food support.

Session 9

Policy, synthesis and way forward to Bonn and beyond

Session Leader: Heidi Wittmer

Session Note taker: Patrick ten Brink (IEEP)/ Ingo Bräuer (Ecologic)

Contributions from the floor

A participant commented from his perspective as a potential end-user (politician) of the planned review and the workshop. According to his understanding the group should keep in mind that politicians at COP9 are friends – they are already persuaded, but they need arguments to convey to others in the government.

- In addition the public awareness of biodiversity issues is increasing. This political public awareness should be used, and we should try to follow the same pathway that climate change took.
- He is surprised that nobody present said anything about biodiversity indicators. In his opinion there are still no reliable indicators to measure biodiversity – this is still a big challenge.
- The group should keep in mind how powerful good success stories are, as the example of PES in Costa Rica shows.

It was suggested from the floor that reference should be made to the World Charter for Nature – it gives an extremely clear formulation on how to value and how to look at it.

- There are inter- and intra-generation equity issues to be considered – and these can be considered!
- The term "trade offs" should be avoided, maybe instead talk about "trade ups" – try to sell the evidence as it were an overall gain for all (even if there is an "off" to someone).
- It should be kept in mind that values only have a guiding function. The policy process is the one that decides "the value" in the end. The presented value estimate can thus only function as a guideline – it will not be the final "value" decided by policy / society

Three comments looked into the future and raised specific questions on how to organise the next steps of the report.

- The first contribution demanded the need to flag the developing country positions, formulated at the end of the Potsdam initiative. We should address these, e.g.
  - ABS
  - Benefit and technology transfer
  - Capacity building
- There is a need for an IPCC for biodiversity. Hence we should try to link the review to the IMOSEB. Even though it is a little bit unorganised at the moment, it has potential.
- One suggested challenge for phase II is to look at the costs of biodiversity restoration and how these fit into the big picture. It would be beneficial to demonstrate that the loss of restoration is more costly than conservation in the first phase.

Session 10:

Lessons learnt from the workshop, closure & thanks

Pavan Sukhdev noted that at the time of the Stern Review, there were people in the public arena questioning whether climate change was actually happening. Unlike climate change, no-one questions that biodiversity loss is happening. From a biodiversity review perspective, this is an advantage. He also noted that ecosystems are already on the agenda of the financial world and others. That is also a benefit: we don't have to fully break the ice.

Pavan Sukhdev reminded the workshop that Lord Stern's Review focused not just on valuation but also on risk and on ethics. There was also a focus on policy. It is important that we create policy pathways and linkage between policies and biodiversity. Market based instruments have a role to play to help leverage action and to increase cost-effectiveness. Nevertheless, markets do not address fairness. Furthermore it is important to focus on the end game – on what policy makers can play with.

Pavan also noted that he was in the process of constituting his advisory board, and noted that he aims to have a mix of advisors. Achim Steiner has confirmed that he has agreed to be on the advisory board. Similarly, it is expected that there be a good business representation.

Pavan noted that the call for evidence has been very helpful, and complemented this with a "call for help", asking various members of the audience to supply further information on particular points/experiences raised during the workshop that could be valuable if integrated into the 50page report to COP9. This included requests on:

- Costa Rica (PES)
- Welfare and wellbeing and their relevance for conservation
- Business engagement and instruments to do so
- Insights on WTP & option values
- Examples from Africa
- The Earth Charter

He concluded that there is a need for a new economics, where the three different elements of capital (economic, social and environmental) are more equal than they are now. He also noted that there have been a range of efforts to create this new economics and indeed the new economics is already there – as in the words of Arundhati Roy, in the God of Small Things[29].

Ladislav Miko closed the workshop noting that biodiversity is one of the most complex issues we have, yet that a non-complicated message to politicians is a necessity. He also noted that inaction is no option. He noted that valuation is one of the promising tools to help our cause. Some existing evidence already shows that acting now is better than waiting – and we need to show this more. We may also link biodiversity issues to other problems, and notably that of climate change, and together have a strong voice.

He also reminded the audience that politicians do not always chose the most cost effective solution; the decision also depends on who spends and who receives and the timescale as to when the costs arise and when the benefits are reaped. It is important, when considering the messages, and the information needs, that one thinks of the decision making processes and political powers.

