Common International Classification of Ecosystem Services (CICES, Version 4.1)

Paper prepared following consultation on CICES Version 4, September 2012

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We thank those who have provided comments on the CICES website and via e-mail exchange. The views and interpretations presented here, however, are solely those of the authors, and although prepared as a briefing document for the European Environment Agency, do not necessarily represent their position.

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Response to Comments on CICES V4, August-September 2012

1. Introduction

This paper sets out key issues that should be considered for the further development of Common International Classification of Ecosystem services (CICES). The discussion is based on the comments received in the CICES website (www.cices.eu) up to 21st September 2012, and additional e-mail communication from the wider community passed to the coordinators.

The document is intended as a briefing for the European Environment Agency, which sponsored the development of the original proposals as part of their input to the revision of the System of Economic and Environmental Accounting (SEEA2012). It is also intended to provide feedback to those who have supplied comments or who are interested in the further evolution of the system.

The document is structured around a set of general issues that we have identified from the comments received. It seeks to clarify the issues raised in an integrated way so that further comment can be made. In Appendix 1 we provide a summary of the comments by the Topics initially set up on the website. All the material should be looked at in conjunction with the accompanying spreadsheet, which shows both the initial structure for CICES Version 4, and the way we have responded to comments, as CICES Version 4.1.

In any subsequent communication please note which version is being considered and identify the cells in the classification using the EXCEL nomenclature.

2. The Development of CICES

2.1 History and Purpose

The concept of ecosystem services is an attractive one because it potentially helps us describe some of the ways that humans are linked to and depend on nature. It is also challenging, because the connections between people and nature are complex and different specialist groups look at them in different ways. For example, some need to describe ecosystem services so that they can be valued economically. Others are more interested in how human impact on ecosystems changes their capacity to deliver services, so that appropriate policies can be developed. These kinds of concern imply the need for some kind of accounting system for natural capital. The Common International Classification of Ecosystem Services (CICES) has been developed as a tool to help negotiate the different kinds of perspective that have developed around the ecosystem service concept and assist in the exchange of information about them.

The first draft of CICES was tabled for discussion in December 2009 by the European Environment Agency (EEA). There then followed two rounds of consultation with the international community in 2010 and 2011. Much of the work has subsequently focussed on the meetings organised by the EEA that involved the technical experts linked with the UNSD initiative to revise the System of Economic and Environmental Accounts (SEEA). However, the wider relevance of CICES for the ecosystem service assessment and valuation was always noted, and the development of the current set of proposals was also informed by recent efforts in the EU to develop a consistent classification of

ecosystem services for ecosystem mapping[1]. Ecosystem services cannot be valued, mapped or included in accounts if they cannot be described and measured. CICES has been designed to help provide the clarity that is needed in all these applications.

2.2 Structure of CICES

If people are to use environmental accounts and have confidence in them, then ways ecosystem services are described must echo broader understandings in the research and practitioner communities. Thus a consideration for the design of CICES is that it should, wherever possible, have resonance with the other widely used frameworks that people use in discussing ecosystem services, especially in terms of the terminology adopted. This is not to say that terminology cannot evolve, but the idea was that wherever possible familiar or accepted terms and concepts should be used.

Thus CICES took as its starting point the typology of ecosystem services suggested in the Millennium Ecosystem Assessment (MA 2005), and refined it to reflect some of the key issues that have been discussed in the wider research literature. It is, for example, more explicitly hierarchical in structure (see accompanying spreadsheet, CICES V4.1). At the highest level are the three familiar categories used in the MA: provisioning, regulating and maintenance, and cultural. Below these major 'Sections' in the classification are nested a series of 'Divisions', 'Groups' and 'Classes'.

The hierarchal structure of CICES was proposed as a way of handling some of the challenges that arise in relation to the different spatial and thematic scales used in different applications. Accounts, like more general assessments, have to be based on a well-defined and credible metrics which are often specific to particular geographical or situations or ecosystem types. For the purposes of reporting or comparison these may need to be aggregated and generalised. Thus the hierarchical structure allows users to go down to the most appropriate level of detail required by their application, but then group or combine results to making wider comparisons or generalised reports, as and when they are needed.

The feedback gained during the early consultation on CICES suggested that the naming of the higher levels should be as generic and neutral as possible. Thus, for example, 'regulation of flows' is suggested, as opposed to 'regulation of hazards'. The assumption is that users will identify the specific services that they are dealing with as 'Classes' and 'Class types', and use the hierarchal structure to show where the focus of their work lies, or to aggregate results as required.

The proposals for CICES V4.1 suggest that for mapping and assessment purposes the 'class-type' level may be most appropriate, whereas for accounting information at the level of Classes or even Groups may be sufficient. However, there is no restriction about how these different levels might be used in different sorts of application. This issue should be explored in future work, including that on experimental ecosystem accounts, that now follows the publication of the *Central Framework* of the SEEA2012.

