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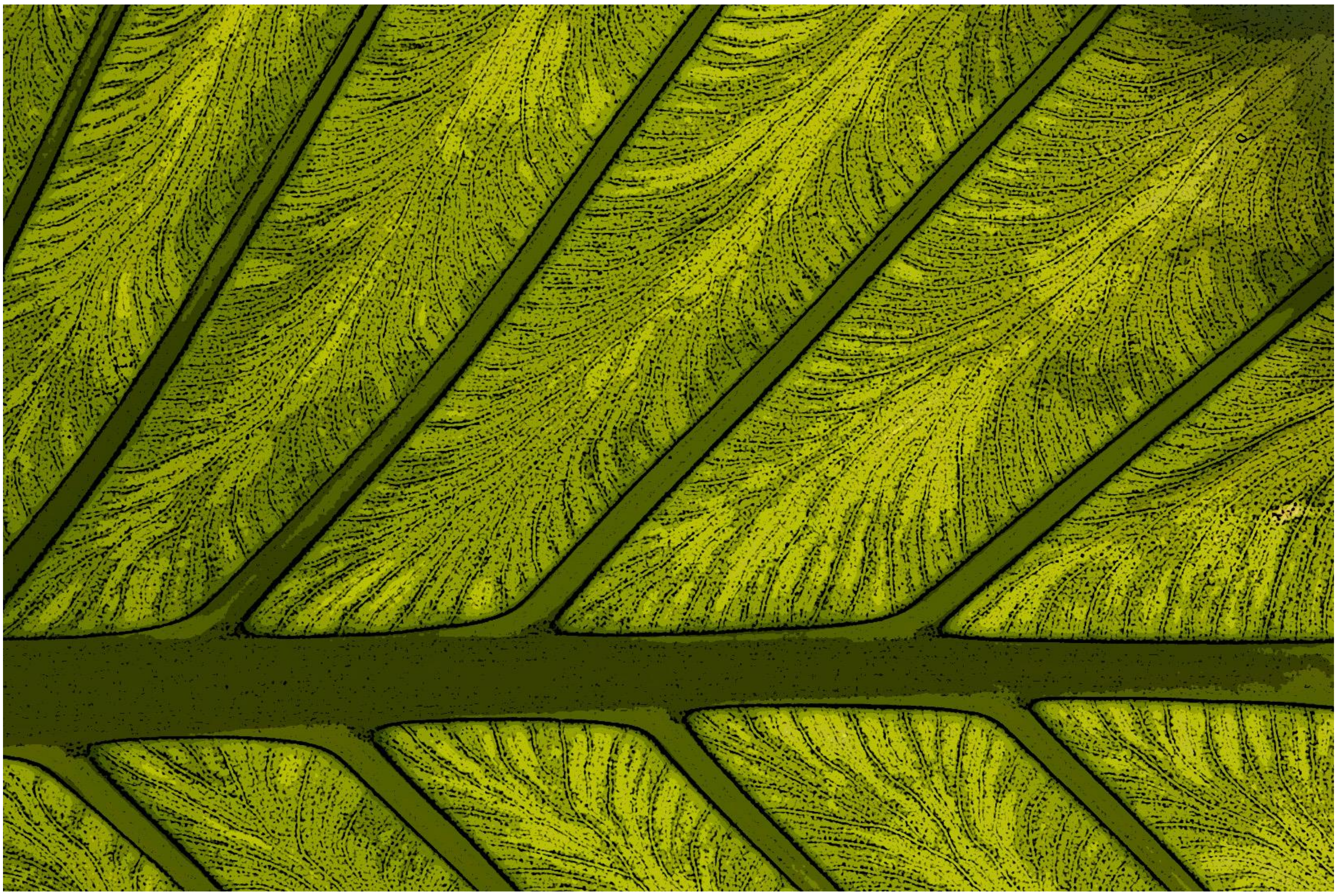

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Categorisation systems: The classification challenge

Roy Haines-Young and Marion Potschin[1,2]

Introduction

Categorising and describing ecosystem services is the basis of any attempt to measure, map or value them. It is the basis of being transparent in what we do, so that we can communicate our findings to others, or test what they conclude. So fundamental is the need to be clear about how we classify ecosystem services that it might seem that it is an issue that must be already well and truly resolved. The aim of this chapter is to suggest that this might, in fact, not entirely be the case, and that the way we categorise ecosystem services is something that still represents a challenge.

