2 What defines ecosystem services-based approaches?

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2.1 INTRODUCTION

It has long been held that human life depends on the existence of a finite natural resource base, and that nature contributes to the fulfilment of human needs (Malthus 1888; Meadows *et al*. 1972). This knowledge has led to different and evolving ways of understanding the relationship between humans and nature (Raymond *et al*. 2013). The notion of ecosystem services is one of these, which began to be developed in the late 1960s (King 1966; Helliwell 1969; Study of Critical Environmental Problems 1970; Odum and Odum 1972). How human needs and wellbeing interact with quantities and qualities of the finite natural resource base, and how changes to the natural environment impact on human activities and vice versa, are key questions underlying the conceptual development of ecosystem services and related concepts.

In 2000, the Secretary-General of the United Nations called for a worldwide initiative, the Millennium Ecosystem Assessment, 'to assess the consequences of ecosystem change for human well-being and the scientific basis for action needed to enhance the conservation and sustainable use of those systems' (Millennium Ecosystem Assessment 2003). Ecosystem services were defined as 'the benefits that people obtain from ecosystems' and the Millennium Ecosystem Assessment emphasised the need to incorporate the value of ecosystem services into decision-making to reverse increasing degradation of ecosystems. Since the publication of the Millennium Ecosystem Assessment in 2005, economic approaches to the understanding and management of natural resources based on the notion of ecosystem services have been increasingly discussed in the scientific literature (Fisher *et al*. 2009; Norgaard 2010; Ojea *et al*. 2012). The Millennium Ecosystem Assessment was followed by a number of other initiatives to assess ecosystem services, the most significant global assessment being *The Economics of Ecosystem Services and Biodiversity* (Kumar 2010). Other national-level assessments, for example, the UK National Ecosystem Assessment (2011; see Schaafsma *et al*., this book) and the Spanish Millennium Ecosystem Assessment (EME 2011) have also been published. Incorporation of these assessments into policy making is not yet well established; however, there is clear interest in very diverse contexts across the world. For example, there are ongoing discussions about how to incorporate ecosystem services in the upcoming river basin planning cycles within the Common Implementation Strategy of the European Water Framework Directive (Martin-Ortega 2012; Blackstock *et al*., this book). Also, in Malawi, the Decentralised Environmental Management Guidelines produced by the Ministry of Local Government and Development (2012) to guide environmental management at the district level include elements of an ecosystem services-based approach (Waylen and Martin-Ortega 2013), and the South East Queensland Ecosystem Services Framework in Australia provides an example at the catchment level (Maynard *et al*., this book).

In parallel to the popularisation of the idea of ecosystem services, related concepts such as payments for ecosystem services have increasingly been considered as economic instruments to enhance or safeguard ecosystem service supply for the benefit of society across both developing and industrialised countries (Schomers and Matzdorf 2013). Payment for ecosystem services schemes aim to reach mutually beneficial agreements between providers and beneficiaries of ecosystem services, and entail a reward mechanism for ecosystem managers to maintain or improve provision of services valued by beneficiaries (Engel *et al*. 2008; Wunder *et al*. 2008). The number of payments for ecosystem services schemes and related applications has grown significantly in the past two decades, particularly in Latin America (Brouwer *et al*. 2011; Martin-Ortega *et al*. 2013; Mulligan *et al*., this book).

Integration of ecosystem services and ecosystem capital into national accounts is also of growing academic and policy interest (Edens & Hein 2013). Beyond academia and the policy domain, preliminary research has been initiated to explore business opportunities in managing ecosystem services, and there is increasing recognition that enhanced understanding of how businesses depend on natural resources can lead to better decision-making and contribute to reductions in biodiversity loss (Houdet *et al*. 2012). Growing pressure on businesses to consider ecosystems was reflected in the official petition for the business community to contribute to the Convention on Biological Diversity in 2006,

highlighting the need for businesses to develop best-practice guidelines to reduce the impact of their activities on biodiversity (Houdet *et al*. 2012). The need for, and the opportunities of, business engagement in sustainable ecosystem management is evident from other initiatives, including, for example, the Economics of Ecosystems and Biodiversity for Business in Brazil (Pavese *et al*. 2012), the UK Ecosystem Markets Task Force (2013), and the World Business Council for Sustainable Development (2014; Houdet *et al*. 2014; Houdet *et al*., this book).

The concept of ecosystem services has arguably inspired collaboration and enhanced communication between scientists from different disciplines to address complex socio-ecological problems. It has certainly led to wider debate about the representation of environmental issues in decision-making processes among researchers, policy makers, practitioners, and conservation groups. However, popularisation of the concept has also resulted in a lack of clarity about the meaning of 'ecosystem services' and in confusion about terminology, for example in relation to the broader Ecosystem Approach, as defined by the Convention on Biological Diversity (2000) (see Box 2.1).