In the sections that follow more specific issues relating to the structure of CICES are discussed. On the basis of the feedback received we make a number of recommendations about how future work might proceed.

[1] See Ecosystem Assessment Topic on the CIRCABC website

3. Definitions and underlying principles

3.1 Final and Supporting Services

Many of the points made in the consultation involve consideration of the concept of final services and so it is useful to clarify their role in CICES.

A key early decision in designing CICES was to exclude the so-called supporting service from the classification and focus only on the provisioning, regulating and cultural components. The reason for doing this was that if ecosystem and economic accounts were to be linked, then an essential step is to identify and describe the 'final outputs' from ecosystems that people use and value. Exclusion of supporting or intermediate services, as some people call them, does not imply that they are unimportant or can be overlooked. This is a conscious choice, designed to focus effort on better describing the boundary between ecosystems and society, where the outputs of ecosystems are turned into benefits that contribute to human well-being.

In fact, there is no reason why fully developed environmental and economic accounts cannot also record changes in underlying ecological structures, processes and functions, and systems like CICES may well be extended to cover them. However, given that service may depend on many underlying functions and that those same functions may support a number of different services, it was decided to begin by only looking at the interface between ecosystems and society.

In the current revision of CICES supporting services continue to be excluded, but we recommend that the issue is looked at again once experience from experimental approaches to ecosystem accounting, for example, is available. The CICES classes nevertheless offer a framework in which information about supporting or intermediate services can be nested as referenced, and this may be particularly useful in a mapping context.

3.2 The anthropocentric focus

The ecosystem service concept has been criticised because it seems to promote a utilitarian view that commodifies nature, rather than valuing it for its intrinsic properties. CICES has also been criticised in the responses because it seems to formalise this perspective. Some argue that documenting the way people consume or use the outputs from ecosystems the system can imply agreement with a separation between nature and economy.

While it is the case that CICES takes an anthropocentric perspective, in that it describes the way humans, rather than any other organism, use and value nature, it does not follow that people and nature are separate or that only human values count, or even that economic values trump all. These are all important philosophical questions and the development of CICES has not taken place without paying them some regard. However, the design of a classification system is probably not a useful framework around which these fundamental issues can be resolved. CICES has a more pragmatic and modest set of aims, namely to describe what people mean when they refer to particular types of ecosystem service so that information can be more easily exchanged and insights compared. It is for this reason that we suggest it can be useful in building integrated environmental and economic accounts. Nevertheless, as argued in the section on the production boundary, in designing CICES we do not assume that nature and society are somehow separate. Indeed the focus on 'final services' is used to emphasise just how close these reciprocal relationships are. Moreover, there is no intention that in describing ecosystem service we only focus on natural or semi-natural ecosystems. Many

ecosystems have been created wholly or in part by human action, and to overlook them would make the exercise a narrow one. Biotic and abiotic processes go on all around us and it is important to describe just how they contribute to human well-being, and how human actions can interfere with them. Finally, trying to document these contributions (so that integration with economic accounting can be achieved) must not be taken to imply that only economic valuation counts. Economic valuation may be important in some situations and not in others, and beyond accounting there is nothing in the design of CICES that would prevent it supporting social, moral or aesthetic forms of assessment. Indeed physical accounting (i.e. physical measurements of service outputs) may even be sufficient in many decision making contexts.

In general terms, therefore, we recommend that CICES is regarded primarily as an attempt to describe ecosystem outputs as they directly affect human well-being, so that discussions about appropriate assessment frameworks (economic, social, aesthetic and moral) can take place.

3.3 The hierarchical structure of CICES

Some of the feedback received concerns the hierarchical structure of CICES, and whether it is indeed a classification. The hierarchical structure was proposed to take account of the fact that different accounting and mapping applications will take place at different thematic and spatial scales. In CICES, as we move successively from Section, through Division, Group and Class the description of the service is progressively more specific and that there may be many service types *nested* within these broader categories. This feature therefore enables an application at national scale in a particular geographical region, to aggregate and prepare accounts on all the elements within, say, the 'Terrestrial plants and animals for food' Group. In another geographical area a similar *and comparable* report at the level of 'Terrestrial plants and animals for food' could be made even though the mix of elements within that aggregation would be different. There is therefore 'dependency' in the CICES hierarchy in the sense that the characteristics used to define services at the lower levels are inherited from the Sections, Divisions and Groups that above them. There is also a sense of 'taxonomy' in that elements within the same Group or Class are conceptually more similar to each other, in terms of the ways they are used by people, than they are to services elsewhere in the system. As such CICES can be regarded as a *classification*.

In addition to the nested structure a second feature of CICES that makes it a classification rather than an arbitrary nomenclature is that while at the class level it is designed to open so that people can add services that mean something to them by nesting them within the system at the lower levels, at the upper levels the categories are regarded as more *exclusive*. Thus the three-fold division between provisioning, regulating and cultural is designed to capture, respectively, the material and energetic uses of ecosystems, the uses of ecosystems to regulate the ambient environment of people, and non- material intellectual or symbolic uses. These three groupings are intended to capture *all* the final uses of living processes implied by the notion of ecosystem services.