A number of different typologies, or ways of classifying ecosystem services are available, including those used in the *Millennium Ecosystem Assessment* (MA) and *The Economics of Ecosystems and Biodiversity* (TEEB), and a number of national assessments, such as those in the UK, Germany and Spain. The problem with them is that they all approach the classification problem in different ways, and so they are not always easy to compare. In order to try to partly overcome this 'translation problem', the *Common International Classification of Ecosystem Services* (CICES)[3] was proposed in 2009 and revised in 2013 (Haines-Young and Potschin 2013; Potschin and Haines-Young 2016). This represents yet another way of categorising services. This chapter will draw on our experience in developing CICES, not to argue that it is better than any other system, but to reflect on the difficulty of designing a classification system that is simple and transparent to use. We will argue that the problem of classification is still worth working on – and it is certainly not something that can be taken for granted. We would encourage everyone to think about it when they embark on any kind of analysis involving ecosystem services. The conclusion that we would like to advance is that the ecosystem service community probably need to develop a number of different classifications or typologies that can be used to name and describe all the elements in the cascade that we described in Chapter 2.3, namely: the ecosystem or habitat units that give rise to the ecosystem services of interest, the ecological functions that are associated with them, as well as the benefits and beneficiaries whose well-being is dependent on the output of services, and of course the values that people assign to these benefits.

What are ecosystem services?

Many people work with the definition of ecosystem services used in the MA which describes them simply as the benefits that ecosystems provide to people (MA, 2005). Others, however, follow the definition of TEEB which views them as the direct and indirect *contributions* of ecosystems to human well-being (De Groot et al., 2010). If we read these definitions carefully then it is clear that they are quite different in terms of what they take services to be: according to TEEB, services *give rise* to benefits, whereas or the MA they are the same thing. To add to this confusion we might note that both categorisations take the ideas of 'services' and 'goods' to be synonymous. Unfortunately, not everyone follows looks at things in his way. For example, in the UK National Ecosystem Assessment (UK NEA) (Mace et al., 2011), 'goods' and 'benefits' are taken to be identical, representing categories

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3 www.cices.eu

of things that people assign value to; they taken to be quite distinct from services, which are seen as the ecosystem outputs from which goods and benefits are derived (Mace et al., 2012).

Do these differences in the way we categorise ecosystem services, goods and benefits really matter? Well, it depends on one's perspective. Some have argued that one of the important characteristics of the field of ecosystem services is that many different disciplines have come together to explore the insights that the concept offers for understanding the relationships between nature and society. It is this diversity that explains the different approaches that people have taken to categorising ecosystem services. They have also argued that the multiple interpretations that people bring to the concept is especially important, because it is a 'boundary object', that is an idea that can be adapted to represent different perspectives while retaining some sense of continuity across these different viewpoints (Abson et al., 2014).

Boundary objects are especially important in multi- or trans-disciplinary situations, because they create the space in which novel discussions and research interactions can occur. The dynamic, multi-faceted nature of the ecosystem service community is certainly part of its fascination. However, these 'boundary objects' are not much use when it comes to the problem of naming, describing and measuring things apparently as fundamental as 'ecosystem services'. When we start to think about this issue, then we start to appreciate the alternative perspective on the problem of whether the differences in the way differences in the way we categorise ecosystem services, goods and benefits really matters. This is the one that we will explore in the rest of this chapter.

