

Towards a Common International Classification of Ecosystem Services (CICES) for Integrated Environmental and Economic Accounting

(Draft V1)

Report to the

European Environment Agency



Contract No: No. EEA/BSS/07/007

Prepared by:

Roy Haines-Young and Marion Potschin,
Centre for Environmental Management,
University of Nottingham, UK

Dolf de Groot,
University of Wageningen, Netherlands

Felix Kienast & Janine Bolliger,
Swiss Federal Research Institute WSL, Switzerland

Contact:

Roy Haines-Young
Centre for Environmental Management
School of Geography, University of Nottingham
Nottingham, NG7 2RD
Email: Roy.Haines-Young@Nottingham.ac.uk



The University of
Nottingham



Centre for Environmental
Management

Executive Summary

1. The aim of this report is to propose a draft Common International Classification for Ecosystem Services (CICES). The need for CICES arises because despite recent efforts, there is no accepted definition or classification of ecosystem services.
2. The development of CICES has been premised on the fact that any new classification has to be consistent with accepted typologies of ecosystem services currently being used in the international literature, and compatible with the design of Integrated Environmental and Economic Accounting methods being considered in the revision of SEEA 2003.
3. **Ecosystem services are defined as the contributions that ecosystems make to human well-being, and arise from the interaction of biotic and abiotic processes.** Ten generic classes of ecosystem services are proposed, which cover provisioning, regulating and cultural outputs from ecosystems. These groups nest into the three major functions of natural capital identified by the SEEA 2003. The proposed structure of CICES is shown below and in more detail overleaf:

CICES Ecosystem Service Groups	CICES Code and Broad Service Class	Correspondence to SEEA 2003 'function' of natural capital
Food & Beverages	Provisioning 1	Resource function
Materials	Provisioning 2	Resource function
Energy	Provisioning 3	Resource function
Regulation of waste assimilation processes	Regulating 1	Sink function
Regulation against hazards	Regulating 2	Service function (environmental quality)
Regulation of biophysical conditions	Regulating 3	Service function (environmental quality)
Regulation of biotic environment	Regulating 4	Service function (environmental quality)
Information	Cultural 1	Service function (amenity)
Symbolic	Cultural 2	Service function (amenity)
Experiential	Cultural 3	Service function (amenity)

4. The generic naming of the proposed service groups allows CICES to be cross referenced to the existing standard classifications for activities and products used in the System of National Accounts, namely: the International Standard Industrial Classification of All Economic Activities (ISIC V4), the Central Products Classification (CPC V2), and the Classification of Individual Consumption by Purpose (COICOP). An indicative cross-tabulation for each of them is presented.
5. The cross tabulation of CICES groups with international standard classifications for products and activities assists in identifying the 'final outputs' of ecosystems, and potentially helps overcome the problem of 'double counting' in valuation studies.
6. The report concludes by reviewing the issues that arise in attempting to define a common classification of ecosystem services, which include: (a) the extent to which CICES it should exclude non-renewable, mineral resources; (b) given that products and activities combine human and natural capital, how respective contributions can be expressed in terms of 'production functions'; (c) how scale issues can be handled; and (d) how CICES might be linked to existing classifications of land cover and land use so that the impact of change on service output and economic activities can be examined.

Proposed CICES Groups and Classes

CICES Service Groups	Classes	Examples
Food & Beverages	Crop based production	Cereals
	Animal based production	Live animals and animal products
	Marine fishing	Crustaceans
	Freshwater fishing	Wild salmon
	Aquaculture	Salmon farming
	Potable water	Spring, well water
Materials	Biotic materials	Timber, straw, wild genetic resources, ornamental resources, medicinal resources
	<i>Abiotic materials</i>	<i>Salt, aggregates, etc.</i>
Energy	Renewable biofuels	Peat, wood fuel, dung, etc.
	<i>Renewable abiotic energy sources</i>	<i>Wind, tidal, hydro. etc.</i>
Regulation of waste assimilation processes	Remediation	Bioremediation mechanisms on brownfield sites
	Waste assimilation	Decomposition of organic materials in soils
Regulation against hazards	Air flow regulation	Windbreaks
	Water flow regulation	Wetlands reducing discharge peak
	Mass flow regulation	Stabilisation of mudflows, erosion protection
Regulation of biophysical conditions	Air quality regulation	Dust removal and filtering odours
	Water quality regulation	Water purification
	Soil quality regulation	Maintaining soil structure
	Global climate regulation (incl. C-sequestration)	Atmospheric composition, hydrological cycle
	Local climate regulation	Modifying temperature, humidity, providing shade etc.
Regulation of biotic environment	Lifecycle maintenance & habitat protection	Pollination
	Pest and disease control	Biological control mechanisms
	Gene pool protection	Maintaining nursery populations
Information	Scientific research	
	Education	
Symbolic	Aesthetic, Cultural	Sense of place
	Religious	Sacred places or species
Experiential	Recreation	Bird or whale watching
	Volunteering	Conservation volunteers



Potentially excluded because ecosystem output not based on biodiversity

Table of Contents

1	Introduction	1
2	Contexts and Constraints	1
3	Classification of Ecosystem Services	2
4	Classifying natural capital in the SEEA2003	6
5	Draft Standard Classification of Ecosystem Services (CICES)	9
6	Cross Tabulating Ecosystem Services with Existing Standard Classifications	11
7	Issues arising	16
	References	19

List of Figures

Figure 1:	Conceptual framework for development of a common classification of ecosystem services	2
Figure 2:	Defining ecosystem functions, services and benefits (Haines-Young and Potschin, 2010; modified)	3

List of Tables

Table 1:	Ecosystem Service-classification suggested through the TEEB Initiative (after De Groot et al., Ch1 in TEEB Assessment Report, in prep.)	5
Table 2:	Read-across between SEEA2003 concept and ecosystem service categories	7
Table 3:	Draft classification of ecosystem services for CICES	9
Table 4:	Cross tabulation of proposed CICES classes with ISIC V4 sections	11
Table 5:	Coding of ISIC classes according to proposed CICES classes for two ISIC sections	12
Table 6:	Cross tabulation of proposed CICES classes with COP V2 classes	14
Table 7:	Cross tabulation of proposed CICES classes with COICOP classes	15
Table 8:	Illustrative breakdown of proposed CICES groups that are consistent with product and activity classifications and existing ecosystem service typologies	17

Towards a Common International Classification of Ecosystem Services (CICES) for Integrated Environmental and Economic Accounting (Draft V1)

1. Introduction

The recent report of the US EPA Science Advisory Board suggests that for ecosystem services to be readily and accurately valued then two things are essential. We must be able to identify relevant ecosystem services as a common list that can serve different purposes and that classification methodologies should follow some basic principles (EPA, 2009). They argue that it is essential that classifications should help us avoid the problem of double counting. Moreover, they suggest that to be described unambiguously, ecosystem services should have concrete outcomes that can be clearly expressed in terms that the public can understand. If ecological outcomes are to provide useful input into valuation, they must be described in terms that are meaningful to those whose values are to be assessed.