We therefore recommend that the hierarchical structure of CICES is retained and the initial focus of testing and refinement is on the upper levels in the hierarchy to ensure that they cover all the major types of contribution that ecosystems make to human well-being, and that the definitions of these broad categories enable users to place the services with which they are concerned into the system using, say, a set of taxonomic decision rules.

In developing CICES it was suggested at the outset that the system was not meant to replace all other classifications of ecosystem services but to enable people to move more easily between them and to understand more clearly how people are measuring and analysing information. This is not a modest ambition, in the sense that the field of ecosystem services is a very broad one. As the discussions around accounting and mapping applications have shown, people bring different perspectives to the debate, and the negotiation of these differences will be a complex undertaking. If decisions are to be made, and the value of the information we collect about the environment is to be fully realised, then we need to find ways of making links across the various disciplinary divides; as a classification system CICES attempts to help in that communication process.

4. Recommendations on key topics from consultation

4.1 Final Ecosystem Services and the SEEA 'Production Boundary'

Given that a primary aim of CICES was to support the development of integrated environmental and economic accounting, it is important that its design should be consistent with the structure of the *Central Framework* of the SEEA (SEEA2012). A particularly important issue for the design of CICES is how it related to the so-called 'production boundary'.

In the SEEA *Central Framework*, the 'production boundary' represents the interface between the economy and the environment (Figure 1). Within the economy activities that are carried out under the control and responsibility of 'economic units', which use labour, assets and goods and services to produce outputs of goods and services. These outputs are collectively known as 'products'. Within the SEEA 'the environment' is taken to include all living ***and*** non-living components that comprise the bio-physical environment, including all types of natural resources and the ecosystems within which they are located (SEEA, 2012, para. 2.10). The SEEA2012 goes on to describe flows from the environment to the economy as 'natural inputs', which include flows of minerals, timber, fish, and water etc.. In addition to the flow of inputs from the environment into the economy, the *Central Framework* identifies a contra-flow across the production boundary, namely that of 'residuals', which include solid wastes, air emissions, and the return flows of water to the environment.

Although the terminology may be different to that used in the ecosystem services literature, the conceptualisation shown in Figure 1 is broadly consistent with current thinking within the ecosystem services literature; to see the *similarities* it is useful to compare this diagram with Figure 2. If 'final' ecosystem services are the things that people directly use and value, then in this model clearly defines something equivalent to the SNA production boundary. These final services can represent inputs to the economy (in the form of provisioning services, e.g. timber), or services to the economy such as the assimilation and processing of waste (these would include some of the regulating services).

In terms of the *differences* between the conceptualisations in Figures 1 and 2, three features are apparent:

i. In the 'ecosystem services paradigm' represented by Figure 2, services can have *social* as well as *economic* value; social values can include cultural significance as well as moral and aesthetic significance for people, that is a range of 'non-market goods'. Thus in contrast to Figure 1, the ecosystem services model implies more of a 'social boundary' rather than a narrower 'production boundary' (see SEEA2012, para 2.149). Nevertheless, while a listing of ecosystem services may be much longer than one simply drawn up form an economic

Figure 1: Physical flows and natural inputs, products and residuals (after SEEA2012)