There is also concern about the gap between the conceptualisation and endorsement of ecosystem services by policy makers and the incorporation of ecosystem services-based approaches into actual natural resources management practice (Nahlik *et al*. 2012). Many initiatives are at an early stage, or remain at a conceptual level. Mechanisms to monitor the effectiveness of ecosystem services-based management approaches are not widely in place, or do not yet provide sufficient evidence. Also, it remains subject to debate whether at least some of those initiatives are being influenced and driven by a genuine ecosystem services paradigm, or whether part of the popularisation of ecosystem services can be attributed to re-framing or re-labelling existing approaches, i.e. 'old wine in new bottles'. The rapid and widespread adoption of the term 'ecosystem services' in the scientific literature (see Figure 2.1) and in the policy domain carries the risk of its use becoming detached from any specific meaning. Gómez-Baggethun *et al*. (2010) express concerns that mainstreaming ecosystem services may result in applications that diverge from the purpose of the concept. Specifically, they are concerned about the shift away from its original purpose

Box 2.1 The Ecosystem Approach (versus ecosystem services-based approaches)

The terms ecosystem approach and ecosystem services are often used interchangeably and it is worth discussing the differences (Waylen *et al*. 2013, 2014).

The Ecosystem Approach (capitalised) is a specific *framework for action* adopted by the Convention on Biological Diversity (2000) as 'a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way'. It is based on the application of the 12 Malawi Principles, which are explicit and prescriptive characteristics of this framework for action. While being different in essence, the specific Ecosystem Approach and the more generic ecosystem services-based approaches as defined in this book (i.e. as a flexible *way of understanding*), overlap in certain critical areas. Notably, the Ecosystem Approach considers humans as an integral part of ecosystems (close to core element 1 in this book's definition of ecosystem service-based approaches – see Section 2.3). It also recognises, in Malawi Principle 4, the need to understand ecosystems in an economic context (e.g. internalising the benefits), which is implicit in our core element 4. Both the Ecosystem Approach and ecosystem services-based approaches prescribe the involvement of stakeholders and various forms of knowledge in natural resource management (Malawi Principle 11; our core element 3). However, the Ecosystem Approach goes further in that it involves prescription of how ecosystems should be managed. By contrast, in our definition, ecosystem services-based approaches may or may not encompass action.

It could be said that existing management and conservation frameworks, such as the Ecosystem Approach,[a] have shaped ecosystem services-based approaches, and, conversely, ecosystem services-based approaches have influenced the general paradigm of natural resource management and the operationalisation of the Ecosystem Approach in practice. For example, the conceptual framework of phase 2 of the UK National Ecosystem Assessment has now been clearly embedded within the wider Ecosystem Approach to include aspects of governance and decision-making (Scott *et al*. 2014). Conversely, after the release of the Millennium Ecosystem Assessment reports, the Convention on Biological Diversity has suggested that the use of ecosystem services concepts and language could help support its goals (Convention on Biological Diversity 2006)

In summary, while the terms 'Ecosystem Approach' and 'ecosystem services-based approaches' are sometimes used interchangeably, it is important to note that the two are not the same and that the adoption of an ecosystem services-based approach is not a substitute for, or equal to, adopting the Ecosystem Approach. Although an ecosystem service-based approach can fit within an Ecosystem Approach, implementing an ecosystem service-based approach does not necessarily involve the range of considerations encapsulated by the 12 Malawi Principles.

[a]As well as Integrated Water Resources Management (see Niasse and Cherlet, this book).