It is against the background of such arguments about the need to develop rigorous classifications of ecosystem services that this paper is set. One approach to resolving the problems of identifying 'concrete outcomes' would be to cross reference services with existing classifications of products or activities, so that the *contributions that ecosystems make* in the form of services can be better identified and quantified. The need for these better understandings is particularly important in the context of the on-going international efforts of develop approaches to Integrated Environmental and Economic Accounting, which are currently seeking to integrate current thinking about ecosystem services into the revision of the framework first published in 2003 (SEEA, 2003)¹.

This paper explores what kinds of links can be made between classifications of ecosystem services and three existing UN standard classifications:

- International Standard Industrial Classification of All Economic Activities (ISIC V4).
- Central Products Classification (CPC);
- Classification of Individual Consumption by Purpose (COICOP)²; and,

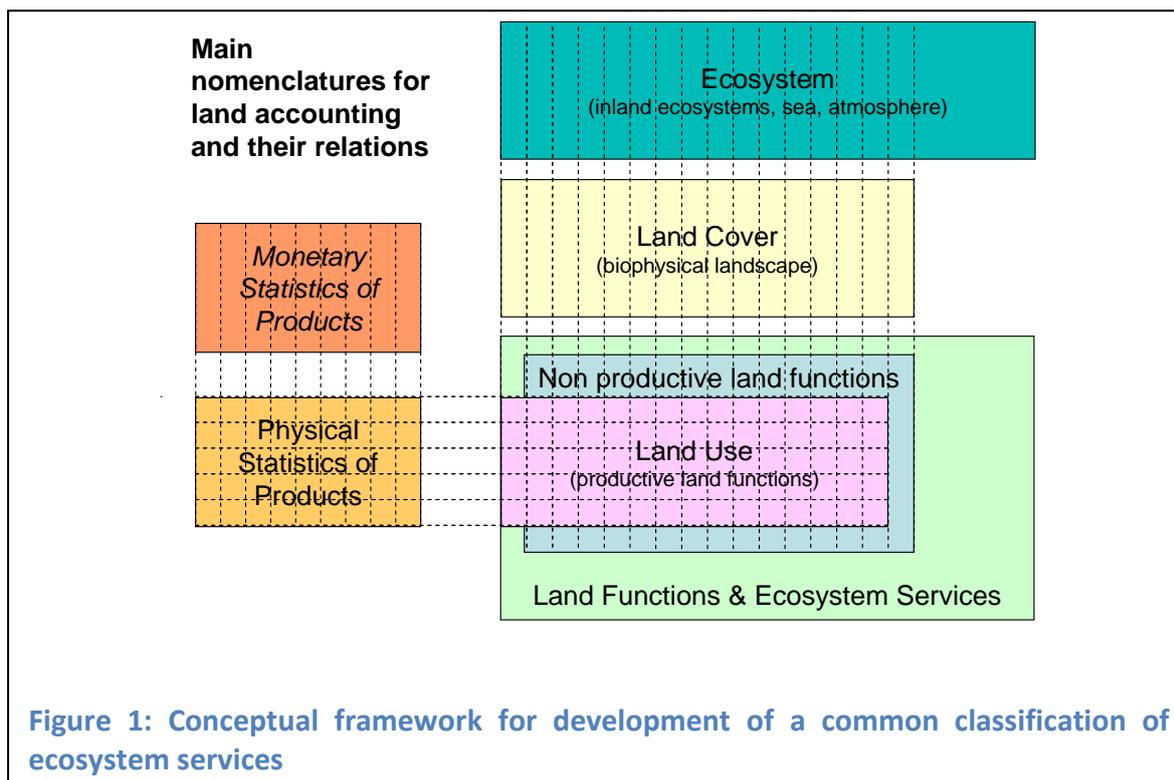
The aim of the work is to examine whether a 'read-across' can be achieved between existing classifications of ecosystem services and these existing standards, or whether some reclassification of ecosystem services might be proposed to resolve ambiguities or inconsistencies. The intention is to propose a Common International Classification of Ecosystem Services (CICES).

2. Contexts and Constraints

The development of CICES is constrained by a number of factors, which include the considerable body of work that exists in relation to the classification of products and activities, and the development of typologies for ecosystem services. Any new standard classification of ecosystem services would have to both be consistent with accepted

¹ The revision was undertaken under the joint responsibility of the United Nations, Eurostat, IMF, OECD and the World Bank. Much of the work was done by the London Group on Environmental Accounting.

² Note there is a cross tabulation of COP and COCIP at <http://unstats.un.org/unsd/cr/registry/regso.asp?Ci=7&Lg=1>



categorisations and conceptualisations and allow the easy translation of statistical information between different applications. The boundary conditions³ in which the current work is set are described in Figure 1.

To develop accounts that are able to link our understandings of changes in ecosystem structures and processes to their economic consequences, there has to be some cross-tabulation of ecosystem services and land cover on the one hand and ecosystem services and classifications of products etc. on the other. The ambition is eventually to construct the classification in the green box that links land cover to products via services. This paper represents a first step in the process, namely to examine what bases exist are for establishing a connection between services, products and activities.

3. Classification of Ecosystem Services

The need for CICES arises because despite recent efforts, there is no accepted definition or classification of ecosystem services. While much of the current debate and usage has been framed around the ideas of the Millennium Ecosystem Assessment (MA), it is clear that other initiatives have approached these problems differently and suggested alternative ways of looking at the world.

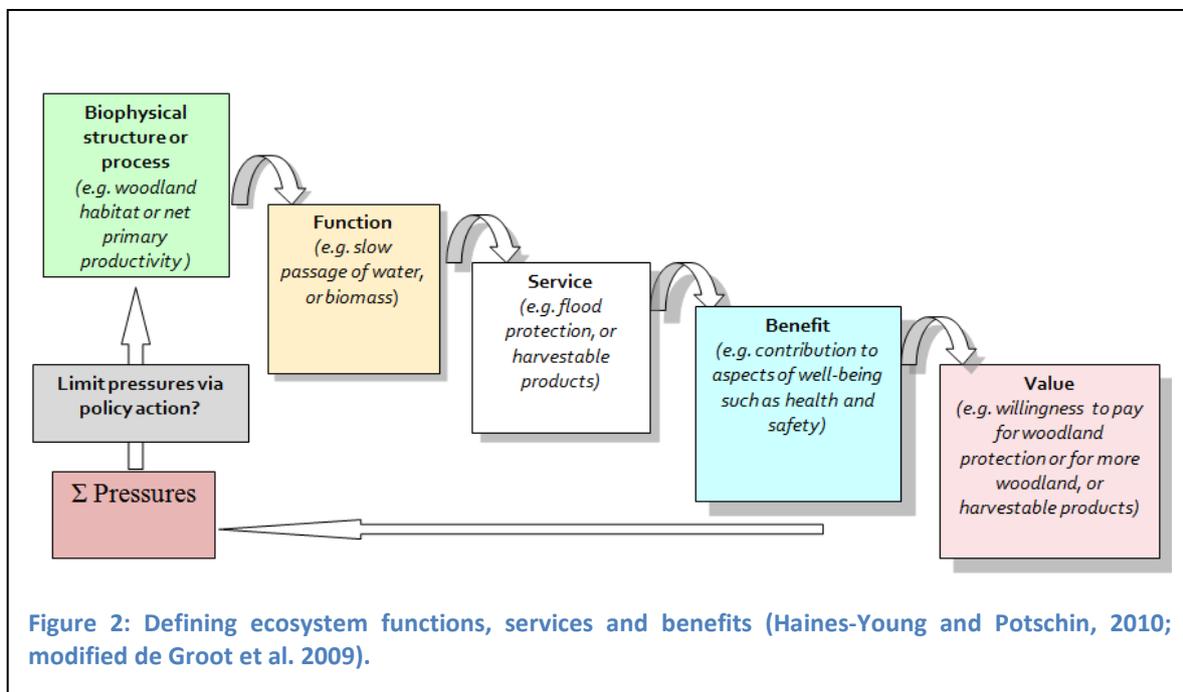
The Millennium Ecosystem Assessment defined ecosystem services simply as ‘the benefits people obtain from ecosystems’ (MA, 2005) and identified four main types of services:

³ This framework has to be referenced as FAO & EEA, Land Cover and Land Use Classifications in the SEEA Revision, UNCEEA/4/11, Fourth Meeting of the UN Committee of Experts on Environmental-Economic Accounting, 24 - 26 June 2009, New York.

- **Provisioning Services:** which cover material or energetic outputs from ecosystems, including food, water and other resources;
- **Regulating Services:** which cover factors that affect the ambient biotic and abiotic environment, such as flood and disease control;
- **Cultural Services:** which cover non-material (intellectual/cognitive/symbolic) uses, such as spiritual, recreational, and cultural benefits; and,
- **Supporting Services,** such as nutrient cycling and primary productivity, that maintain the conditions for life on Earth.

For ease of understanding, the MA considers all these benefits together as ‘ecosystem services’ because it is sometimes difficult to determine whether a benefit provided by an ecosystem is, in fact, a ‘good’ or a ‘service’.

The MA-definition of a service has the advantage of being simple. However, its simplicity also leaves room for confusion and different interpretations. The TEEB-study⁴, for example, states that there is a distinction between service and benefit. These authors argue that most services, like food, have multiple benefits; for food they include health, pleasure and sometimes even to cultural identity. Moreover, many benefits are the result of combining natural and human capital and so attributing them entirely to ecosystems would be misleading. Thus the TEEB-study suggests that ecosystem services should be defined as ‘the direct and indirect **contributions** of ecosystems to human well-being’ (de Groot et al., in prep). Such a definition was also proposed following an international workshop held at the EEA in 2008.⁵



⁴ ‘The Economics of Ecosystems and Biodiversity’ see www.teebweb.org

⁵ Expert Workshop held at the EEA, Copenhagen December 2008

To make assessment of ecosystem services consistent and compatible with the SEEA, then the conceptual framework has to be clear and well defined. Much of the focus of recent debates has been to understand more clearly the nature of the contributions that ecosystems make, and in particular how to quantify them unambiguously. Figure 2 illustrates how the 'pathway' from ecosystems (left main box) to human wellbeing (right box) might be seen. The key features of the 'production chain' shown in Figure 2 are:

- **That it is important to distinguish between ecosystem structure, process, and function:** Ecosystems are composed of physical, biological and chemical components such as soils, water, plant and animal species and nutrients. Interactions among and within these components allow the ecosystem to perform certain functions. Ecosystem functions, in turn determine the capacity of the system to provide services and benefits to human users.

The building blocks of ecosystem functions are the interactions between structure and processes, which may be physical (e.g. infiltration of water, sediment movement), chemical (e.g. reduction, oxidation) or biological (e.g. photosynthesis, denitrification), whereby 'biodiversity' is more or less involved in them all, although the precise detail of the relationship is often unclear or limited.

- **That it is important to distinguish between ecosystem functions and services:** For many years, the terms "function" and "service" have been used interchangeably by some authors, creating a confusion that still exists today despite ongoing efforts to formalize definitions and nomenclatures (e.g., Daily, 1997, Boyd and Banzhaf 2007; Fisher et al. 2009, Granek et al., 2009). The capacity to deliver a service exists independently of whether anyone wants or needs that service. According to the cascade model (Figure 2), that capacity only becomes a service if some beneficiary can be clearly identified, and clearly a service flood protection may depend on a number of functional properties of an ecosystem. Thus it is useful to distinguish these two elements in the production chain.

Whatever wording is chosen, however, it has to be acknowledged that the mix of structures – processes – function is what generates the services that ultimately provide benefits to people. Thus, services are best seen as the 'useful things' ecosystems 'do' for people in relation to enhancing human well-being directly or indirectly, and that we should strive to be clear about what we label as a service and how it is to be measured and valued.

- **That it is useful to distinguish between services and benefits:** Another contested issue that emerges from recent debates is the distinction between services and benefits which, some claim, is crucial for economic valuation and for accounting purposes (Boyd and Banzhaf, 2007; Mäler et al., 2009). It has been argued that a clear distinction between ecological phenomena (functions), their direct and indirect contribution to human welfare (services), and the welfare gains they generate (benefits) is necessary to avoid the problem of 'double counting'. It is argued that valuation should *only* be applied to the thing directly consumed or used by a beneficiary because the value of the ecological structures and processes that contribute to it are already wrapped up in this estimate (Boyd and Banzhaf, 2007; Wallace, 2008; Fisher and Turner, 2008; Balmford et al., 2008). Thus for the economic valuation of services one must look at the contributions that these 'final

services' make to benefits, and when aggregating values across the different components of human well-being avoid adding up the value of direct and indirect contributions to the same benefits. Thus recent classifications emphasise the importance of provisioning, regulating and cultural components of the MA as the focus for valuation studies, and subsume the value of supporting services in the assessment of these final products.

As a result of these debates a number of different typologies of ecosystem services have been proposed to better distinguish between services and benefits, and services and functions than the MA had done (Appendix 1). The typology developed as the basis for the TEEB study is shown in Table 1; this classification was based on the earlier work of Costanza et al. (1997), De Groot et al. (2002), MA (2005) and Daily et al. (2008), and is used here because it is indicative of recent international discussions. However, it has also been suggested (Costanza, 2008) that classifications can be developed that take account of the scale and spatial relationships between the places where services are generated and consumed, and the degree which people can be excluded from enjoying a benefit or whether their consumption of it reduces the quantities available to others; these alternative classifications have also been included in Appendix 1.

Table 1: Ecosystem Service-classification suggested through the TEEB Initiative (after De Groot et al., Ch1 in TEEB Assessment Report, in prep.)