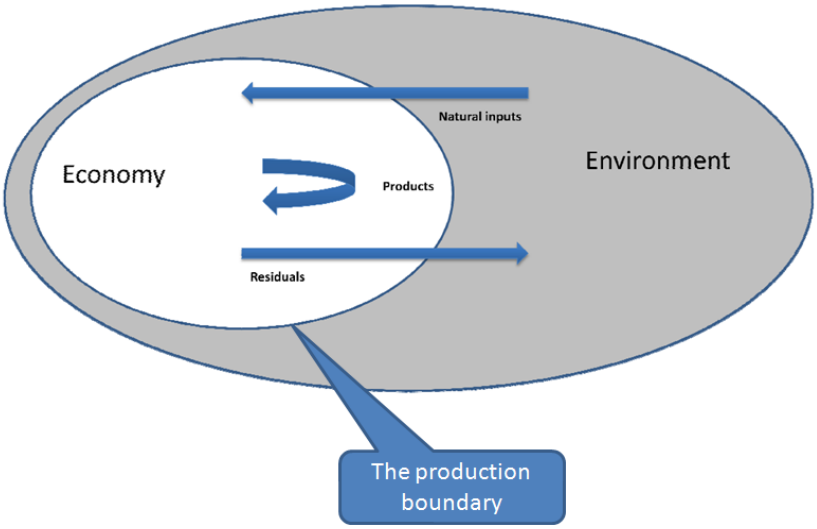
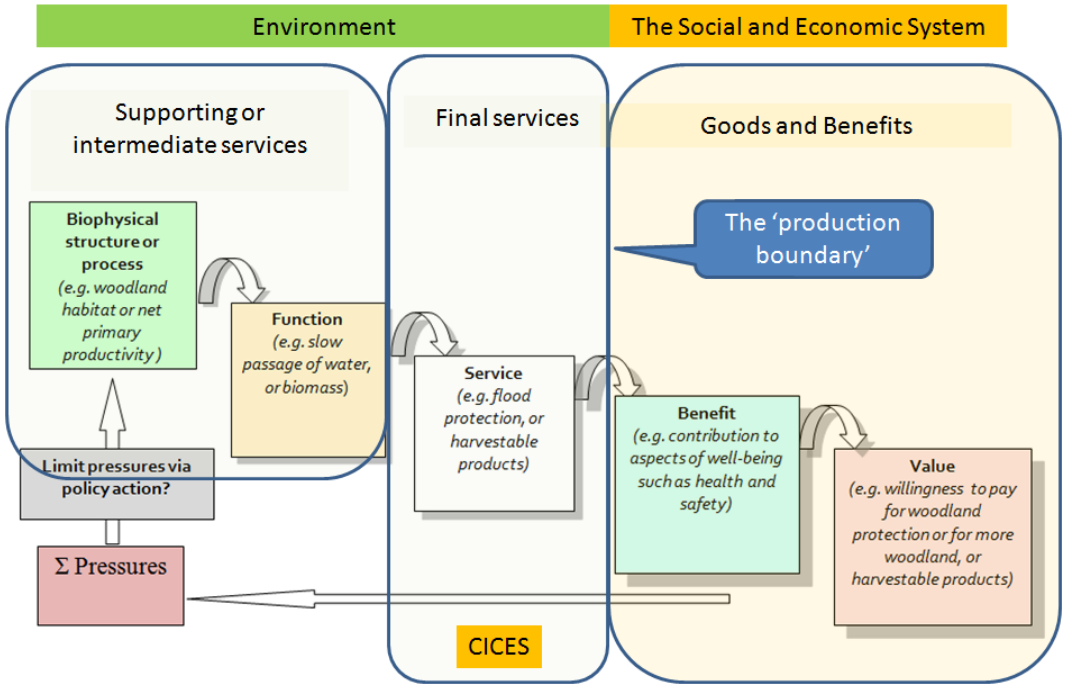


Figure 2: The Ecosystem Service Paradigm (after Potschin and Haines-Young, 2011)



perspective, it is clear that conceptually the two models are consistent in terms of how the environment relates socio-economic systems, and in particular how the flows (=ecosystem services) take place between them.

ii. In the *Central Framework* the flows to and from the environment can be both biotic and abiotic. This would suggest that any classification of these exchanges across the production boundary (i.e. any full description of what the environment 'does' for the economy) would need to include ***both*** elements. To the extent that ecosystem services are regarded by many as being

essentially dependent on biodiversity (i.e. living processes), there may therefore be a tension between the statistical and ecological communities about the scope of any typology of ecosystem services or environmental flows. This has been a topic of particular debate in the present consultation (see below).In the *Central Framework* the term 'natural' is used to describe the various inputs from the environment. 'Natural' resources are taken to include all 'natural' biological resources such as timber and aquatic resources, mineral and energy resources, soil resources and water resources. The significant point to note is that *cultivated biological resources* are excluded from what is taken to represent the 'environment' and regarded as part of the 'economy'. The way the 'environment' is framed in the SEEA2012 is perhaps one of the more problematic aspects for those working with ecosystem services, in that it implies that the environment only consists of structures and processes that exist without the intervention of human agency. Setting aside the problem that in Europe and many other parts of the world, few natural habitats or ecosystems exist (many being the result of current or historical human intervention or impact), even in explicitly cultivated ecosystems such as the farmed landscape or plantation woodlands, the habitats make a number of different contributions to human well-being besides those for which they are or were cultivated. Most ecosystems, whether they are artificial, semi-natural or wholly natural are multi-functional and capable of delivering market and non-market benefits. Thus the water regulating or carbon sequestration services of plantation woodlands, for example, are not regarded as flows from the 'environment' in the SEEA model whereas they would under the conventional ecosystem service paradigm.

It is not appropriate to attempt to resolve these differences here, although it seems that whether biotic and abiotic flows from the environment are regarded as ecosystem services and formally made part of the same classification is mainly a pragmatic issue. Neither community is suggesting that they are unimportant, but rather that they might be described in certain ways. Similarly the importance of social values and how they can be accounted for is recognised as an issue in the *Central Framework* and the topic is one that has been identified for discussion in the *SEEA Experimental Ecosystem Accounts,* to which this consultation currently directed.