[29] Arundhati Roy, The God of Small Things (1997) Flamingo Pubs (UK)

Ladislav concluded that, despite different views and perspectives in the workshop, there is a good consensus on the general outcomes and that what is now needed is a streamlined message. The COP9 message needs to be linked to Potsdam ToR and to international level – it is important that it is not Europe-centric. We cannot yet deliver the big number that corresponds to the value of biodiversity loss (that is for phase 2) – but with what we have, we can create something with appropriate value and impact at COP9.

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The Costs of Policy Inaction: The case of not meeting the 2010 biodiversity target (COPI study), under contract with the European Commission:

Partners and key staff
Alterra: Leon Braat (team leader), Chris Klok
IEEP: Patrick ten Brink (deputy team leader), Marianne Kettunen, and Niele Peralta Bezerra
Ecologic: Ingo Bräuer, Holger Gerdes
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Danube Delta National Institute: Iulian Nichersu, Eugenia Marin

Study on the Economics of Conservation of Forest Biodiversity, under contract with the European Environment Agency

Partners and key staff:
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University of Cambridge: Katrina Mullan, Andreas Kontoleon
EEA: Ronan Uhel, Hans Vos, Jean-Louis Weber, Jock Martin

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A good number of reports, articles and other contributions were received in reply to the web-based call for evidence organised by the European Commission, and will also be used in Phase 2. We would like to thank all the respondents to this call; their affiliations are listed in part III below.

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Finally, over 90 experts in economics, ecology, and policy (listed below in part IIII) participated in the workshop on the economics of the global loss of biological diversity held on 5-6 March 2008, Brussels. We are very thankful for the ideas provided and the set of recommendations on the way forward developed. The proceedings of the workshop and the presentations made are available on the TEEB website: http://ec.europa.eu/environment/nature/biodiversity/economics/index_en.htm as well as at the following link: http://www.ecologic-events.de/eco-loss-biodiv/index.htm.

We would like to especially thank the leaders of the sessions – Kerry Turner, Pushpam Kumar, Ben ten Brink, Alistair McVittie, Patrick ten Brink, Ståle Navrud, Joshua Bishop, Anantha Duraiappah, Anil Markandya, and Heidi Wittmer – and the authors of case studies – Salman Hussain, Katrina Mullan, and Jean-Louis Weber – for their substantial inputs.

Part III:
An Inventory of Relevant Resources

a) Relevant experts: Repliers to the Call for Evidence on the Economics of Biodiversity Loss

Name:	Surname	Organisation	City	Country
Tanya	Alwi	Borneo Tropical Rainforest Foundation		
Diego	Azqueta	University of Alcalá	Alcalá de Henares (Madrid)	Spain
Stefan	Baumgärtner	Leuphana University of Lüneburg	Lüneburg	Germany
Giovanni	Bearzi	Tethys Research Institute	Milan	Italy
Maurizio	Bellon	Conservation International		
Johannah	Bernstein		Brussels	Belgium
Kate	Berrisford			
Pierluigi	Bozzi	University of Rome "La Sapienza"	Rome	Italy
Keith	Brander		Copenhagen	Denmark
Peter	Brotherton	Natural England	Sheffield	United Kingdon
Bullock	Craig	Optimize		
Carlo	Carraro	University of Venice	Venice	Italy
Tanya	Cerulus	Departement Leefmilieu, Natuur en Energie (LNE) Vlaanderen	Genk	Belgium
Pakping	Chalad Bruns	Coordination Centre for Natural Resources & Environment management & Environment partnerships		
Mike	Christie	Aberystwyth University	Aberystwyth	Wales

Jose	Cobra	European Cork Confederation	Santa Maria de Lamas	Portugal
Robert	Costanza	University of Maryland, USA		
Ian	Danby	BASC	Wrexham, LL12 0HL	United Kingdom
Pieter	De Corte	European Landowners Organisation (ELO)	1040 Brussels	Belgium
Oliver	Deke	German Advisory Council on Global Change (WBGU)		
Martin	Dieterich	University of Hohenheim		
Laura	Dietzsch	Amazon Institute of Environmental Research, Brazil		
Arthur	Eijs	Ministry of Environment, NL		
Nehal	Farooquee	G.B. Pant Institute of Himalayan Environment and Development	Srinagar - Garhwal	India
Fernando	Gast	Instituto Alexander von Humboldt	Bogotá	Colombia
Sylvie	Gauthier	Canadian Forestry Service		
Mary	Gibby	Royal Botanic Garden	Edinburgh EH3 5LR	Scotland, UK
Yogesh	Gokhale	The Energy and Resources Institute, India	Delhi	India
Andrea	Graham	National Farmers Union,	Stoneleigh Park, Warwickshire, CV8 2TZ	UK
Maryanne	Grieg-Gran	International Institute for Environment and Development	London	United Kingdom
Markus	Groth	Leuphana Universität	Lüneburg	Germany