The Common International Classification of Ecosystem Services (CICES)

CICES has not solved all the problems of categorising ecosystems services, but it is a useful

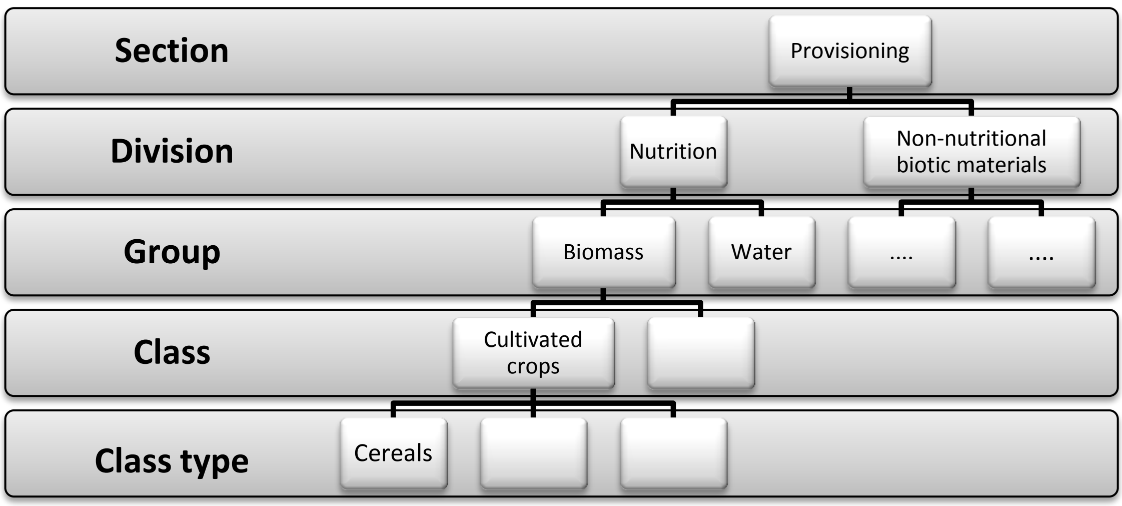
Table 1: The Common International Classification of Ecosystem Services (CICES, V4.3)

CICES V4.3					
Section	Division	Group	Class	MA	TEEB
Provisioning	Nutrition	Biomass	Cultivated crops	Food	Food
			Reared animals and their outputs		
			Wild plants, algae and their outputs		
			Wild animals and their outputs		
			Plants and algae from in-situ aquaculture		
			Animals from in-situ aquaculture		
		Water	Surface water for drinking	Water	Water
			Ground water for drinking		
	Materials	Biomass	Fibres and other materials from plants, algae and animals for direct use or processing	Fibre, Timber, Ornamental, Biochemical	Raw materials, medicinal resources
			Materials from plants, algae and animals for agricultural use		
			Genetic materials from all biota	Genetic materials	Genetic materials
		Water	Surface water for non-drinking purposes	Water	Water
			Ground water for non-drinking purposes		
	Energy	Biomass-based energy sources	Plant-based resources	Fibre	Fuels and fibres
			Animal-based resources		
		Mechanical energy	Animal-based energy		
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	Bio-remediation by micro-organisms, algae, plants, and animals	Water purification and water treatment, air quality regulation	Waste treatment (water purification), air quality regulation
			Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals		
		Mediation by ecosystems	Filtration/sequestration/storage/accumulation by ecosystems		
			Dilution by atmosphere, freshwater and marine ecosystems		
			Mediation of smell/noise/visual impacts		
	Mediation of flows	Mass flows	Mass stabilisation and control of erosion rates	Erosion regulation	Erosion prevention
			Buffering and attenuation of mass flows		
		Liquid flows	Hydrological cycle and water flow maintenance	Water regulation	Regulation of water flows, regulation of extreme events
			Flood protection	Natural hazard regulation	
		Gaseous / air flows	Storm protection		
			Ventilation and transpiration		
	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	Pollination and seed dispersal	Pollination	Pollination
			Maintaining nursery populations and habitats		
		Pest and disease control	Pest control	Pest regulation	Biological control
			Disease control	Disease regulation	
		Soil formation and	Weathering processes	Soil formation (supporting services)	Maintenance of soil fertility
			Decomposition and fixing processes		
		Water conditions	Chemical condition of freshwaters	Water regulation	Water
			Chemical condition of salt waters		