It is perhaps the third point about 'natural' flows that is the most difficult one at this stage, because conceptually it seems to narrow the scope of any proposed classification of ecosystem services for accounting purposes, because it fundamentally changes perspectives on what is an ecosystem and what kinds of service it provides. The problem arises because we are looking at a chain of production that cannot easily be resolved into discrete steps, and which involves the progressive combination of different types of capital (e.g. natural, social, built intellectual and economic) at different points. In order not to close options at this stage in the consultation, we therefore propose a more comprehensive framing of the concept of ecosystem services than that implied by the SEEA2012 which:

- Views **final ecosystem services** as the *contributions* that ecosystems make to human well-being (cf. the definition the Central Framework that sees ecosystem services as the *benefits* provided by living and non-living processes). These services are final in that they are the outputs of ecosystems (whether natural, semi-natural or artificial) that most directly affect the well-being of people.
- Takes **ecosystem good or product** to be the things that people create from this final service that changes the well-being of people. Such goods or products would be across the production

or social boundary on the other side, so to speak, from the 'environment' as defined by the *Central Framework*.

- Uses the term **benefit** to refer to the change in human well-being brought about by people having access to some ecosystem good or product.

These distinctions are useful because we need to account for the fact that ecosystem outputs or final services (e.g. trees) can be used to create different goods (e.g. timber for construction; wood for fuel). The benefits that arise from these goods can also vary from place to place and may in turn depend on the combination of a number of different kinds of ecosystem goods (e.g. shelter may depend on timber for construction as well as other natural products, such a thatch from reeds).

It may well be that the differences between the more general ecosystem services paradigm and the SEEA2012 model might be resolved by looking more closely at the concept of 'natural flows'. The definition of flows in the *Central Framework* involves the idea of physical inputs that are 'moved from their location in the environment' directly or indirectly into production process. For the ecosystem service paradigm it is not so much the physical movement but a ***change in the dependency on biotic or abiotic processes***. Thus the transformation of an ecosystem service into a good represents more of a disconnection of the ecosystem output from the active ecosystem structures and processes that generated it (i.e. the underpinning supporting or intermediate services). Similarly the processing of 'residuals' by the environment represents an exploitation of biotic or abiotic processes, when the flow of matter or energy moves the other way; in this case there is a reconnection to some set of underpinning services that can help society deal with these wastes. Thus the issue is perhaps not whether the ecosystem is 'natural' in the sense that it has not been engineered by human action, but whether the dominant processes that one is dealing with are economic or social ones (in which case we are 'within' the economy or society and are dealing with goods or products, and benefits contributed by the ecosystem), or whether biotic or abiotic processes are the key factor (in which case we are dealing with ecosystem services, generated y underlying ecosystem structures, processes and functions).

To make progress, we recommend that CICES is designed around the idea that it is a classification of final ecosystem services rather than a classification of ecosystem goods or benefits. However, given that many of the comments received in during the consultation process reflect the fact that people are sometimes talking about these different components simultaneously, it is clear that the structure has to indicate how these services map on to goods or products and benefits. We suggest that in the forthcoming work on experimental ecosystem accounts there is a focus on the nature of the production boundary and a discussion of the concept of 'natural' within the Central Framework so that convergence between the systems might be achieved.

4.2 Combining of different forms of capital

In the consultation it was suggested that there should be some place in the classification where the links between ecosystem services and other "capital" inputs, such as human labour, energy are added, since these are often needed to produce a service, especially, for example, in the case of provisioning services. As noted above, this is an important issue because an understanding of the way different forms of capital are combined as ecosystem outputs are transformed into benefits is a fundamental goal of the new ecosystem service paradigm. However, on the basis of the argument presented in the last section we would suggest that such a modification is unnecessary.

Nevertheless, the remark does indicate that some clarification is needed about the role of CICES in these wider debates.

CICES is intended as a classification of final services. In line with the SEEA, they are regarded as final in the sense that, these ecosystem outputs can be used by households, enterprises or government to produce benefits, often by combining these ecosystem goods and services with other forms of capital. Thus CICES aims to describe one step in this 'production chain', and focuses on the things that can be turned into products that are valued in some way. This position does not deny that other types of capital input may be needed to facilitate or manage some of the intermediate steps that give rise to this final service. However, to place values on these would be to open the door to double-counting. Although decisions about what constitutes the final service may be debateable, there are some conventions that we might usefully follow. It was for this reason that in the original CICES proposal the services recognised were cross-referenced to standard classifications of products and activities. This may not be possible for all services, but where a read-across can be made then it is useful as a way of emphasising the dependency of economic activity on the outputs from ecosystems (whether artificial, semi-natural or wholly natural).

In the revised CICES structure examples of products and activities arising from particular services are indicated on the right hand side of the table. For example, the standing crop of trees in a forest would be regarded as an example of a service in the non-food biotic material division of CICES, giving rise to products that may include timber. In order to illustrate the classification is accepted that more work needs to be done on the entries in this column.