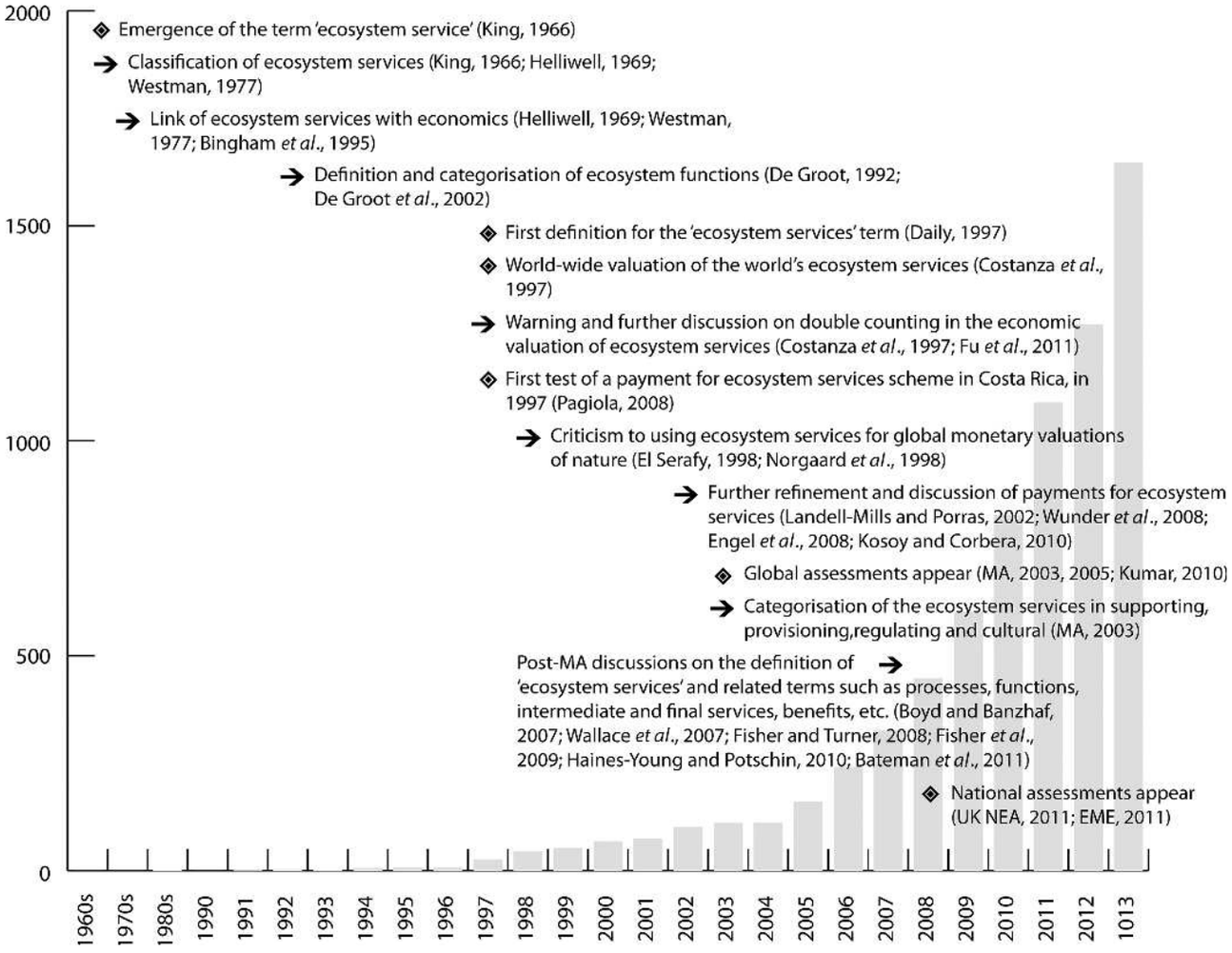

Figure 2.1 Timeline representing the evolution of the notion of ecosystem services, including landmarks (◈) and new aspects entering the scientific discussion (➔). The bar chart illustrates the increase in publications using the term 'ecosystem services' or 'ecological services' based on a computerised search of the ISI Web of Science database during the time period up to 2013 (as an update of Fisher *et al*. 2009).

as an *educational* concept to increase public interest in biodiversity conservation (Peterson *et al*. 2010), towards an emphasis on the commodification of nature for trade in potential markets (Kosoy & Corbera 2010; Corbera & Pascual 2012). Norgaard (2010) states that we might be 'blinded' by the ecosystem services 'metaphor' and thus not see the ecological, economic, and political complexities of the challenges we actually face. Some have argued that the 'economic production metaphor' does not incorporate the important moral and ethical dimensions that humans associate with nature, and which are embedded in held values, beliefs, and norms about nature (Raymond *et al*. 2013) and in the multiple and complex values that humans attribute to nature (Kosoy & Corbera 2010).

In addition, excessive, uncritical faith in the potential of management approaches based on some form of an ecosystem services framework to address complex and conflict-laden resource management problems is likely to result in disillusion if solutions prove to be unsatisfactory. For example, great expectations are currently being placed on the potential of payments for ecosystem services schemes in mitigating water-related problems derived from forest degradation, despite the fact that robust evidence on the positive impacts of existing schemes is lacking (Porras *et al*. 2012; Martin-Ortega *et al*. 2013).

This chapter aims to disentangle the notion of what we call 'ecosystem services-based approaches'. First, we review the evolution of the term 'ecosystem services'. Then we propose a way of characterising ecosystem services-based approaches for research and decision-making. Our purpose is not to provide an ultimate definition of *the* ecosystem service approach, but rather to establish a basis for characterising its applications (in policy

initiatives or research projects). Because we acknowledge that definitions and classifications of ecosystem services are case-specific and purpose-driven, we focus on common key (core) elements that constitute and characterise ways of approaching environmental problems within the ecosystem services paradigm.