	Main service-types
	PROVISIONING SERVICES
1	Food (e.g. fish, game, fruit)
2	Water (e.g. for drinking, irrigation, cooling)
3	Raw Materials (e.g. fibre, timber, fuel wood, fodder, fertilizer)
4	Genetic resources (e.g. for crop-improvement and medicinal purposes)
5	Medicinal resources (e.g. biochemical products, models & test-organisms)
6	Ornamental resources (e.g. artisan work, decorative plants, pet animals, fashion)
	REGULATING SERVICES
7	Air quality regulation (e.g. capturing (fine)dust, chemicals, etc)
8	Climate regulation (incl. C-sequestration, influence of veg. on rainfall, etc.)
9	Moderation of extreme events (e.g. storm protection and flood prevention)
10	Regulation of water flows (e.g. natural drainage, irrigation and drought prevention)
11	Waste treatment (esp. water purification)
12	Erosion prevention
13	Maintenance of soil fertility (incl. soil formation)
14	Pollination
15	Biological control (e.g. seed dispersal, pest and disease control)
	HABITAT SERVICES
16	Maintenance of life cycles of migratory species (incl. nursery service)
17	Maintenance of genetic diversity (esp. gene pool protection)
	CULTURAL SERVICES
18	Aesthetic information
19	Opportunities for recreation & tourism
20	Inspiration for culture, art and design
21	Spiritual experience
22	Information for cognitive development

In addition to the need to identify clearly what the final services are that contribute to human well-being, a second key message to emerge from recent debates is the importance of biodiversity in current thinking about ecosystem services. While ecosystems are made up of biotic and abiotic elements, ecosystem services as conceived by *most* commentators result from the *interaction* of the two. The implication of this position is that resources such as minerals, wind and hydropower are **not** included in most classification schemes.

This review of recent attempts to classify ecosystem services suggests three key questions in seeking to develop a standard for the classification of ecosystem services, namely:

- To what extent must the classification of services be developed to ensure that it links to product and activity classifications through the **final** services that ecosystems provide?
- To what extent is any cross classification hampered by the fact that ecosystem services are those benefits arising out of the interaction of biotic and abiotic factors, rather than those which are underpinned only by abiotic characteristics of ecosystems?
- To what extent should scale and the spatial relationships in production and consumption be considered when developing a classification?

Before these questions are explored in detail and options for a classification of ecosystem services discussed, it is necessary to examine the ways in which the SEEA conceptualises natural resources and the correspondences between approaches.

4. Classifying natural capital in the SEEA2003

According to the SEEA2003⁶, natural capital is generally considered to comprise three principal categories: natural resource stocks, land and ecosystems (see page 5 of SEEA, 2003). All are considered as essential for long-term sustainable development, and are significant in terms of the 'functions' or uses that they support either as part of the formal economy or outside it. Within SEEA2003, the three broad types of functions are identified, namely:

- **Resource functions** which cover natural resources drawn into the economy to be converted into goods and services for the benefit of humankind. Examples are mineral deposits, timber from natural forests, and deep sea fish;
- **Sink functions** which absorb the unwanted by-products of production and consumption; exhaust gases from combustion or chemical processing, water used to clean products or people, discarded packaging and goods no longer wanted. These waste products are vented into the air, water (including sea water) or are buried in landfill sites. These three destinations are often referred to as sinks; and,

⁶ <http://unstats.un.org/unsd/envAccounting/seea2003.pdf>

Table 2: Read-across between SEEA2003 concept and ecosystem service categories

SEEA 2003	Translation	Service categories	Notes
Resource functions	Food, fibre and energy	Provisioning	Include all material and energetic outputs from ecosystems
Sink functions	Waste assimilation	Regulating	Include all factors that control or modify biotic or abiotic parameters that define the environment of people, i.e. all aspects of the 'ambient' environment; these are ecosystem outputs that are not consumed but affect the performance of individuals, communities and populations and their activities. This broad category could also include the maintenance of habitats and populations, although TEEB suggests they are distinct services.
	Environmental quality (air, water, hazard etc.)~ 'survival functions'		
Service functions	Amenity functions	Cultural	Include all non-material uses of ecosystem outputs that have symbolic, cultural or intellectual significance

- **Service functions** which provide the habitat for all living beings including mankind. Some aspects of habitat are essential, such as air to breathe and water to drink. These are called survival functions. If the quantity and quality of survival functions are diminished, biodiversity of species is threatened, not excluding the human species. Other service functions are not essential but improve the quality of life, for example by providing a pleasing landscape for leisure pursuits. These are called amenity functions and affect mankind only (or at least are the only ones measurable to us in human terms).

Although the terminology used in the SEEA differs from that used in contemporary debates about ecosystem services, these 'functional groups' clearly capture many of the important contributions that ecosystems make to human well-being. In fact, given the broad categorisation of services used in such studies as the MA and TEEB, it is possible to develop a simple 'read-across' to the functional breakdown used in the SEEA (Table 2).

A number of features are apparent in the cross-tabulation shown in Table 2 which have implications for developing any classification of services that might link to the SEEA:

- **Resource Functions and Provisioning Services:** The SEEA group of 'resource functions' corresponds almost directly to notion of provisioning services used in the MA and elsewhere. In the ecosystem services literature, provisioning services are commonly understood to be the material and energetic outputs from ecosystems, which generally enter the economy when turned into other types of goods and or services through other forms of capital (human, cultural etc.). The notion of 'provisioning' also covers subsistence uses of the material and energetic outputs as well as those that enter 'the market', but this broader understanding does not undermine the equivalence with the SEEA. However, there is a major difference between the two categorisations in relation to their treatment of resources linked to **biodiversity** and **geodiversity**.

If ecosystems are defined as the interaction between living organisms and their abiotic environment then it is generally argued that *ecosystem services have to be traceable back to some living process* (i.e. **dependent** on biodiversity) (cf. Fisher and Turner, 2008). Thus the notion of 'provisioning services', if strictly applied, would exclude many minerals and things like wind, snow or salt (i.e. elements of 'geodiversity'), and is a somewhat narrower concept than the SEEA grouping of 'resource functions'. It is clear, however, that not all commentators agree, and some (e.g. Brown et al., 2007) do regard non-renewable resources, such as rocks, minerals and fossil fuels as ecosystem goods.

*Thus in developing CICES a key decision to be made is whether the classification should (a) **restrictive** in the classification and only define something as a service if it were dependent on 'biodiversity'; OR (b) **inclusive** and cover non-living outputs from natural systems as services, in which case we could have subcategories of each service group that were 'dependent on biodiversity' or 'dependent on geodiversity'. **Given the content of the current ecosystems service literature our proposal is that CICES should be restricted to those outputs dependent on biodiversity.***

- **Sink Functions and Regulating Services:** It is clear from Table 2 that the SEEA group of 'sink functions' correspond to only a subset of ecosystem outputs conventionally referred to as 'regulating services' by the MA and others. While the broad class of regulating services includes the capacity of ecosystems to absorb or process waste products it also takes in those contributions ecosystems make to human well-being by controlling the ambient environment (e.g. global and local scale climate regulation). In the SEEA these benefits of natural capital are covered in the 'service function' group, which includes the maintenance of 'environmental quality' in relation to air, water characteristics, and the protection against hazards.