CICES was original developed as part of the work on the system of integrated environmental and economic accounting (SEEA) led by the United Nations Statistical Division (UNSD), but it has been used by the wider ecosystem services community to help define indicators of ecosystem services, or map them. In designing it the intention was to provide a way of characterising 'final services', namely those that sit interface between ecosystems and society. In this sense it follows the definition used in TEEB, namely that these final services are the things from which goods and benefits are derived. However, it did try to use as much of the terminology that was already widely employed, and so used the categorisation of 'provisioning', 'regulating' and 'cultural' services that were made familiar by the MA and an overarching framework.

In CICES provisioning services are the material and energetic outputs from ecosystems from which goods and products are derived. Regulating services categories all the ways in which ecosystems can mediate the environment in which people live or depend on in some way, and benefit from them in terms of their health or security, for example. Finally, the cultural category identified all the non-material characteristics of ecosystems that contribute to, or are important for people's mental or intellectual well-being. As Table 1 shows, CICES is hierarchical in structure, splitting these major 'sections' successively into 'divisions', 'groups' and 'classes'. Figure 1 illustrates how this works.

Figure 1: The hierarchical structure of CICES illustrated with reference to a provisioning service (cultivated crops - cereals) (after Potschin and Haines-Young, 2016).



The hierarchical structure was designed to deal with the fact that in working with ecosystem services different people were working at different thematic and well as spatial scales; with this kind of structure it was intended that users could go down to the most appropriate level of detail that they require, but then group or combine results when making comparisons or more generalised reports. There was also an attempt to make it more comprehensive than the classifications used by the MA or TEEB, and so include categories such as biomass based energy that were not explicitly included in these typologies. The broader range of categories at the detailed class level was intended to enable translations between different systems to be made; a simple prototype tool for helping people cross reference some of the more widely used classification systems has, for example, now been developed[4]. Table 1 also shows the equivalences between CICES and the MA and TEEB categories.

In order to build a generally applicable classification the higher categories in CICES were intended to be exhaustive, in the sense that they were sufficiently general to cover all the things that people recognise as ecosystem services in the broadest sense. We recognised from the outset, however, that the system also ought to be open-ended to allow users to nest what was particularly relevant to them into the system at some level. Thus the class types were not specified; instead the assumption was that, given the general structure, users could place the specific things that they were measuring or interested into one of the existing classes.

Facing the Challenges of Categorisation

As we argued in our introduction, it is not our intention here to 'sell' CICES as *the* way to categorise ecosystem services. Rather it was our intention to daw on the experience of developing the current version to highlight the challenges that the task of classifying ecosystem services still poses.

The first challenge working on CICES showed us how difficult it is to categorise 'final ecosystem services'. These according to Boyd and Banzaf (2007) are the 'end-products of nature', who argue that it is important to define them clearly to avoid the problem of 'double counting' when we value; more formally these authors suggest they 'are components of nature, directly enjoyed, consumed, or used to yield human well-being'. The implication is that we should avoid trying to value the processes or ecosystem components that underpin them, not because they are unimportant, but because their value is already embodied in this final output. The difficulty this posed when working on CICES was that it was clear that, to some extent, what constituted a final service was context dependent. Take the cases of the regulating service categorised in CICES as 'pollination'. On the face of it, it looks like a things that has more of an underpinning or supporting role rather than being a 'final service'. However, on closer scrutiny the answer is 'it depends'; certainly *pollination* it an important input to a number of provisioning services such as fruit production. However, encouraging *pollinator species* in our gardens, whether they benefit us by pollinating our fruit or not, can also be regarded as a final service. In this context, pollinators are another iconic group of species that we want to conserve or encourage, like farmland birds, for example. The point here, in relation to CICES is that the list of services in the classification are more a set of *potential* final services and whether they are or are not has to be determined by the circumstances in which the classification is being applied. There probably is no definitive list of things that we can unambiguously categorise as 'final services'. Any future version of CICES would have to help people navigate some of these issues when they seek to describe and measure ecosystem services.