To emphasis the contribution of the CICES services to human well-being, we recommend that further work is done on cross-referencing these services to standard product and activity classifications, to facilitate the valuation process and help identify the ways different types of capital combine to support human well-being.

4.3 The place of biodiversity and abiotic outputs from ecosystems

The importance of living (biotic) processes and the contribution they make to human well-being is, for many, the core of the argument about ecosystem services. To emphasise this many would argue that the role of biodiversity is so fundamental that ecosystem service should only be regarded as outputs from ecosystems that depend on such living processes. The conceptual problem that this poses is that ecosystems can provide a number of abiotic outputs that benefit people that also need to be discussed in some way. Such outputs include, for example, energy sources such as wind and waves, or materials like sand and salt. In the discussion received for the marine sector, and for water more generally, similar dilemmas about what constitutes a service have been identified. For example the presence of natural water bodies could contribute to human well being by permitting *navigation*, but the existence of these water bodies is not dependent on living processes.

The problem of how to handle biotic and abiotic ecosystem outputs is illustrated most starkly by the different comments received on the place of water in the proposed classification. The difficulty comes about because water is an abiotic mineral whose availability is controlled by a range of different biotic and abiotic factors. However, despite its abiotic character, it is essential to recognise in the classification the mediating effect of living processes on water quantity and quality. The options are therefore these:

i. If we restrict the notion of an ecosystem services to the contribution that living processes make to human well-being, then the focus in relation to water must be on how effective these living processes are in controlling the quantity and quality of water, rather than the availability of water per se. Under this option water-related services are best situated entirely under the regulating services rather than in the provisioning section.

ii. If we recognise that the ecosystem service concept covers abiotic ecosystem outputs then the contribution that water makes in nutritional and material terms, would argue for its inclusion under provisioning, as well as under regulating. If water is treated in this way then it would seem consistent to regard other abiotic outputs from ecosystems as services in the classification.

Our review of these different positions suggests that although there is no simple way forward, the different general views about biotic and abiotic ecosystem outputs might be accommodated by recognising that such outputs vary in the degree to which they depend on biotic and abotic factors. In keeping with the spirit of the MA and TEEB, for example, although CICES might focus primarily on those which are fundamentally dependent on biodiversity, but there is no reason why a similar classification approach cannot be adopted for abiotic outputs.

We recommend that in taking the classification forward, the different potential uses of CICES are recognised and biotic and abotic components are therefore defined in separate but complementary blocks. Given that the experimental ecosystem accounts being developed through the SEEA process are mainly concerned with outputs dependent on living processes, the initial effort should on the part of CICES that emphasises biodiversity, but the long the goal should be a more integrated approach.

A potential problem of dealing with ecosystem outputs mainly dependent on biotic and abiotic structures and processes separately is what to call the latter. One suggestion has been to refer only to the former as 'ecosystem services' and use the term 'environmental services' for the latter. ***This we suggest may lead to confusion, given that the term is already being used in other contexts. We recommend that all ecosystem outputs are regarded as services, but that the users qualify their descriptions by indicating whether the services being considered are more or less dependent on biodiversity (or the interaction between biotic and abiotic processes), in contrast to those which are mainly dependent on physical. Providing the same logic underpins the classification it is immaterial whether these two types of service are part of the same classification table. Under this course of action, where 'water' would sit in the classification would therefore be a more a matter of convention or agreement rather than a fundamentally different conceptual position.***

4.4 Cultural ecosystem services

Many of those consulted have pointed out the difficulty of defining and describing cultural ecosystem services. Indeed, one of the complexities recognised in recent debates is that, to some extent, all services potentially have a cultural component. There are, for example, important cultural dimensions to diet and hence what we regard as 'provisioning service'. The situation is perhaps, analogous to the dependency of services on biodiversity, in that there is probably also a spectrum ranging from services that are wholly on cultural factors to others that are less so.

The inclusion of a section that explicitly highlights cultural services in CICES does not deny that cultural values are important across all the services. Indeed many of these cultural factors may be

recognised in the values that people subsequently ascribe to these services. The purpose of distinguishing cultural services is to flag up the fact that there appears to be a set of non-material outputs from ecosystems that are important to people. These outputs are variously described as representing “spiritual” significance, or "meaning", or of encapsulating aspects of peoples “Identity".

The problem with emphasising the non-material aspects of cultural services as a distinguishing feature is that there is a potential ambiguity in the current structure of CICES. At present the services that contribute to hunting and angling (sport fishing), for example, would be classed as supporting a type of cultural practice. However, since they involve the extraction of biomass, they could equally well be placed in the provisioning sector either as a food if the quarry is eaten (e.g. in the Nutrition division in the class “Wild plants and animals and their products”) or as an ornamental service (in the class “biotic materials) if they are treated more as trophies.

For consistency we recommend a change is made to the location of the ‘extractive’ forms of recreation and that they are placed in the provisioning sector of the classification.