Thus in developing CICES then, if we are to retain the broad classifications used in the SEEA and ecosystem services literature, some split within the regulating service group is needed to group services that broadly correspond to sink functions environmental quality functions in the SEEA so that an unambiguous correspondence between the various groupings can be established.

- **Service Functions and Cultural Services:** Table 2 suggests that there is a broad correspondence between the 'amenity functions' described in the SEEA and the idea of cultural services, as used in the wider ecosystem services literature. Both refer to natural capital or ecosystem outputs that have symbolic, cultural or intellectual significance for people. The main problem that seems to arise in developing a read-across between the groupings is the choice of the term 'service function' in the SEEA, which given current usage in the wider research and policy literatures may lead confusion.

It is not the purpose of this document to suggest modifications to SEEA terminology. Nevertheless, if this categorisation of 'service functions' is to be maintained then the implication for CICES is that any grouping of cultural ecosystem services has to be constructed so that 'amenity functions' can be split out from those functions relating to environmental quality.

Table 3: Draft classification of ecosystem services for CICES

SEEA 2003 function	CICES Code	CICES Service themes	Include only renewable resources; exclude mineral and those not dependent on linked bio-physical processes		TEEB Classes		
resource	p1	Food & Beverages	Would include water supply	Food	Water		
resource	p2	Materials	Includes fibre and all other biologically generated materials - e.g. bone, shell	Raw Materials	Genetic resources	Medicinal resources	Ornamental resources
resource	p3	Energy	Includes biogas, wood fuel, peat, excludes gas, oil, lignite etc.				
sink	r1	Regulation of waste assimilation processes	Regulation of wastes and pollution	Air purification	Waste treatment (esp. water purification)		
service	r2	Regulation against hazards	Flow regulation (water, air, mass movement)	Disturbance prevention or moderation	Regulation of water flows	Erosion prevention	
service	r3	Regulation of biophysical conditions	Climate (local/global); air, water, soil quality etc	Climate regulation (incl. C-sequestration)	Maintaining soil fertility		
service	r4	Regulation of biotic environment	Gene pool protection; pollination; pest control etc.	Gene pool protection	Lifecycle maintenance	Pollination	Biological control
service	c1	Information	Includes scientific value and genetic resources for manufacture/research	Information for cognitive development			
service	c2	Symbolic	Aesthetic, spiritual and religious	Aesthetic information	Inspiration for culture, art and design	Spiritual experience	
service	c3	Experiential	Recreation	Recreation & tourism			
	G,N,L	Scale	Global, national, local (cf. own (subsistence) or intermediate products)				

5. Draft Standard Classification of Ecosystem Services (CICES)

On the basis of the considerations outlined above, a draft classification of ecosystem services can be suggested (Table 3). The aim of this classification is to develop a flexible structure that broadly links the categories of ecosystem service that are being discussed in on-going international initiatives such as TEEB, and the functional groupings considered in the SEEA. In proposing this structure the aim is not to suggest a schema that *replaces* any existing typologies, but to provide a standard that allows the translation *between* different systems. The development of this draft standard has also taken account of the need to link service classes to groupings used in the various product and activity classifications; a prerequisite of the design has been that the groupings should initially be generic and amenable to further sub-categorisation to produce a nested, hierarchical structure.

The proposed classification of ecosystem services that might form the basis of the standard is shown in Table 3, in the column labelled 'CICES Service themes'. Ten classes are proposed, three for the provisioning service, four for regulating services and three for

cultural services. The relationship between these classes and the SEEA functional groupings is indicated by the coding in the first column of the Table.

To show how the grouping of services relates to other international classifications of ecosystem services, the relationship between the broad service groupings and those of TEEB is shown on the right-hand side of Table 3. The table suggests that it is relatively easy to nest the TEEB service groupings into the ten classes proposed as the basis for CICES. The important feature to note, however, is that in naming the latter an effort has been made to use a generic terminology that can identify classes that can progressively be refined according to the interests of the user. Thus potentially, the TEEB categories 'raw materials', 'genetic', 'medicinal' and 'ornamental' resources could be sub-classes of the CICES materials group. The central column in Table 3 provides a note of the assumptions that are used to define the proposed CICES classes.

The main discontinuity with the suggested TEEB classification is in the treatment of so-called 'habitat services'. The importance of ecosystems in maintaining the gene-pool and life systems is mentioned in the current SEEA, and included within the 'Service Function'. While TEEB chooses to identify them as a distinct service grouping at the highest level, the draft classification presented here suggests they are part of the regulating group. They form a sub-class that captures aspects of natural capital that are important for the regulation of the 'biotic' environment (e.g. pest and disease control, pollination, gene-pool protection etc.).

A final feature of the classification shown in Table 3 is that in addition to classifying services by broad uses or the kinds of contribution they make to human well-being, we might also note the scale on which the services they operate in relation to the activity or product. This feature has been introduced to link CICES to other approaches for classifying ecosystem services noted above. Thus the last line in the table suggests that the service classification might be augmented with a code to indicate whether it was operating at the global, national/regional or local scales. It is suggested that the classification of scale should be made from the perspective of the service beneficiary or consumer. If the final service potentially flows to the consumer from 'anywhere', it is denoted as 'global' in scale (thus 'salmon' might be purchased on the global market). For something to be classified as local/regional, a defined flow from a place to a place should be identified (thus 'salmon' may be purchased from a defined area and used in production of regionally distinct products – e.g. 'Scottish Salmon'). Finally, services might be consumed 'locally' at or near to their point of origin, often for subsistence or pleasure (e.g. salmon caught on a particular river for sport or domestic consumption). Clearly there is no simple one-to-one relationship between service and scale, but would depend on the circumstances under which the service arose and linked to human use. The extent to which it is useful to include a note of scale in the classification of services will be examined below.

It is apparent that many classifications of ecosystem services are possible and in seeking to justify the use of any one of them, the test must be whether it is 'fit for purpose'. In proposing the draft shown in Table 3 the initial constraint has been that it is both consistent with the SEEA framework and compatible with developing international approaches to describing ecosystem services. Given that the proposed classification

broadly meets this criterion, a more severe test is whether it can also be linked to other types of product and activity classification that are key constituents of integrated environmental and economic accounting. As noted at the outset, the ultimate aim in developing CICES is to provide a framework for linking data on the ecosystem structure and dynamics of ecosystems and information on economic performance. The extent to which the proposed standard is fit for such a purpose will be examined below.

6. Cross Tabulating Ecosystem Services with Existing Standard Classifications

The suitability of the ecosystem services classification proposed for CICES was tested by attempting to cross-tabulate them with the classes defined in the following three UN standard statistical classifications, namely the:

- International Standard Industrial Classification of All Economic Activities (ISIC V4);
- Central Products Classification (CPC, V2); and,
- Classification of Individual Consumption by Purpose (COICOP).