The terminology adopted here has been carefully considered. We refer to approaches and not frameworks, because we refer to the *way* complex relationships between humans and the environment are understood, and not to a formalised supporting structure. We use the plural because we consider ecosystem services-based approaches to be based on a paradigm that encompasses different ways of articulating that understanding. These different articulations can take the form of conceptual theoretical frameworks, such as the ones proposed by the UK National Ecosystem Assessment (Bateman *et al*. 2011; Schaafsma *et al*., this book), the Valuing Nature Network (UK National Ecosystem Assessment 2014) or the well-established ecosystem service's cascade from Haines-Young and Potschin (2010); frameworks of action such as the Ecosystem Approach (Box 2.1) and Integrated Water Resources Management (Niasse and Cherlet, this book); or classification or accounting frameworks (such as the Common International Classification of Ecosystem Services developed by the European Environment Agency.[1]) The term *services-based* is used to explicitly differentiate from the Ecosystem Approach. The term *core elements* is used rather than principles, to further ensure clear differentiation with the Malawi *Principles* of the Ecosystem Approach, and to reflect the idea that the elements we propose are at the *core* of what we understand is an ecosystem services-based approach.

2.2 ORIGINS AND EVOLUTION OF THE NOTION OF 'ECOSYSTEM SERVICES'

Gómez-Baggethun *et al*. (2010) link the historic development of the concept of ecosystem services to the evolution of general economic concerns about nature, and the emergence and expansion of environmental economics as a discipline. In this context, the authors describe the evolution from the original economic conception of nature's benefits as use values in Classical economics; their conceptualisation in terms of 'exchange values' in Neoclassical economics; and the expansion of monetary valuation to what they call the 'mainstreaming of the new economics of ecosystems', in which the ecosystem services notion is embedded. Here we focus on the emergence of the term 'ecosystem service' itself, and the evolution of its meaning and use (see Figure 2.1 for a graphical representation).

The term *ecosystem services* was first mentioned in the 1960s. King (1966) was concerned with the interaction between ecological and economic relationships of humans, and defined six values associated with wildlife that are 'positive' to people'.[2] Helliwell (1969) identifies recognisable benefits from wildlife and proposed the monetisation of values to incorporate them into conventional cost–benefit analysis. Westman (1977, p.961) discusses the importance of accounting for the benefits of nature's *services*, understood as the 'dynamics of ecosystems' that 'impart to society a variety of benefits', and differentiated them from ecosystems' standing stock or nature's free goods. In their article 'Extinction, substitution and ecosystem services', Ehrlich and Mooney (1983) highlight that extinctions of species would result in the loss of *services* to humanity, which could range from trivial to catastrophic. Further publications appeared in the early 1990s (e.g. Ehrlich & Wilson 1991; Costanza & Daly 1992; Ehrlich & Ehrlich 1992). Bingham *et al*. (1995) discuss the relationship between ecosystem services and economic valuation. These studies used the term ecosystem service, but none gave specific definitions.

Key milestones were the publication of Daily's book *Nature's Services: Societal Dependence on Natural Ecosystems* (1997), and Costanza *et al*.'s (1997) seminal work 'The value of the world's ecosystem services and natural capital'. Daily (1997, p.3) provides the first definition of the term 'ecosystem services', as 'the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life'. She also highlights that failure to foster delivery of ecosystem services undermines economic prosperity, forecloses options, and diminishes other aspects of human wellbeing. Costanza *et al*. (1997) set the ambitious goal of assigning a monetary value to the world's ecosystems and estimated an aggregated value of the entire biosphere. Costanza *et al*.'s work has been subject to criticism; El Serafy (1998) raises concerns about the comparison between the world's ecosystem services values and the global gross national product; Norgaard and Bode (1998) focus their criticism on the use of marginal values 'when the total collapse of some services seemed not only plausible but the driving concern'. Both highlight the fact that separate valuations of ecosystem services could result in double counting (a fact that had been acknowledged by Constanza *et al*. themselves). Despite these criticisms, this work contributed significantly to placing the valuation of ecosystem services very high on the research agenda.

From the late 1990s onwards, the literature on ecosystem services grew rapidly (e.g. Limburg & Folke 1999; Bockstael *et al*. 2000; De Groot *et al*. 2002). In particular, De Groot *et al*. (2002) made a critical contribution by emphasising the role of the *ecosystem functions* underlying the provision of services and

[1] www.cices.eu

[2] The six values listed by King (1966) are: commercial, recreational, biological, esthetic, scientific, and social values.

goods. They list and describe a set of ecosystem functions as 'the capacity of natural processes and components to provide goods and services that satisfy human needs, directly or indirectly' (De Groot *et al*. 2002, p.394). Based on an earlier paper (De Groot 1992), four general types of ecosystem functions were defined: regulation, habitat, production, and information functions.

These publications provided the foundation for the Millennium Ecosystem Assessment (2003 2005), which is undoubtedly the turning point in the popularisation of the ecosystem services concept. The assessment aimed to demonstrate how the decline in biodiversity (and degradation of ecosystems more generally) directly affect ecosystem functions that underpin services essential for human wellbeing. It provided a broad definition of ecosystem services as 'the benefits people obtain from ecosystems' (2003, p.49) and the most frequently quoted typology of services: provisioning (production), regulating (regulation), supporting (habitat), and cultural (information) services. The Millennium Ecosystem Assessment explicitly promoted the use of the notion of ecosystem services to inform decision-makers across the globe, and has clearly inspired the development and application of different forms of ecosystem services-based approaches.