Haripriya	Gundimeda	Indian Institute of Technology, India		
Andreas	Hauser	BAFU Federal Office For the Environment	3000 Bern	Switzerland
Jaakko	Heikkilä	MTT Economic Research	Helsinki	Finland
John	Henson Webb	IUCN UK Secretariat c/o Joint Nature Conservation Committee	Peterborough PE1 1JY	United Kingdom
Josef	Hoppichler	Federal Institute for Less-Favoured and Mountainous Areas	Vienna	Austria
Achim	Kälberer	Free Journalist, Berlin		
Ursula	Kirchholtes	Witteveen+Bos	Rotterdam	The Netherlands
Anil	Kumar Nadesa Panicker	Programme Director (biodiversity) M S Swaminathan Research Foundation	CHENNAI- 600 113	INDIA
Alessandra	La Notte	University of Torino	Torino	Italy
Markus	Lehmann	Convention on Biological Diversity		
Henrik	Lindhjem	Norwegian University of Life Sciences		
Sigrid	Lüber	European Coalition for Silent Oceans	CH-8820 Waedenswil	Switzerland
Alistair	MacDonald	Delegation of the European Commission to the Philippines		

William	Marthy		Bogor	Indonesia
Berta	Martín-López	Universidad Autónoma de Madrid	Madrid	Spain
Arthur	Michalowski	Wroclaw University of Economics	Hajnowka	Poland
Dominic	Moran	Scottish Agricultural College (SAC)	Edinburgh	UK
Shaun	Mowat	Defra Area 4E, 4th Floor, 9 Millbank	London	UK
Norman	Myers		Oxford	UK
Ståle	Navrud	Norwegian University of Life Sciences		
Karacheponen N	Ninan	Centre for Ecological Economics and Natural Resources Institute for Social and Economic Change	Bangalore 560 072	India
Charles	Perrings	Arizona State University and DIVERSITAS ecoSERVICES	Tempe AZ	USA
Melinda	Smale	Senior Research Fellow, International Food Policy Research Institute	Washington, DC, 20006-1002	USA
Lilian	Spijkerman	Conservation International	Arlington VA 22202	USA
Ridhima	Sud	Development Alternatives	New Delhi	India
Brian	Thornberry	Biodiversity Policy Unit, National Parks & Wildlife Service, Ireland		
John	Tschirhart			
Bernard	Vaissière	INRA, Laboratoire Pollinisation & Ecologie des Abeilles		

Sybille	van den Hove		Valldoreix (Barcelona)	Spain
Chantal	van Ham	IUCN - The World Conservation Union		
Zoltan	Waliczky	Royal Society for the Protection of Birds (RSPB)	Sandy	United Kingdom
Frank	Wätzold	Helmholtz Centre for Environmental Research	04318 Leipzig	Germany
Daan	Wensing	Triple E		NL
Richard	White	Devon Wildlife Trust	Exeter	United Kingdom
Ada	Wossink	University of Manchester	Manchester	U.K.
Bulat	Yessekin	National Council on Sustainable Development of the Republic of Kazakhstan		
Carlos Eduardo	Young	Instituto de Economia – UFRJ		

Note: Some of the contributors responded to the call on own account (cross reference)