Table 4: Cross tabulation of proposed CICES classes with ISIC V4 sections

Level	Code	ISIC Section	Food & Beverages	Materials	Energy	Regulation of waste assimilation processes	Regulation against hazards	Regulation of biophysical conditions	Regulation of biotic environment	Information	Symbolic	Experiential	Global, national, local
0	A	Agriculture, forestry and fishing	x	x					x	x		x	
0	B	Mining and quarrying			x								
0	C	Manufacturing											
0	D	Electricity, gas, steam and air conditioning supply											
0	E	Water supply; sewerage, waste management and remediation activities				x		x					
0	F	Construction		x									
0	G	Wholesale and retail trade; repair of motor vehicles and motorcycles			x								
0	H	Transportation and storage										x	
0	I	Accommodation and food service activities	x									x	
0	J	Information and communication								x			
0	K	Financial and insurance activities								x			
0	L	Real estate activities											
0	M	Professional, scientific and technical activities								x			
0	N	Administrative and support service activities									x	x	
0	O	Public administration and defence; compulsory social security											
0	P	Education								x			
0	Q	Human health and social work activities											
0	R	Arts, entertainment and recreation								x		x	
0	S	Other service activities										x	
0	T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	x	x	x								
0	U	Activities of extraterritorial organizations and bodies											

The cross tabulation exercise was undertaken to determine whether a clear rationale for defining the potential links could be established and what any attempt to link them might mean in terms of future work.

ISIC V4

The cross-tabulation of the proposed CICES classes with the ISIC V4 at the most general, section level is shown in Table 4. ISIC provides a comprehensive framework within which economic data can be collected and reported in a format that is designed for purposes of economic analysis, decision-taking and policy-making. It covers economic activities within the production boundary of the System of National Accounts, as well as activities that lie outside this boundary that relate to the subsistence activities of households.

To the extent that many of provisioning and cultural ecosystem services support economic activities it should be possible to establish how the various classes might be linked. Table 4 shows how in general terms this can be achieved. The Table was developed by looking at the detailed activities below the section level within the ISIC classification and marking up a cross link at the section level if at least one of the subclasses could be related to one of the proposed CICES classes. The principle is

Table 5: Coding of ISIC classes according to proposed CICES classes for two ISIC sections

Level	Code	ISIC Section and Division	Food & Beverages	Materials	Energy	Regulation of waste assimilation processes	Regulation against hazards	Regulation of biophysical conditions	Regulation of biotic environment	Information	Symbolic	Experiential	Global, national or local	CICES Code
0	A	Agriculture, forestry and fishing	x	x					x	x		x		110.0001.101
1	1	Crop and animal production, hunting and related service activities	x	x					x	x		x	g,n,l	110.0001.101
1	2	Forestry and logging	x	x	x					x			g,n,l	111.0000.100
1	3	Fishing and aquaculture	x	x									g,n,l	110.0000.000
0	B	Mining and quarrying			x									001.0000.000
1	5	Mining of coal and lignite												000.0000.000
1	6	Extraction of crude petroleum and natural gas												000.0000.000
1	7	Mining of metal ores												000.0000.000
1	8	Other mining and quarrying			x								n,l	001.0000.000

illustrated in Table 5, by the more detailed view of two levels in the ISIC hierarchy, dealing with 'Agriculture, Forestry and Fishing' (ISIC Section A) and 'Mining and Quarrying' (ISIC Section B).

Table 5 illustrates a number of other features, namely:

- How the ISIC classes can potentially be coded according to the ecosystem services that underpin them; the coding system uses the three blocks of services (provisioning, regulating and cultural) and within them indicates the existence of a link by a binary code ('0' =no link or '1' = link)⁷.
- However, depending on the geographical context in which the particular products are being considered, the coding system could take note of the scale at which the ecosystem service is operating (global, national/regional or local). Given the structure of ISIC, this coding would relate to the nature of the market and so primarily relate to economic activities. Subsistence activities and their links to ecosystem services (which are mostly local in character) would be covered in ISIC Division T, 'Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use'.
- That while the main links between activities and services is through provisioning and regulating services, some links are apparent via the regulating group. Thus 'Support activities to agriculture and post-harvest crop activities' (ISIC Division 16) includes such activities as 'pest control' and 'maintenance of land to keep it in good condition for agricultural use' which broadly can be classified as having links to the ecosystem service category 'regulation of the biotic environment' (or potentially 'regulation of biophysical conditions' or 'hazard regulation'). In Table 4 further links to regulating services were found in ISIC Divisions E, 'Water supply; sewerage, waste management and remediation activities' (via for example, 'purification of water for water supply purposes' and 'treatment of non-hazardous wastes').
- That if we define ecosystem services as outputs from ecosystems that depend on the interaction of biotic and abiotic factors, then there would be no linkage to activities within the mining and quarrying division that depend only on mineral elements (peat extraction would be included since there latter is an organic material). Using the same criteria of dependence on biodiversity, no links to services were also found for ISIC divisions C, D, L, O, Q and U (see Table 4).

A more complete initial draft of the cross tabulation of ISIC and the proposed CICES classes is given in the excel spreadsheet ('CICES cross tabulations') that accompanies this document.

CPC V2

The cross-tabulation of the proposed CICES classes with the CPC V2 at its most general level is shown in Table 6. The classification of products seeks to capture the different types of output that are within the production boundary of the System of National Accounts in ways that are helpful to decision makers.

⁷ These individual codes could be extended over the range 0-9 if subclasses for services are defined.

Table 6: Cross tabulation of proposed CICES classes with COP V2 classes

Level	Code	CPC Description	CICES Classes										CICES Code	
			p1	p2	p3	r1	r2	r3	r4	c1	c2	c3		scale
			Food & Beverages	Materials	Energy	Regulation of waste assimilation processes	Regulation against hazards	Regulation of biophysical conditions	Regulation of biotic environment	Information	Symbolic	Experiential	Global, national, local	
1	0	Agriculture, forestry and fishery products	x	x	x				x		x	x		111.0001.011
1	1	Products of agriculture, horticulture and market gardening	x	x	x				x		x	x		111.0001.011
1	2	Live animals and animal products (excluding meat)	x	x	x				x		x	x		111.0001.011
1	3	Forestry and logging products		x	x						x	x		011.0000.011
1	4	Fish and other fishing products	x		x									101.0000.000
1	1	Ores and minerals; electricity, gas and water	x	x	x									111.0000.000
1	2	Food products, beverages and tobacco; textiles, apparel and leather products	x	x										110.0000.000
1	3	Other transportable goods, except metal products, machinery and equipment		x										010.0000.000
1	4	Metal products, machinery and equipment												000.0000.000
1	5	Constructions and construction services		x										010.0000.000
1	6	Distributive trade services; accommodation, food and beverage serving services; transport services; and electricity, gas and water distribution services										x		000.0000.001
1	7	Financial and related services; real estate services; and rental and leasing services												000.0000.000
1	8	Business and production services								x		x		000.0000.101
1	9	Community, social and personal services					x	x	x	x		x		000.0111.101

The approach to cross tabulation with the proposed CICES classes is similar to that outlined for the ISIC, with links indicated at the higher levels in the classification hierarchy if one of the products in the sub-classes is found to be dependent upon a particular type

of ecosystem service. As with the earlier cross-tabulation, links are mainly exist through the provisioning and cultural services, although some regulating services form the basis of products, most notably in the context of regulation of the biotic environment. Thus within the CPC, ‘seed production’ and the production of ‘reproductive material of animals’ would both form part of the biotic regulation category in CICES (maintenance of life cycles). A wider range of regulating services is linked within the ‘Community, social and personal services’ grouping of the CPC, by virtue of the services provided as part ‘Sewage and waste collection, treatment and disposal and other environmental protection services’.