Since publication of the Millennium Ecosystem Assessment, different interpretations and critiques of the definition and classification of ecosystem services have emerged. Ojea *et al*. (2012) reviewed the range of definitions that have been proposed, and found that interpretations differ according to the nature and types of services that are considered to have value for society. One post-Millennium Ecosystem Assessment definition is that of Boyd and Banzhaf (2007, p.619), who define final ecosystem services as 'the components of nature directly enjoyed, consumed, or used to yield human well-being'. The authors consider services as the end products of nature (and hence the term *final* ecosystem services), and distinguish them from intermediate natural components and from benefits. Boyd and Banzhaf propose to value only services as defined above, and exclude benefits in which anthropogenic inputs are involved (e.g. recreational angling would have non-natural inputs such as tackle and boats) and intermediate components, which they define as part of the process resulting in ecosystem services. Fisher *et al*. (2009) define ecosystem services as the aspects of ecosystems utilised (actively or passively) to generate human wellbeing. Based on this definition, they distinguish between (1) abiotic inputs such as rainfall; (2) intermediate services such as water regulation; (3) final services such as constant stream flow; and (4) benefits, such as water for irrigation, for hydroelectric power, or recreation. Wallace (2007) and Fisher and Turner (2008) highlight that the same service can be either intermediate or final, depending on the context (e.g. primary production to regulate water or to benefit directly as food). Fisher *et al*. (2009) also point to the importance of stakeholders' perceptions in defining whether a service is intermediate or final.

The focus on final ecosystem services is motivated by the need to avoid double counting when valuing ecosystem services. As Lele (2009) explains for the case of water services, structural changes in ecosystems (e.g. timber plantations) can influence watershed processes (e.g. increase of erosion rates). These changes can result in different kinds of human impact, which can be negative (e.g. decreased reservoir capacity due to sediment load resulting in reduced hydropower production capacity) or positive (e.g. increased fertilisation of floodplains). Lele points out that the 'process' should not be the focus of valuation. Rather, it is the outcome of the process (the final service), which has an impact on human wellbeing and, therefore, has economic value. According to Fu *et al*. (2011), the exclusion of intermediate services in economic valuation does not indicate that they have no value, but that their values are realised through the value of the final ecosystem services.

The idea of *final* ecosystem services has been incorporated into recent assessments of ecosystem services, for example, in the latest report on The Economics of Ecosystems and Biodiversity (Kumar 2010); the UK National Ecosystem Assessment (Bateman *et al*. 2011); and other literature (Haines-Young & Potschin 2010). Supporting (and in some cases even regulating) ecosystem services have been located in the intermediate ecosystem services group due to their indirect repercussions on human wellbeing (Wallace 2007; Fu *et al*. 2011) – for example, their role in preserving the delivery of provisioning services.

A further distinction is that of final services and *goods*. The UK National Ecosystem Assessment defines goods as the objects (both of use and non-use character) that people value (Bateman *et al*. 2011; Schaafsma *et al*., this book). Goods should therefore be at the centre of any assessment, while services are the flows that originate from ecosystems and contribute to the provisioning of goods. The Common International Classification of Ecosystem Services also recognises the need to distinguish between final ecosystem services and ecosystem goods and benefits (collectively referred to as 'products') and defines ecosystem services as the contributions that ecosystems make to human wellbeing (Common International Classification of Ecosystem Services 2012). These services are final in that they are the outputs of ecosystems that most directly affect the wellbeing of people. According to the Common International Classification of Ecosystem Services, a fundamental characteristic is that final services retain a connection with the underlying ecosystem functions, processes, and structures that generate them. Ecosystems products are the goods and benefits that people create or derive from final ecosystem services. These final outputs from ecosystems have been turned into products or experiences that are not functionally connected to the systems from which they were derived.

A parallel discussion has developed around the monetisation of the value of ecosystem services. In environmental economics, the predominant paradigm for the interpretation of the notion of value

of ecosystem services has been that of Neoclassical economics (Gómez-Baggethun *et al*. 2010). Within this paradigm, the value of ecosystem services is measured in terms of the welfare change associated with changes in ecosystem status in monetary units (Pearce & Turner 1989). The need for and validity of monetary assessments of ecosystem services values has been, and continues to be, heavily criticised, particularly from ecological economics perspectives (Proops 1989; Martinez-Alier *et al*. 1998; Azqueta & Delacámara 2006; Spangenbergh & Settele 2010). Even though alternative indicators of wellbeing that do not rely on monetary values have been suggested and applied (Byg 2015), they have only recently found their way into actual assessments of ecosystem services. For example, Kenter *et al*. (2013) investigated the recreational use and non-use values of UK divers and sea anglers in potential marine protected areas in the context of the UK National Ecosystem Assessment, using a combination of monetary and non-monetary valuation methods and an interactive mapping application to assess site visit numbers.