A second challenge that we faced in designing CICES, and which would have to be resolved by those designing any alternative, concerns the scope of any classification. During the consultation processes that gave rise to CICES there was considerable debate about whether abiotic ecosystem outputs like wind or hydropower, or minerals like salt, should be categorised as 'ecosystem services'. In the end, the augment that the category 'ecosystem services' should be restricted to those ecosystem outputs that were dependent on living processes won the day. The telling point was that a key feature of the concept was that it helps make the case for the importance of biodiversity, and to include other things that are not dependent on living processes would dilute it. The problem is, of course, that these abiotic ecosystem outputs are not unimportant, discussion of them will still

[4] Available at: http://openness.hugin.com/example/cices

involve trade-offs etc., and in any case lay people often do not see the different between these products of nature and those dependent on biodiversity.

The point about scope that can be illustrated from the example of CICES is that to some extent these kinds of decision are arbitrary, and have to be guided by the kinds of purposes that people want to apply the system too. The arbitrary nature of these decisions is illustrated, for example, by the place of water in CICES. Water is indeed an abiotic ecosystem output – but it is included in the classification as a provisioning service. Water quantity and quality of water can be *regulated* by living processes and these kinds of thing ought to feature somewhere in the classification. However, strictly speaking living processes do not 'produce' water, and so it probably be in the classification as a provisioning service. However, the people consulted felt it was too important not to be included.

The final challenge that we encountered in designing CICES that is worth sharing, is the difficulty that people have (including us sometimes) in distinguishing services and benefits. The distinction is a difficult one to make because it involves deciding where the 'end-product of nature' is transformed into a good, product or benefit as a result of human action of some kind. Take the case of crops standing in a field. In CICES, these would be regarded as a final ecosystem service because they are still connected to the ecological processes associated with the farmed landscape that produced them. That crop can then be turned into a product by harvesting it; in other words the end-product of nature crosses what could be terms the 'production boundary'. While many ecosystem service applications also regard crops in a field as examples of a provisioning service, this is at odds with those developing accounting applications. According to the concepts underpinning the System of Integrated Environmental and Economic Accounts (SEEA), for example, outputs like crops, plantation timber, and aquaculture, are considered *benefits* produced as a combination of final ecosystem services and human inputs; according to the way national accounts are constructed only things whose growth is dependent on *natural* processes can be categories as an ecosystem service[5]. The difficulty that this seems to pose for us is that at a time when we are seeking to make sure that the value of nature is fully taken into account, the criterion of reliance 'natural processes' would seem to exclude much of what goes on across the majority of landscapes not only in Europe but also elsewhere. Agro-ecosystems my not be *natural*, but they do still depend on *ecological* processes, and so it is this dependency or connection that perhaps we should emphasise and take account of.

The way that the SEEA attempts to categorise ecosystem services is perfectly legitimate and rational, given the perspective of the people. The point we want to make is noting the issue is that classification systems inevitably depend on the ways the groups involved view the world; the paradigms that they inhabit. Reflecting on the design of the current version of CICES we conclude that we need to be much clearer developing a terminology that distinguishes services from the benefits that are associated with them in different situations, and that probably we need a more comprehensive system for categorising benefits as well as services. The example of the 'FEGS' system developed by the US-EPA (Landers et al., 2016) suggests that there may scope in looking at the way services, benefits and beneficiaries are aligned in different classification systems, so that a more complete picture can be established. Since it is clear that the 'end-products of nature' can give rise to multiple benefits, and that different groups may value in different ways, future categorisation systems probably need to be much more sophisticated in the way they help us to conceptualise these things.

