Chapter 11: Frameworks for ecosystem assessments[1]

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[a] What is a framework?

A framework is a way of organising our thinking or working practice. In the context of ecosystem assessment, such frameworks are particularly important because the field brings together researchers, resource managers and decision makers each with their own skills and backgrounds, and as they embark on a common task it is essential to develop a shared perspective of how things should be approached and what outcomes are required. As Munns et al. (2015) have observed, a major barrier to successful transdisciplinary projects is the misunderstandings and inconsistencies that arise when different disciplines come together. Whether some kind of 'standard lexicon' can be constructed - or is ultimately really necessary - remains to be seen. In this chapter we therefore review these issues, and consider some of the different frameworks for ecosystem assessments that have been discussed in the literature and what has been achieved with them.

[a] The role of conceptual frameworks

In 2012 the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) was established as an independent intergovernmental body open to all member countries of the United Nations, with the aim of 'strengthening the science-policy interface for biodiversity and ecosystem services'. The goal was to better conserve biodiversity, promote its sustainable use and hence secure long-term human well-being. Díaz et al. (2015) provide a useful summary of some of its early work IPBES that was directed at developing a common conceptual framework for the Platform.

Given the focus of their concerns, IPBES took a conceptual framework to be "a concise summary in words or pictures of relationships between people and nature..." (Díaz et al., 2015, p.3), the purpose of which is to set out the key social and ecological components of the system to be studied and the relationships between them. Díaz et al. (2015) argue that the while the resulting framework (Figure 1) was 'highly simplified' in the way it depicted the interactions between people and nature, the work that led up to it was innovative both in the open and transparent way it was undertaken, and in the way it combined different scientific traditions and cultural perspectives. The simplification was justified, they suggest, because of the interdisciplinary and cross-cultural understanding that needed to be achieved in setting up to the platform.

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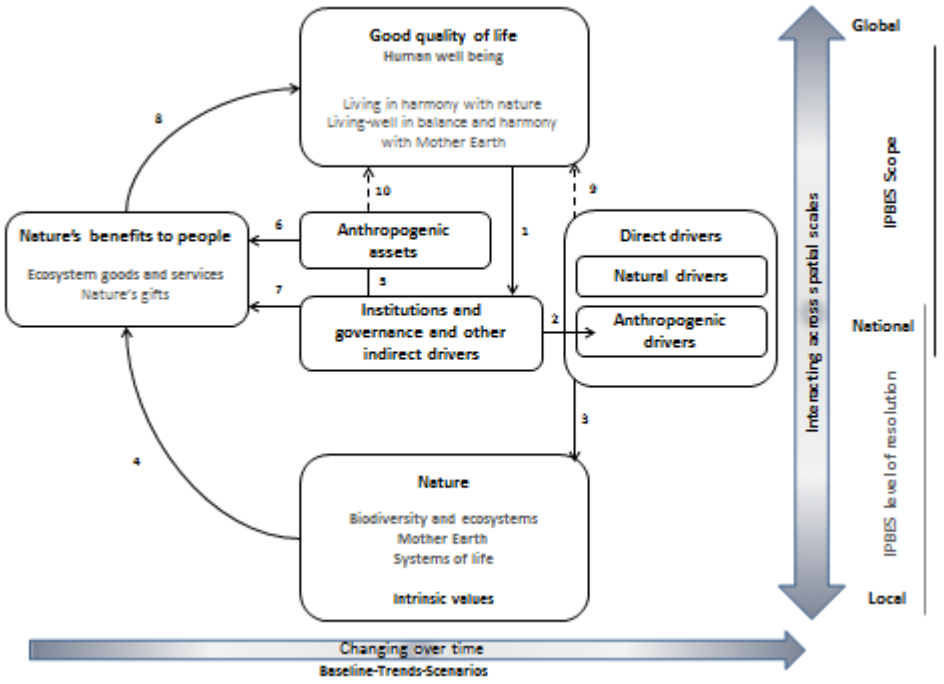
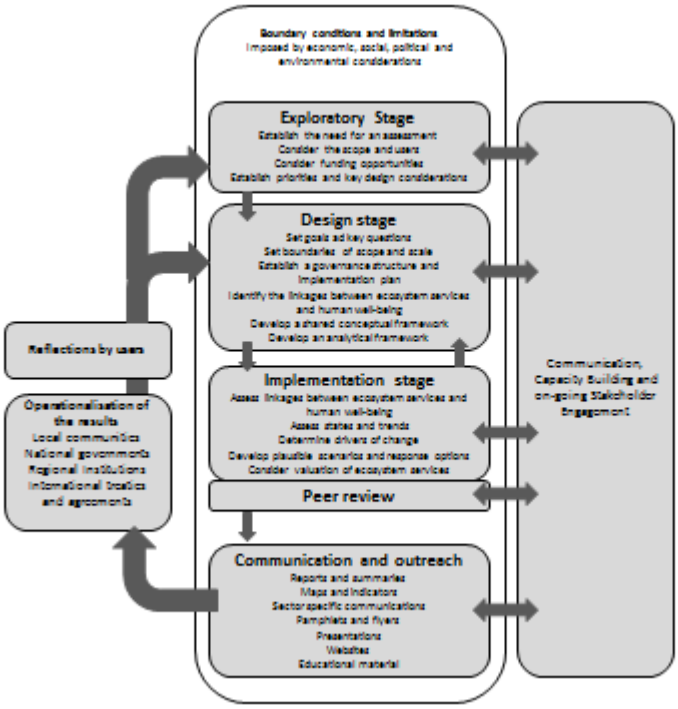