2.3 ECOSYSTEM SERVICES-BASED APPROACHES: DEFINITION AND CORE ELEMENTS

As demonstrated above, there is no clear consensus on how exactly ecosystem services should be defined and classified, and as research on ecosystem services evolves, further interpretations might emerge. Major differences between definitions arise from the *purpose* the ecosystem service concept is expected to serve (Fisher & Turner 2008; Fisher *et al*. 2009). A purely *descriptive* objective, for example, illustrating human–nature relationships, can use the most generic and broad definitions, such as those given by the Millennium Ecosystem Assessment (2005) and Daily (1997). For the specific purpose of creating an ecosystem services or 'green' inventory that can be balanced against economic national accounts – and therefore an *evaluative* use of the term – it is useful to think beyond aspects that are 'valued' and define ecosystem services more narrowly, as in the Common International Classification of Ecosystem Services developed from the work on environmental accounting by the European Environment Agency. Frameworks of identified ecosystem services will then differ depending on the specific descriptive or evaluative objectives behind the task (see Fisher *et al*. 2009).

Instead of drawing upon extensive but generic 'lists' of services such as the ones published in the Millennium Ecosystem Assessment, the selection and definition of relevant ecosystem services should be on a project-by-project basis to avoid a mismatch of purpose and underlying conceptual framework. Research papers should make clear the underlying purpose of the work and how the term ecosystem service is defined. Unlike Nahlik *et al*. (2012), we understand that specific projects should define and operationalise frameworks to achieve their own specific targets. As stated previously, rather than trying to provide an ultimate definition of *the* Ecosystem Services *Framework*, we propose a set of common guiding core elements of *generic ecosystem services-based approaches* that underpins the characterisation of research and policy applications.

Broadly, then, an ecosystem services-based approach is *a way of understanding the complex relationships between nature and humans to support decision-making, with the aim of reversing the declining status of ecosystems and ensuring the sustainable use/management/conservation of resources*. An ecosystem services-based approach entails the following core elements:

(1) *The focus on the status of ecosystems, and the recognition of its effects on human wellbeing*. An ecosystem services-based approach takes a viewpoint of anthropocentric instrumentalism, placing the emphasis on the benefits that *humans obtain from nature*, and recognising that *humans* are the ones who assign value to aspects of ecosystems. This is in contrast to alternative ways of interpreting the relationships between humans and nature, which consider the human system to be part of a broader ecological system and reject the idea of decision-making being purely driven by anthropocentric views, including notions of intrinsic value and bio- or eco-centric viewpoints.

(2) *The understanding of the biophysical underpinning of ecosystems in terms of service delivery*. This represents a new way of understanding and describing ecosystems in terms of the biophysical structures, processes, and functions leading to the delivery of services to humans (production chain). Traditionally, ecologists and other natural scientists have not thought about ecosystems in terms of human wellbeing, but rather in terms of biogeochemical cycles, energy flows, species behaviour, population dynamics, etc. An ecosystem services-based approach implies that there should be a 're-phrasing' of science in terms of how nature delivers to humans and what roles humans play in that delivery. Moreover, it requires the description and adequate quantification of the interactions of an ecosystem's components and their effects upon a single service or a range of services (acknowledging complex interdependencies), across temporal and spatial scales.

(3) *The integration of natural and social sciences and other strands of knowledge for a comprehensive understanding of the service delivery process*. An ecosystem services-based approach is, by definition, transdisciplinary in nature; this requires the integration of different academic disciplines, for example, via jointly developed models, which inevitably trade-off precision in disciplinary approaches to achieve outcomes that are of use to

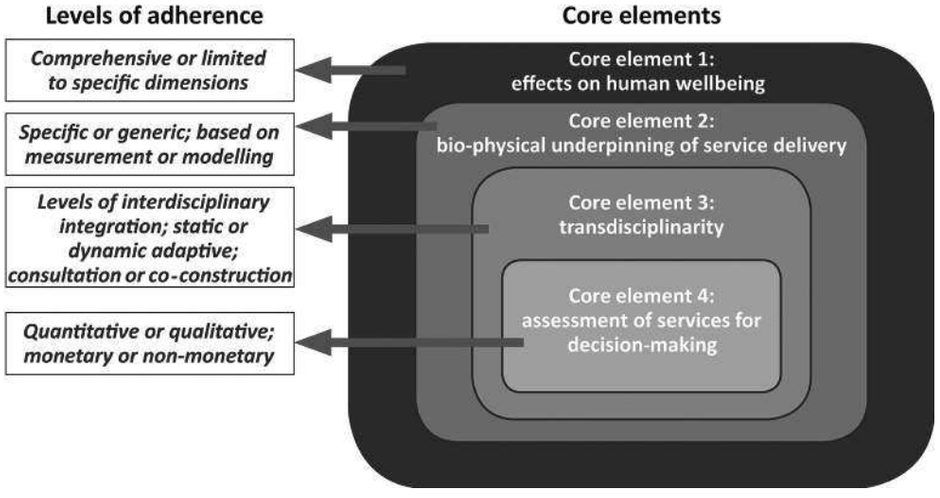

Figure 2.2 Nested core elements characterising ecosystem services-based approaches.