Moreover given the comments received, we recommend that a clearer distinction is also needed between what are regarded as ecosystem services and the benefits they generate. Thus terms such as recreation or activities like hiking and diving are best avoided except in those parts of the table that illustrate link of the service to goods and benefits.

On the basis of the comments received a classification has been suggested that differentiates the physical or experiential use of ecosystems and what they represent intellectually or symbolically. Thus in revising the classification of cultural ecosystem services, a one possible structure distinguishes at Division level: (a) the physical and experiential use of ecosystems; and, (b) their intellectual or symbolic representation.

In the UK NEA[2] cultural services were also described as ‘environmental settings’, and were conceived as locations or places which, at different scales, give rise to the cultural goods such as leisure, recreation and tourism, and religious, spiritual and health benefits (Figure 3). In general terms these environmental settings can be regarded as socio-ecological systems of some kind, that is socially determined units in which nature and society are linked materially and culturally. Therefore in order to emphasise the ‘physicality’ of the things regarded as cultural services in CICES, the term ‘settings’ has also been used in the titles at Division Level. The settings concept is also reflected in the definition at the Class level and in the terminology that places the cultural goods and benefits in the illustrative column to the right.

[2] Based on Max-Neef’s “Human-Scale Development Matrix”

Appendix 1:

The comments received on the CICES website were organised around a number of discussion topics. In reporting them we have retained the original numbering, although it was clear that there was some overlap in the points made and some issues are more easily dealt with by combining them. It is not possible here to report in detail how the comments were dealt with but rather give a general picture of the debate. Many of the key issues have been discussed in greater depth in the main text of this document. An updated spreadsheet showing ht e revised classification is attached. A comparison between Versions 4 and 4.1 in this spreadsheet shows what changes have been made.

Topic 1: Marine

The main adjustments to CICES V4 in the marine sector were an expansion of the classification to more fully include the biotic marine environment and to exclude ecosystem outputs from marine systems that were not dependent on living processes such as renewable abiotic energy sources and abiotic materials. Setting aside the debate about whether abiotic ecosystem outputs should be included (see Issue 4), no significant shortcoming in the classification was identified for provisioning, and regulating.

There was, however, some discussion about "transport services" and a case was put for their inclusion. The argument echoes that of DeGroot (2006), who identified a so-called "carrier function" for ecosystems, defined in terms of their ability to provide a suitable substrate or medium for human activities and infrastructure. Such services would, if abotic services are excluded from CICES, also lie outside the classification, except in so far as organisms may regulate or mediate navigation, say, via their effect on sediment movement or water flow, but this is something that probably only applies to freshwater systems. At present these services are covered in 'Flow regulation'. The same topic was identified in the exchanges about water (see Issue 3).

Topics 2 & 5: The place of abiotic energy sources and energy more generally.

The discussion points made here rehearsed many of the arguments for and against including abiotic services in the classification. It was suggested for example that by including abiotic ecosystem outputs there was a danger of making the system too broad. One respondent argued, for example, "From a scientific point of view one might want to make a complete-all-inclusive system in its own right, but with a view to the political task on our hands, which stems from the Biodiversity Convention, it might be wise to settle for less complexity and focus on the most important aspects". This discussion thread was continued in the comments for water (Topic 3) and biotic materials (Topic 4); see below.

However, in terms of energy issues, assuming they are retained in the system, it was noted that there had been some applications in Belgium using the original classification and the respondent endorsed the present structure in conceptual terms.

Topic 3: Water

Much of the discussion focussed on the problem of classifying water because it is, as a number of contributors pointed out it an abiotic component of ecosystems. Thus one suggestion was that it should be moved entirely to a section covering abiotic services. However, living processes clearly play a role in regulating its quantity and quality, and so it was suggested that it should be eliminated

from provisioning, and only referred to in the regulating section; in this case the service would be the regulating capability or contribution that living organism make in the water cycle, say or via their capacity to purify. The options for water have been discussed in the main text of this document. At this stage we have retained water in the provisioning and regulating Divisions, mainly on the basis that this seems to be the convention, following the MA.

In the wider comment received on the general problem of abiotic ecosystem outputs it was noted in the discussion that the present situation largely reflects the historical development of the ecosystem service framework, and that we still need to work towards a "coherent and robust" framework. It was also argued that the separation between biotic and abiotic is somewhat artificial; the general tone of the comments received was that some unified treatment was probably desirable.

Topic 4: Biotic materials

Some quite specific comments were made here. It was noted for example that dependency on fungi and micro-organisms, should be covered alongside plants and animals in nutrition, and that the term fibre should be generalised to materials. Finer resolution of the genetic category was also proposed.

Other comments suggested that the scope of the classification of biotic materials as intermediate service and final services needed to be clarified (e.g. should plant based fertilisers and fodder be identified in the classification?). These issues are discussed in terms of the concept of final service – see above- and the notion of products (goods) as distinct from services.