As with ISIC some classes have no links to ecosystem services. These largely concern manufacturing related to ‘metal products, machinery and equipment’ and ‘financial services’. It is proposed that the CPC links to the main CICES ecosystem service categorise could be coded in the same way as for ISIC; similar coding for scale could also be added.

A more complete initial draft of the cross tabulation of CPC and the proposed CICES classes is given in the excel spreadsheet (‘CICES cross tabulations’) that accompanies this document.

Table 7: Cross tabulation of proposed CICES classes with COICOP classes

Level	Code	Description	CICES Classes										
			p1	p2	p3	r1	r2	r3	r4	c1	c2	c3	scale
			Food & Beverages	Materials	Energy	Regulation of waste assimilation processes	Regulation against hazards	Regulation of biophysical conditions	Regulation of biotic environment	Information	Symbolic	Experiential	Global, national, local
1	1	Food and non-alcoholic beverages	x										
1	2	Alcoholic beverages, tobacco and narcotics	x								x		
1	3	Clothing and footwear		x									
1	4	Housing, water, electricity, gas and other fuels		x	x								
1	5	Furnishings, household equipment and routine household maintenance		x									
1	6	Health		x									
1	7	Transport			x								
1	8	Communication											
1	9	Recreation and culture								x	x	x	
1	10	Education								x			
1	11	Restaurants and hotels										x	
1	12	Miscellaneous goods and services											
1	13	Individual consumption expenditure of non-profit institutions serving households (NPISHs)		x		x	x	x	x			x	
1	14	Individual consumption expenditure of general government		x						x		x	

COICOP

The cross tabulations of the classification of Consumption by Individual Purpose and the CPC already exist, and so in principle once a cross-tabulation of CPC with the finalised CICES classes is made, then links to COICOP can also be established.

Table 7 suggests a tentative cross tabulation, using the same approach as that outlined for ISIC and CPC. A more complete initial draft of the cross tabulation of CPC and the proposed CICES classes is given in the excel spreadsheet ('CICES cross tabulations') that accompanies this document.

7. Issues arising

The cross-tabulations of product and activity classes with the proposed CICES classes is tentative at this stage, and the links identified would clearly have to be refined and discussed before the new classification of ecosystem services was used. Before such an exercise is undertaken, however, more fundamental questions arise about the acceptability of the structures proposed, and what modifications might be considered if a final standard is to be produced. **It is the purpose of this document to lay out some of the issues and stimulate such a discussion.**

An feature of the cross tabulations suggested here is that the product and activity classes could potentially be linked to more than one ecosystem service group at the higher levels in the classification, although this could probably be resolved as more detailed sub-classes are defined. One approach to the more detailed classification of services within CICES is shown in Table 8.

The merit of the cross tabulation of CICES groups with these international standard classifications for products and activities is that it assists in identifying the 'final outputs' of ecosystems, and thus potentially helps overcome the problem of 'double counting' in valuation studies. The linkages to activity and product classifications certainly helps to define the 'concrete outcomes' sought by the EPA in its 2009 report (EPA, 2009). **In this context the exclusion of non-renewable, mineral outputs from the classification of services needs to be confirmed⁸.**

Although cross tabulation of services, products and activities seems possible, it is also apparent that since the products and activities depend on the combination of natural and human capitals, the 'links' are complex. Cross-tabulation implies the need to develop some method of weighting to indicate the relative strengths of the different kinds of capital input to each product and activity. This could be achieved by constructing some kind of 'production function'. These production functions would have to be tailored to the particular application, but would seem to be vital if the aim of better understanding the links between economy and environment is to be achieved. They may also need to take account of the scale at which a given ecosystem service operates. **The extent to which scale should be included in the classification of services is a second issue that to be resolved.**

⁸ They could, for example, be included as a sub-class of the CICES 'materials' category, which at its highest level could split biotic and abiotic materials.

Table 8: Illustrative breakdown of proposed CICES groups that are consistent with product and activity classifications and existing ecosystem service typologies

CICES Service Groups	Classes	Examples
Food & Beverages	Crop based production	Cereals
	Animal based production	Live animals and animal products
	Marine fishing	Crustaceans
	Freshwater fishing	Wild salmon
	Aquaculture	Salmon farming
	Potable water	Spring, well water
Materials	Biotic materials	Timber, straw, wild genetic resources, ornamental resources, medicinal resources
	<i>Abiotic materials</i>	<i>Salt, aggregates, etc.</i>
Energy	Renewable biofuels	Peat, wood fuel, dung, etc.
	<i>Renewable abiotic energy sources</i>	<i>Wind, tidal, hydro. etc.</i>
Regulation of waste assimilation processes	Remediation	Bioremediation mechanisms on brownfield sites
	Waste assimilation	Decomposition of organic materials in soils
Regulation against hazards	Air flow regulation	Windbreaks
	Water flow regulation	Wetlands reducing discharge peak
	Mass flow regulation	Stabilisation of mudflows, erosion protection
Regulation of biophysical conditions	Air quality regulation	Dust removal and filtering odours
	Water quality regulation	Water purification
	Soil quality regulation	Maintaining soil structure
	Global climate regulation (incl. C-sequestration)	Atmospheric composition, hydrological cycle
	Local climate regulation	Modifying temperature, humidity, providing shade etc.
Regulation of biotic environment	Lifecycle maintenance & habitat protection	Pollination
	Pest and disease control	Biological control mechanisms
	Gene pool protection	Maintaining nursery populations
Information	Scientific research	
	Education	
Symbolic	Aesthetic, Cultural	Sense of place
	Religious	Sacred places or species
Experiential	Recreation	Bird or whale watching
	Volunteering	Conservation volunteers



Potentially excluded because ecosystem output not based on biodiversity

In reviewing the suitability of the proposed CICES classes it should be remembered that an additional constraint is that they should also be amenable to cross tabulation with land cover and land use classifications, and be sensitive to land cover and land use changes. An examination of the extent to which these CICES classes can be linked to classifications of land cover and land use such as those used by the EEA for its land and ecosystem accounting, or the FAO in its statistical work, will be considered in a later phase of this study (see Gong et al., 2009; Weber 2009 and Gong and Weber, 2009). The first step in this larger enterprise is, however, to test the best ways of handling ecosystem services within the SEEA framework – this has been the primary aim of the current document.