decision-making. An ecosystem services-based approach also requires the consideration of non-academic strands of knowledge, including the views and perceptions of stakeholders at the relevant scales. Co-construction of knowledge with stakeholders is essential to understand the variety of ways in which ecosystems generate wellbeing, and to establish the legitimacy of decisions based on the valuation of ecosystem services.

(4) *The assessment of the services provided by ecosystems for its incorporation into decision-making*. An ecosystem services-based approach inherently implies an assessment (qualitative or quantitative) of the services delivered by ecosystems, and the identification of the social/individual values of services in monetary and/or non-monetary terms. This is motivated by the need to incorporate these values into decision-making processes.

The above core elements are logically related to each other in a nested structure. Core element 1 is a necessary condition for core element 2 to apply. Similarly, core elements 1 and 2 are implied in the integrative work of core element 3, and for the assessment established in core element 4, i.e. as pre-requisites for the assessment of ecosystem services and the incorporation of their values into decision-making. Figure 2.2 illustrates this.

The nested structure of the core elements accommodates variations in the application of ecosystem services-based approaches. Our proposition is that an ecosystem services-based approach necessarily implies that the core elements are present, but that different research or policy case studies vary in how the core elements are represented.[3] According to the nested structure, any ecosystem services-based application is necessarily grounded in the acknowledgement that ecosystem status and human wellbeing are linked (core element 1); however, the effects on human wellbeing can be perceived in a comprehensive manner, or be focused on specific dimensions of wellbeing only (for example, whether solely economic welfare effects are considered, or whether shared social values, happiness, health, security, etc., are included as well). In core element 2, variation may arise from the way the biophysical underpinning of service delivery is established. For example, biophysical analysis can be predominantly based on either measurement or modelling. Also, some applications might be based on a more complex, site-specific biophysical analysis than others that, for example, rely on transferring knowledge on biophysical effects of ecosystem changes from similar contexts. Similarly, the integration of knowledge across disciplines and domains (core element 3) can also be examined along a range of dimensions; the degree of knowledge integration can involve only a few scientific disciplines and domains, or co-generation of knowledge can involve many disciplines and domains; integration can be either static, following pre-defined paths in which knowledge flows between all the parties involved, or dynamic, allowing for feedback loops and adjustments in the conditions and assumptions underlying knowledge creation. Adherence to core element 3 can be achieved through (quantitative) surveys or (qualitative) participatory processes with stakeholders that aim to co-construct knowledge. Finally, the assessment of services (core element 4) can be quantitative or qualitative, or be conducted in monetary or non-monetary terms. The suggestions for characterising adherence to the four core elements (see Figure 2.2) are not meant to be comprehensive. Rather, we hope that the idea of the nested core elements will stimulate discussions among researchers and policy makers about plausible and useful characterising terms. Furthermore, any characterisation may be adjusted over time to

[3] Examples of levels of adherence can be found in the boxes on the left-hand side of Figure 2.2. Many of the pairs of terms in the figure describe extremes, while a case study may actually sit somewhere in between.

Box 2.2 An ecosystem services-based approach to the understanding of water-related forest ecosystem services

In a water context, an ecosystem services-based approach:

- recognises that structural changes to forests can influence several watershed processes (e.g. erosion rates, sediment load, water chemistry, peak flow levels, total flow, base flow, or groundwater recharge) in different ways and that, in turn, these changes result in different kinds of impact on human wellbeing (e.g. increased costs of water purification, increased fertilisation of floodplain lands, decreased reservoir capacity due to siltation, flood damage, changes in agriculture) (Lele 2009) – core element 1.
- requires the understanding of the biophysical processes that determine the way forest cover, forest structure, soil–vegetation dynamics, etc. affect the amount and quality of freshwater to the extent that it impacts on human wellbeing (through use or non-use) by the beneficiaries (core element 2).
- combines knowledge of the service delivery processes that are based on natural sciences (e.g. plant physiology, ecology, hydrology) with information from social sciences (e.g. economics, psychology, political science) and (local) stakeholder knowledge (e.g. farmers, drinking water users, floodplain residents, hydropower companies, regulators) that jointly help to understand, for example, where benefits arise in relation to where ecosystem change takes place (core element 3).
- requires at least some degree of measurement of changes in the final services delivered (e.g. increase of the flow of water associated with forest cover) coupled with a qualitative interpretation of the implications for human wellbeing, or the valuation of associated benefits through, for example, willingness to pay for increased water availability, so that these benefits can be incorporated into decision making (for example, on afforestation or the creation of protected forest areas) – core element 4.

accommodate novel developments in ecosystem services-based approaches methodology or application.