It was also suggested that the placing of ornamental is problematic in that use is essentially determined by culture. However the same could be said of all foods, but we would probably not to move these to the cultural service section. TEEB has it here, under provisioning. Perhaps it should go at class-type level as specific types of non-food vegetal and animal materials.

Topic 5: Regulating Services

There were a number of comments made about the structure of this Division. One contributor put expressed their concerns as follows:

1. We felt that this ES group and classes "dilution and sequestration" is an odd case in the CICES list, as it is one of the few groups which are split up based on processes. We (CICES-Be) prefer not to split up ESS according to processes, but rather based on the type of service they provide.
2. Some of the division names in the regulation and maintenance are quite vague and very broad: We therefore propose on the level of division to replace the term "regulation of the biophysical environment" by "regulation of wastes, pollution and nutrients", and park here 4 ES groups: Soil pollution remediation, Water quality regulation, Air quality regulation and Noise regulation. The other group "regulation of the physic-chemical environment" can then also be deleted and replaced by the more specific descriptor "regulation of climate".

It was subsequently endorsed by other contributors. The original contributor suggested four elements at the Group level, with corresponding classes:

- Regulation of wastes, pollution and nutrients: (Soil pollution remediation; Water quality regulation; Air quality regulation; Noise regulation)
- Water & mass flow regulation: (Water and soil stability; Protection against peak events)

- Regulation of climate : (Atmospheric regulation; Regional climate regulation; Local climate regulation)
- Regulation of biotic environment: (Regulation of agriculture, forest & fishery production; Regulation invasive species; Regulation human diseases)

Further discussion is probably needed at this point. The clearer distinction between regulation of the physical and biotic environment used in earlier versions of CICES may make the classification easier to use.

At a more detailed level, the point was made that if "Regulation of biotic environment" includes "the nursery functions that habitats have in the support of provisioning services" then there appears to be scope for double counting. One contributor asked: Is the nursery function of an ecosystem counted as a provisioning service (in the form of the animals that are eventually harvested) or as a regulating service (in the form of the maintenance of a harvested resource)? They argued that it cannot be both, and that the definition suggested in the revised classification seems to reintroduce the concept of supporting services, which have been explicitly excluded from CICES. Certainly clarification is needed. As example here would be the case of shrimp farming where wild seed are collected, bought and sold. This is not a direct nutritional use; it could be regarded as harvesting a genetic resource under biotic materials. Given the discussion on the nature of the production boundary above – the shrimp seed is more of an ecosystem good, and it is the mangrove in an appropriate functioning state that represents the final services.

An additional regulating service suggested was the stabilising effect of biodiversity on ecosystems that contributes to an improved "ambient environment" for human performance. It was argued that support for this view can be found in Consensus Statement 2 in the recent summary review Nature article by Cardinale at al., 2012 ("Biodiversity loss and its impact on humanity"). The definition for the Regulating and Maintenance section of CICES is based on the assumption that it broadly describes the regulation for the human environment, and covers the state of bio-physical conditions as well as risk and hazards that arise by virtue of various natural processes.

"Trapping", under dilution and sequestration was thought to be ambiguous, in that for some the word is used in the context of hunting or harvesting animals. Nutrient trapping is, however, an established phrase in the scientific literature and so could be retained.

Topic 6: General

In the discussion a number of general comments were made as well as a number of specific ones. The broader issues are covered in the main part of this document. The more particular suggestions are summarised below.

At a practical level it was suggested that:

a) For the purposes of illustration, the examples and indicative benefit sections might be illustrated with, example final ecosystem services, ecosystem goods and benefits , so that policy makers might better understand the relevance of this work for promoting sustainable use of agriculture/forest areas.

b) Use of animals for transport (motive power) was identified as a gap;

c) There were also some overlaps noted, especially in terms of the cultural services

Issue 7: Cultural Services

A new topic was added during the consultation, given the comments that were received.

It was suggested that the distinction between “Symbolic” and “Intellectual and Experiential” was not helpful and possibly inconsistent with the definition in Box 1 of the briefing document. To resolve the inconsistency it was recommended that the major distinction that perhaps should be made was between physical or experiential uses, and intellectual ones. Another commentator argued that perhaps "Meaning" or "Sense of Identity" was better than Symbolic because it conveyed more clearly what was intended.

A number of gaps were identified. For example one commentator observed that the cultural section seems limited given the definition of culture by UNESCO which includes identity, diversity, life satisfaction etc. Thus it was suggested that there should be reference to psychological services (health improvement: not the physiological effects), as well as a sociological one: socialisation. Echoing the remarks made about sense of identify, it was argued that another collectively enjoyed individual services are identity formation, the formation of a society's semiotic system (defining values and meaning), and environmental stability as a condition of individual life planning, which in turn is a condition of quality of life, and of development. The discussion on cultural services in the main text may help clarify these issues, which revolve around whether the classification is dealing with final ecosystem services, goods or benefits. We have modified the examples to help illustrate the approach and indicate were these topics might be located.

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