b) Relevant experts: Participants to the International Workshop

	Name	First Name	Organisation	Country
1	Azqueta	Diego	University of Alcala	Spain
2	Baumgärtner	Stefan	Leuphana University of Lüneburg	Germany
3	Bearzi	Giovanni	Tethys Research Institute	Italy
4	Bishop	Joshua	International Union for Conservation of Nature	Supranational
5	Blanquet	Pascal	Ministry of Environment	France
6	Bozzi	Pierluigi	University of Rome "La Sapienza"	Italy
7	Braat	Leon	Alterra, Wageningen University	The Netherlands
8	Bräuer	Ingo	Ecologic	Germany
9	Carl	Mogens Peter	European Commission	Supranational
10	Chiabai	Aline	Fondazione Eni Enrico Mattei	Italy
11	Christie	Mike	Aberystwyth University	United Kingdom
12	Cokeliss	Zoe	Context	United Kingdom
13	Conder	Deighton	European Commission	Supranational
14	Constantino	Roberto M.	Metropolitan Autonomous University	Mexico
15	Couvet	Denis	Natural History Museum	France
16	de Burlet	Fergus	European Commission	Supranational
17	de Groot	Rudolf	Wageningen University	The Netherlands
18	Devillers	Pierre	Convention on Migratory Species	Belgium
19	Dieterich	Martin	Society for Conservation Biology, European Section	Germany
20	Dietzsch	Laura	Amazon Institute of Environmental Research	Brazil
21	Duraiappah	Anantha	United Nations Environment Programme	Kenya
22	Fonseca	Gustavo	The Global Environment Facility	USA
23	Gast	Fernando	Humboldt Institute	Colombia
24	Gokhale	Yogesh	The Energy and Resources Institute	India
25	Grieg-Gran	Maryanne	International Institute for Environment and Development	United kingdom
26	Gundimeda	Haripriya	Indian Institute of Technology - Bombay	India
27	Haffer	Sören	Ecologic	Germany
28	Haines-Young	Roy H.	University of Nottingham	United Kingdom
29	Hanks	John	International Conservation Services	South Africa
30	Harlow	Julian	Natural England	United Kingdom
31	Hayden	Mark	European Commission	Supranational
32	Holowko	Elzbieta	European Commission	Supranational
33	Hussain	Salman	Scottish Agricultural College	United Kingdom
34	Karousakis	Katia	Organisation for Economic Co-operation and Development	Supranational
35	Kettunen	Marianne	Institute for European Environmental Policy	Belgium
36	King	Nick	Global Biodiversity Information Facility	Denmark
37	Kuik	Onno	Free University Amsterdam	The Netherlands
38	Kumar	Anil	M S Swaminathan Research Foundation	India

39	Kumar	Pushpam	University of Liverpool	United Kingdom
40	Lambillotte	Francoise	European Commission	Supranational
41	Lazdinis	Marius	European Commission	Supranational
42	Lehmann	Markus	Convention on Biological Diversity	Supranational
43	Leiner	Stefan	European Commission	Supranational
44	Lipovska	Katarina	European Commission	Supranational
45	Lüber	Sigrid	OceanCare	Switzerland
46	Markandya	Anil	Fondazione Eni Enrico Mattei	Italy
47	Martin	Jock	European Environment Agency	Supranational
48	Martin-Lopez	Berta	Autonomous University of Madrid	Spain
49	McKenzie	Emily	Joint Nature Conservation Committee	United Kingdom
50	McVittie	Alistair	Scottish Agricultural College	United Kingdom
51	Miege	Robin	European Commission	Supranational
52	Miko	Ladislav	European Commission	Supranational
53	Miko	Ladislav	European Commission	Supranational
54	Moldan	Bedrich	Senate of the Parliament - Czech Republic	Czech Republic
55	Morling	Paul	Royal Society for the Protection of Birds	United Kingdom
56	Mowat	Shaun	Department for Environment, Food and Rural Affairs	United Kingdom
57	Mullan	Katrina	University of Cambridge	United Kingdom
58	Murphy	Patrick	European Commission	Supranational
59	Navrud	Stale	Norwegian University of Life Sciences	Norway
60	Neuville	Aude	European Commission	Supranational
61	Nickel	Elsa	Federal Ministry for Environment, Nature Conservation and Nuclear Safety	Germany
62	Ninan	Karachepone	Institute for Social and Economic Change	India
63	Nunes	Paulo	Fondazione Eni Enrico Mattei	Italy
64	Pedersen	Susanne	European Commission	Supranational
65	Poggi	Patrizia	European Commission	Supranational
66	Portela	Rosimeiry	Conservation International	USA
67	Quinn	Martijn	European Commission	Supranational
68	Rayment	Matt	GHK Consulting Ltd	United Kingdom
69	Rodrigues	Ana	University of Cambridge	United Kingdom
70	Rodriguez	Carlos	Conservation International Foundation	Costa Rica
71	Ruhweza	Alice	Forest Trends	Uganda
72	Ruijgrok	Elisabeth	Witteveen+Bos	The Netherlands
73	Sainteny	Guillaume	French Ministry of Ecology and Sustainable Development	France
74	Schauer	Mark	Federal Ministry for Environment, Nature Conservation and Nuclear Safety	Germany
75	Schröter-Schlaack	Christoph	Helmholtz-Centre for Environmental Research	Germany
76	Slabihoudkova	Jana	European Commission	Supranational
77	Smale	Melinda	International Food Policy Research Institute	USA
78	Sousa Pinto	Isabel	Society for Conservation Biology	Portugal