Box 2.2 describes the core elements of an ecosystem services-based approach using the understanding of forests' water-related ecosystem services as an example.

2.4 CONCLUSIONS

We view ecosystem services-based approaches as a particular way of understanding the complex relationships between humans and nature; that is, a particular *way of looking* at socio-oecological issues. An ecosystem services-based approach is *not* a management tool *per se*, but rather a pair of *glasses* that one (researcher, analyst, policy maker, or land manager) might wear to tackle the problem at hand. As such, it is expected to promote holistic systems thinking, identifying connections between an ecosystem's components, and to help understand how ecosystem services benefit different social groups at different locations, revealing what dis-services and trade-offs might exist.

The concept of ecosystem services has arguably inspired collaboration and enhanced communication between scientists from different disciplines to address complex socio-ecological problems. It has certainly led to wider debate about the representation of environmental issues in decision-making processes among researchers, policy makers, practitioners, and conservation groups. It has helped to incorporate into the debate often ignored benefits that people derive from ecosystems and to recognise the many values of nature within different decision-making contexts that affect a broad range of stakeholders.

Despite this enthusiasm and popularisation, or maybe precisely because of it, we see three major risks associated with the adoption of ecosystem services concepts. The first risk relates to current confusion about terminology and the understanding of related concepts. We believe that an increasingly blind and uncritical adoption of ecosystem service terminology that is devoid of any specific meaning can over time be detrimental to the targeted application of ecosystem services-based approaches and their potential to inform decision-making processes. This is because consensus (between researchers, policy makers, stakeholders) may be based on each party's own interpretation of the terminology and associated/underlying conceptual foundations, and it may create 'fake consensus' situations where problems only surface when affected parties are probed more deeply about what they actually mean. At the extreme, the ecosystem services 'discourse' may be exploited to sell 'business as usual' in research and decision-making, and solely to create new research demands rather than to clarify existing needs. We therefore think there is a greater need for researchers and decision-makers alike to question their use of ecosystem service terminology, and also the use of ecosystem service terminology by their peers.

The second risk stems from overlooking the limitations and potential negative consequences of applying ecosystem services-based approaches. Among the limitations of moving from the conceptual level to the practical implementation of ecosystem services-based approaches are the challenges associated with the current capacity of understanding of the effects of interventions

Box 2.3 Key messages

- The concept of ecosystem services has inspired collaboration and enhanced communication between scientists, policy makers, practitioners, and conservation groups.
- The popularisation of the concept has also resulted in a lack of clarity about the meaning of 'ecosystem services' and in confusion about terminology.
- This chapter defines 'ecosystem services-based approaches' as a way of understanding the complex relationships between nature and humans to support decision-making, characterised by four core elements:
  (1) The recognition that the status of ecosystems affects human wellbeing, from an anthropocentric point of view.
  (2) The understanding of the biophysical underpinning of ecosystems in terms of service delivery, which implies that science should acknowledge what nature delivers to humans and what roles humans play in that delivery.
  (3) The integration of natural and social sciences for a comprehensive understanding of the service delivery process, and consideration of non-scientific stakeholder perceptions to both understand the variety of ways in which ecosystems generate wellbeing, and establish legitimacy of decisions based on the valuation of ecosystem services.
  (4) The assessment of the services provided by ecosystems for the incorporation of (monetary or non-monetary) values into decision-making.
- Ecosystem services-based approaches are neither a silver bullet nor a panacea and need to be assessed and monitored appropriately.
- They have the great virtue of having stimulated dialogue, but it is now important to make sure this dialogue remains meaningful and purpose-driven.

impacting on land use and water management in terms of final ecosystem services and, hence, the possibility of accurately valuing benefits. If incentive mechanisms for land and water management, such as payments for ecosystems services, are put in place based on the false assumption that the desired benefits will be delivered, then the process is likely to be counterproductive.

Finally, even if non-monetary assessments are used, the essentially anthropogenic nature of ecosystem services-based approaches might indeed lead to the 'commodification' of nature and natural assets. This could introduce unforeseeable effects on societies if the service notion clashes with their world views (e.g. according to Ibarra *et al*. 2011, a payment for ecosystem services scheme caused the food insecurity of an indigenous community in Mexico), and/or result in the neglect of negative impacts on aspects of ecosystems for which final services and benefits have not yet been identified.

In summary, ecosystem services-based approaches are neither a silver bullet nor a panacea and need to be assessed and monitored appropriately. They have the great virtue of having stimulated dialogue, but it is now important to make sure that this dialogue remains meaningful and purpose-driven.

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