References

- Balmford, A., Rodrigues, A., Walpole, M. J., ten Brink, P., Kettunen, M., Braat, L., & de Groot, R., (2008) *Review of the Economics of Biodiversity Loss: Scoping the Science*. Brussels: European Commission.
- Boyd, J. and Banzhaf, S. (2007) "What are ecosystem services? The need for standardized environmental accounting units." *Ecological Economics* 63(2-3) 616-626.
- Brown, T. C., Bergstrom, J. C. and Loomis, J. B. (2007) Defining, valuing, and providing ecosystem goods and services. *Natural Resources Journal* 47(2) 329-376.
- Costanza, R. (2008) Ecosystem services: multiple classification systems are needed. *Biological Conservation*, 141, 350-352.
- Costanza, R., D'Arge, R., DeGroot R., Farber, S., Grasso, M., Hannon B., Limburg, K., Naeem, S., O'Neill, R., Paruelo, J., Raskin, R., Sutton, P. and van den Belt, M. (1997) The Value of the World's Ecosystem Services and Natural Capital. *Nature*, 387, 253–260.
- Daily, G. C. (1997) Introduction: What are Ecosystem Services? In: Daily, G.C. (Ed.) *Nature's Services: Societal Dependence on Natural Ecosystems*. Island Press, Washington, D.C., 1-10.
- Daily, G.C. and Matson, P.A. (2008) Ecosystem services: From theory to implementation. *PNAS* 105(28) 9455–9456
- De Groot, R.S., Wilson, M.A. and Boumans, R.M.J. (2002) A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics*, 41, 393–408.
- De Groot, R.; Fisher, B.; Christie, M.; Aronson, J.; Braat, L.; Haines-Young, R.H.; Gowdy, J.; Killeen, T.; Maltby, E.; Neuville, A.; Polasky, S.; Portela, R. and Ring, I. (in prep) Integrating the ecological and economic dimensions in biodiversity and ecosystem service valuation. Draft Chapter 1 of The Economics of Ecosystems and Biodiversity (TEEB) study.
- EPA (2009) *Valuing the Protection of Ecological Systems and Services: A Report of the EPA Science Advisory Board*. United States Environmental Protection Agency Washington, DC 20460, EPA-SAB-09-012.
- Fisher, B. and Turner, K. (2008) Ecosystem services: Classification for valuation. *Biological Conservation*, 141, 1167-1169.
- Fisher, B., Turner, R. K. and Morling, P. (2009). "Defining and classifying ecosystem services for decision making." *Ecological Economics* 68(3) 643-653.
- Gong, X., Marklund, L.G. and Tsuji, S. (2009) Land Use Classification. Paper presented to the 14th Meeting of the London Group on Environmental Accounting Canberra, 27 – 30 April 2009, LG/14/10.
- Gong, X. and Weber, J.L (2009) Land Cover and Land Use Classifications in the SEEA Revision. Paper presented to the Fourth Meeting of the UNCEEA. 24 - 26 June 2009, UN Headquarters, New York, ESA/STAT/AC.189 and UNCEEA/4/11.
- Granek, E.F., Polasky, S., Kappel, C.V., Reed, D.J., Stoms, D.M., Koch, E.W., Kennedy, C.J., Cramer, L.A., Hacker, S.D., Barbier, E.B., Aswani, S., Ruckelshaus, M., Perillo, G.M.E., Silliman, B.R., Muthiga, N., Bael, D., Wolanski, E. (2009) Ecosystem services as a common language for coastal ecosystem-based management. *Conservation Biology* (in press).
- Haines-Young, R.H. and Potschin, M.P (2010) The links between biodiversity, ecosystem services and human well-being In: Raffaelli, D. & C. Frid (eds.) *Ecosystem Ecology: a new synthesis*. BES Ecological Reviews Series, CUP, Cambridge (in press).

- MA [Millennium Ecosystem Assessment] (2005) *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC.
- Mäler, K. G., Aniyar, S. and Jansson, A. (2009) Accounting for Ecosystems. *Environmental & Resource Economics* 42(1) 39-51.
- SEEA (2003) *Handbook of National Accounting: Integrated Environmental and Economic Accounting 2003*. United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, World Bank. <http://unstats.un.org/unsd/envAccounting/seea2003.pdf>
- Wallace, K. (2008) Ecosystem services: Multiple classifications or confusion? *Biological Conservation*, 141, 353-354.
- Weber, J.-L. (2009) Land Cover Classification for Land Cover Accounting. Paper presented to 14th Meeting of the London Group on Environmental Accounting, Canberra, 27 – 30 April 2009, Session 4 – Asset Accounting, Point 11 – Land classification, LG/14/9.

Appendix

Table A.1: Classification of ecosystem services (after MA, 2005)

<p style="text-align: center;">Provisioning Services <i>Products obtained from ecosystems</i></p> <ul style="list-style-type: none"> • Food • Fresh Water • Fuelwood • Fiber • Biochemicals • Genetic resources 	<p style="text-align: center;">Regulating Services <i>Benefits obtained from regulation of ecosystem processes</i></p> <ul style="list-style-type: none"> • Climate regulation • Disease regulation • Water regulation • Water purification • Pollination 	<p style="text-align: center;">Cultural Services <i>Nonmaterial benefits obtained from ecosystems</i></p> <ul style="list-style-type: none"> • Spiritual and religious • Recreation and ecotourism • Aesthetic • Inspirational • Educational • Sense of place • Cultural heritage
<p>Supporting Services <i>Service necessary for the production of all other ecosystem services</i></p> <ul style="list-style-type: none"> • Soil Formation • Nutrient cycling • Primary Production 		

Note this is not a comprehensive list of services; those listed are indicative only

Table A.2: Ecosystem services classified by their spatial characteristics (after Costanza, 2008)

<p>Global non-proximal (does not depend on proximity)</p> <ul style="list-style-type: none"> • <i>Climate regulation</i> • <i>Carbon sequestration (NEP)</i> • <i>Carbon storage</i> • <i>Cultural/existence value</i> <p>Local proximal (depends on proximity)</p> <ul style="list-style-type: none"> • <i>Disturbance regulation/ storm protection</i> • <i>Waste treatment</i> • <i>Pollination</i> • <i>Biological control</i> • <i>Habitat/refugia</i> <p>Directional flow related: flow from point of production to point of use</p> <ul style="list-style-type: none"> • <i>Water regulation/flood protection</i> • <i>Water supply</i> • <i>Sediment regulation/erosion control</i> • <i>Nutrient regulation</i> <p>In situ (point of use)</p> <ul style="list-style-type: none"> • <i>Soil formation</i> • <i>Food production/non-timber forest products</i> • <i>Raw materials</i> <p>User movement related: flow of people to unique natural features</p> <ul style="list-style-type: none"> • <i>Genetic resources</i> • <i>Recreation potential</i> • <i>Cultural/aesthetic</i>

Table A.3 Ecosystem services classified according to their excludability and rivalness (After Costanza, 2008)

	Excludable	Non-excludable
Rival	Rival Market goods and services (most provisioning services)	Open access resources (some provisioning services)
Non-rival	Non-rival Club goods (some recreation services)	Public goods and services (most regulatory and cultural services)