[5] See for example, http://unstats.un.org/unsd/envaccounting/seeaRev/eea_final_en.pdf

Using CICES – Taking Stock

In this chapter we have used CICES to explore some of the challenges that we need to face when developing systems for categorising ecosystem services. These systems are complex, and experience suggests that they will need to be developed in an iterative way, using experience to find out what work where and how naming conventions and definitions can be improved. While we have used CICES to illustrate some of these issues, it is important not to overlook the fact that it is a system that 'works' and has been used effectively.

For example, CICES forms part of the mapping framework designed to support the EU's Biodiversity Strategy to 2020 (Maes et al., 2014, 2016); the second report of the Mapping and Assessment of Ecosystem Services (MAES) uses the CICES classes to identify a range of indicators that can be used for mapping and assessment purposes[6]. Elsewhere, a number of papers have appeared in the peer reviewed scientific literature that have either used CICES or commented upon it as part of their methodological discussion.

CICES has, for example, been used as the basis of the German TEEB study (Naturkapital Deutschland – TEEB DE, 2014) as well as the German National Ecosystem Assessment, NEA-D (Albert et al., 2014). It has also been refined at the most detailed class level to meet the requirements of ecosystem assessment in Belgium (Turkelboom et al., 2013). Mononen et al. (2015) used CICES to develop an indicator framework at the national scale in Finland. These kinds of application suggest that the detailed class level in CICES can be useful as building block from broader reporting categories, the advantage being that these broader categories are themselves defined in a transparent way.

At the case study level, Saastamoinen et al. (2014) have used it to classify ecosystem services associated with the boreal forests of Finland. Accounting applications include those of Schröter et al. (2014). Elsewhere, CICES has been used to look at the basis for developing or comparing indicators of ecosystem service supply and demand; examples include the work of Castro et al. (2014), Kosenius et al. (2013), von Haaren et al. (2014) and Tenerelli et al. (2016). The latter used CICES as a way of categorising crowdsourced indicators, derived from go-sources images, for cultural ecosystem services for mountain ecosystems. In other work, Bürgi et al. (2015) have used CICES to examine how ecosystem service output had changed for a Swiss landscape since about 1900; the classification framework was used to code the reports from archive sources about whether things that we would now regard as ecosystem services were documented as important in past periods.

While the applications of CICES suggest that the current framework is appropriate for many uses, it is also clear that we need to think carefully about how such systems can be developed. For example, the work of Armstrong et al. (2012) and Liquete et al. (2013), suggest that it may need to be adapted to ensure that it is suitable for the assessment of marine and coastal ecosystems, or integrated more closely with typologies for describing underlying ecosystem function. It is the case that marine interests were probably under-represented in the consultations that led to the current version.

Thus while the current version of CICES clearly works for many purposes, given the importance of categorising ecosystem services in clear and transparent ways, the development of this and other systems needs to be reviewed constantly as our needs and concepts evolve (see Maes, 2016). They are essential tools for our mapping and assessment work. Crossman et al. (2013) for example, has suggested that a classification, such as CICES, might form as part of a more general systematic

[6] see also: http://biodiversity.europa.eu/maes/#ESTAB (accessed 30/01/2016)

approach or ‘blue print’ for mapping and modelling ecosystem services. Busch et al. (2012) have also argued that it is important to develop classification systems, such as CICES, that are ‘geographically and hierarchically consistent’ so that we can make comparisons between regions, and integrate detailed local studies into a broader geographical understandings. Our concluding point is, that whether CICES has a role to play or not, these kinds of system will not build themselves. We need to be aware of the challenges that the categorisation of ecosystem services still poses, and the fact that we have only just started to address them.

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