79	Sud	Ridhima	Development Alternatives	India
80	Sukhdev	Pavan	Green Indian States Trust	India
81	ten Brink	Ben	Netherlands Environmental Assessment Agency	The Netherlands
82	ten Brink	Patrick	Institute for European Environmental Policy	Belgium
83	Tinch	Rob	Environmental Futures Ltd.	Luxembourg
84	Turkelboom	Francis	Research Institute for Nature and Forest	Belgium
85	Turner	Kerry	University of East Anglia	United Kingdom
86	Vaissiere	Bernard	French National Institute for Agricultural Research	France
87	Vakrou	Alexandra	European Commission	Supranational
88	van den Hove	Sybille	Median	Spain
89	van Reeth	Wouter	Research Institute for Nature and Forest	Belgium
90	Vos	Hans	European Environment Agency	Supranational
91	Walpole	Matt	United Nations Environment Programme	Supranational
92	Ward	John	Commonwealth Scientific and Industrial Research Organisation	Australia
93	Wätzold	Frank	Centre for Environmental Research	Germany
94	Weber	Jean-Louis	European Environment Agency	Supranational
95	Wensing	Daan	Triple E	The Netherlands
96	White	Stephen	European Commission	Supranational
97	Winkler	Sebastian	The World Conservation Union	Supranational
98	Wittmer	Heidi	Helmholtz Centre for Environmental Research	Germany
99	Wossink	Ada	University of Manchester	United Kingdom
100	Yessekin	Bulat	Sustainable Development Fund	Kazakhstan
101	Young	Carlos	Federal University of Rio de Janeiro	Brazil
102	Zivian	Anna	University of California, Santa Cruz	USA

c) Research networks:

- Association of Environmental and Resource Economists
  http://aere.org/
- BIOECON - BIOdiversity and Economics for Conservation
  http://www.bioecon.ucl.ac.uk/
- ENVALUE - Environmental Valuation Database
  http://www.environment.nsw.gov.au/envalue/
- Environmental Valuation Laboratory
  http://www.diseae.unict.it/envalab/en/index.aspx
- EVRI - Environmental Valuation Reference Inventory
  http://www.environment.nsw.gov.au/publications/evri.htm
- MarBEF - Marine Biodiversity and Ecosystem Functioning EU Network of Excellence
  http://www.marbef.org/
- Natural Capital Project: Making Conservation Economically Attractive & Commonplace.
  http://www.naturalcapitalproject.org/
- Nature Valuation and Financing Network
  www.naturevaluation.org

d) Programmes:

- EEPSEA: Economy and Environment Program for Southeast Asia
  http://www.idrc.ca/en/ev-7199-201-1-DO_TOPIC.html
- IUCN/WWF Biodiversity Economics Site:
  A directory of environmental experts can be found at www.biodiversityeconomics.org .
- LACEEP: The Latin American and Caribbean Environmental Economics Program
  http://www.laceep.org/
- PREM: The Poverty Reduction and Environmental Management (PREM) programme. PREM is active in Asia and Africa.
  http://www.prem-online.org/
- SANDEE: The South Asian Network for Development and Environmental Economics
  http://www.sandeeonline.org/
- SELS: 'Speerpunt' Ecosystem and Landscape Services:
  http://www.fsd.nl/sels
- UKNEE: the UK Network of Environmental Economists.
  http://www.eftec.co.uk/

e) Projects:

- Assessing the Economic Value of Ecosystem Conservation. (2004). By World Bank, Washington, DC.
  http://129.3.20.41/eps/othr/papers/0502/0502006.pdf
- Biodiversity Economics
  http://www.biodiversityeconomics.org/
- CLIBIO - Impacts of Climate Change and Biodiversity Effects. (2006-2009). By Department of Economics, University Ca'Foscari of Venice, Venice, Italy. Funded by the European Investment Bank, EIBURS Programme.
  http://www.dse.unive.it/centri-e-partners/ceem/progetti-di-ricerca/clibio/home/
- COPI- Cost of policy inaction: The case of net meeting the 2010 biodiversity target. (2007-2008). By Alterra, Wageningen University and Research,Wageningen, The Netherlands. Funded by DG Environment, EC.
- Economic Values of Protected Areas: Guidelines for Protected Area Managers. No. 2. Task Force on Economic Benefits of Protected Areas for the World Commission on Protected Areas (WCPA). (1998). By IUCN in collaboration with the Economics Service Unit of IUCN, 1998, xii + 52pp.
  http://www.iucn.org/dbtw-wpd/edocs/PAG-002.pdf
- EXIOPOL - A New Environmental Accounting Framework Using Externality Data and Input-Output Tools for Policy Analysis. (2007-2011). By FEEM, Milan, Italy. Funded by EC, FP6.
  http://www.feem-project.net/exiopol/
- Handbook of Biodiversity Valuation: A Guide for Policy Makers. (2002) By Pearce, D.W., Moran, D., Biller, D., Organisation for Economic Co-operation and Development (OECD), Working Group on Economic Aspects of Biodiversity. p.156. Case studies can be downloaded from:
  http://www.oecd.org/document/11/0,2340,en_2649_34285_34312139_1_1_1_1,00.html
- Making economics work for biodiversity conservation. (2005). By Biological Diversity Advisory Committee, Department of the Environment and Heritage. Land & Water Australia.
  http://www.environment.gov.au/biodiversity/publications/economic-valuation/pubs/conservation.pdf
- Scaling up ecosystem services values: methodology, applicability and a case study. By Ecologic, Berlin, Germany. Funded by European Environment Agency.
- SESAME - Southern European Seas: Assessing and Modelling Ecosystem changes. (2006-2010). By Hellenic Centre for Marine Research (HCMR), Attiki, Greece. Funded by EC, FP6.
  http://www.sesame-ip.eu/scientist/ph-ds

e) Models:

- EcoValue - An interactive decision support system for assessing and reporting the economic value of ecosystem goods and services in geographic context
  http://ecovalue.uvm.edu/evp/default.asp
- GLOBIO - Model of impacts of environmental change on biodiversity
  http://www.unep-wcmc.org/GLOBIO/
- ICES – Moded on Intertemporal Computable Equilibrium System
  http://www.feem-web.it/ices/

f) Internet resources:

- BirdLife International
  http://www.birdlife.org/
- CGIAR: The Consultative Group on International Agricultural Research
  http://www.cgiar.org/impact/genebanksdatabases.html
- CI Biodiversity Hotspots
  http://www.biodiversityhotspots.org/Pages/default.aspx
- Conservation International
  http://www.conservation.org/Pages/default.aspx
- Defra
  http://www.defra.gov.uk/wildlife-countryside/biodiversity/index.htm
- Ecosystem Services Database - data and analysis portal to assist the informed estimation of the economic values of ecosystem services
  http://esd.uvm.edu/
- European Commission
  http://ec.europa.eu/environment/nature_biodiversity/index_en.htm
- EVRI database: global database of environmental economic valuation studies
  http://www.evri.ca/english/default.htm
- Global Development Research Center Tools for Environmental Management:
  http://www.gdrc.org/uem/e-mgmt/cover.html
- Guidelines for environmental impact assessment (EIA) in the Arctic: This guide provides very clear and straightforward guidance on how to do an impact assessment:
  http://www.nepa.gov/nepa/eiaguide.pdf
- Guidelines on biodiversity-inclusive Environmental Impact Assessment (EIA):
  http://www.biodiv.org/doc/reviews/impact/EIA-guidelines.pdf

- International Association of Impact Assessment:
  www.iaia.org
- IUCN
  http://cms.iucn.org/
- Reefbase: Free and easy access to data and information on the location, status, threats, monitoring, and management of coral reef resources in over 100 countries and territories.
  http://www.reefbase.org/
- RSPB
  www.rspb.org.uk
- The Conservation Finance Alliance:
  www.conservationfinance.org
- The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States.
  http://ccma.nos.noaa.gov/ecosystems/coralreef/coral_report_2005/
- Tropical Rain Forest Information Center (TRFIC):
  http://www.trfic.msu.edu/
- UK Biodiversity Action Plan
  http://www.ukbap.org.uk/
- UK Joint Nature Conservation Committee
  http://www.jncc.gov.uk/
- WWF and IUCN:www.biodiversityeconomics.org. Within this site see the Biodiversity Economics Basics
  http://www.biodiversityeconomics.org/library/basics/index.html
- WWF-US Center for Conservation Finance:
  www.worldwildlife.org/conservationfinance