Figure 1: The IPBES Conceptual Framework (after Díaz et al. 2015)

In the conceptual framework shown in Figure 1, the major headings in the boxes set out broader more inclusive concepts agreed by the participants. However, the diagram also shows the way the language and concepts used by different knowledge systems are related both to them and each other. By way of illustration, consider the way different terminologies are combined under the heading of 'good quality of life'. In the context of the 'western' ecosystem services paradigm we interpret this concept through notions of 'human-well-being' (see for example, the iconic diagram from the Millennium Ecosystem Assessment; MA 2005). In contrast, 'living-well in balance and harmony with Mother Earth' is a perspective shared by many indigenous peoples worldwide. In considering the differences between them under the general heading of 'good quality of life' it is important to note that we might not just be looking at different labels for the same thing. The idea of 'mother earth', for example, is not simply a synonym for 'nature' as used in western science. Rather, it is taken to denote a holistic entity that not only sustains all living things, including people, physically and spiritually, but which is *entitled with rights as a collective subject of interest* (Pacheco, 2014; Díaz et al. 2015). Indeed, the concept has been incorporated into the constitutional and legal frameworks Ecuador and Bolivia (Radcliffe, 2012; Satterfield et al., 2013).

The example of the IPBES illustrates that conceptual frameworks are not just a matter of conceptual discussion but also the basis for *action*. Such participative and practical characteristics are in fact essential ingredients of the idea of an *ecosystem assessment* as a 'social process' (Fish et al., 2016, this volume). The Millennium Ecosystem Assessment saw this social process as a way of enabling scientific understandings about the causes of ecosystem change and their consequences for human well-being made relevant to the needs of decision-makers (MA, 2005). As a result there must be an interaction between participants so that the needs of users of scientific knowledge can be identified and refined, and the content and character of scientific knowledge evaluated, and, for any ecosystem assessment to be successful, it must be 'credible', 'salient' and 'legitimate' (Cash et al.,

2003; Tomich et al., 2010; Mac Donald et al., 2014). In the context of the particular set of problems to which the assessment is directed, credibility concerns the *adequacy* of the scientific knowledge, saliency its *applicability*, and legitimacy the fact that outcomes are co-constructed in a fair and un-biased way that respects the different values, beliefs and circumstances of the various stakeholder groups involved.



>>> **Figure 2: An Ecosystem Assessment Process** (adapted from Ash et al. 2010, by the SGA network, http://www.ecosystemassessments.net/about/ecosystem-assessments.html)

If one accepts that ecosystem assessments are indeed social processes then it follows that conceptual frameworks cannot simply be taken 'off the shelf'; the collaborative effort in building one is part of the social learning that all participants need to go through if they are to begin to understand each other (Axelsson et al. 2013); see also Figure 2. Thus 'blueprints' of the kind described by Seppelt et al. (2012), or the standardised lexicons suggested by Munns et al. (2015) cannot be seen as easily transferrable or uniformly applicable approaches to the problem of assessment. As best, for example, the 'PARSIM' template of Seppelt et al. (2012) merely proposes that in describing an ecosystem study one needs to document its Purpose, Scope, Analysis, Recommendations and the methods used for Monitoring its outcomes. Instead it is the procedural aspects of building assessments that need to be emphasised.

To use conceptual frameworks effectively in the context of ecosystem assessment it is worth reflecting in more detail on the different types of purpose to which they are put within the social process that surrounds their construction. In its preliminary documentation IPBES (United Nations,

2012; see also Díaz et al. 2015) suggested that conceptual frameworks could be viewed as having four purposes:

- tools to make complex systems as simple as they need to be for their intended purpose;
- providing support to structure and prioritize work;
- helping to clarify and focus thinking about complex relationships, supporting communication across disciplines, knowledge systems and between science and policy; and,
- allowing buy-in from a variety of stakeholders, by involving them in the development of the framework, and thus increase policy relevance.

While none of these purposes are mutually exclusive, this Chapter has mainly focussed on the last two points which deal more with the tasks of ensuring *engagement* and *advocacy*, than with the more theoretical and methodological dimensions implied by the first two items in this list. The need to represent complex systems 'as simple as they need to be' resonates strongly with the spirit and purpose of using *models* in science, which is fundamentally a theoretical undertaking (Kienast and Helfenstein, 2016, this volume). Whether these models be qualitative or quantitative in character, if they are to be credible then the important point is that they should be *testable* in some way; conceptual frameworks are therefore not altogether arbitrary but ideally based on knowledge which has been or can be critically evaluated. Nor is the point about structuring and prioritising work a theoretical. Problem recognition, together with an understanding what might provide a solution to that problems is essentially conjectural in character. This is especially so when confronted with the kind of complex, 'wicked problems' that surround the interactions between people and nature.

The numbered links between the main elements in the IPBES schema (Figure 1) illustrate just how accepted, theoretical understandings are used to build a conceptual framework. For example, Díaz et al. (2015, p.9) argues that "the evidence so far suggests that causal links between nature and benefits to people [i.e. link 4, Figure 1] are strongly scale-dependent, and also straddle over several scales". Similarly, the proposition in the diagram that intrinsic values and anthropocentric values are separate and distinct is essentially a theoretical one. According to the IPBS framework, intrinsic values "have no relationship with possible benefits to humans or their quality of life", so that they "fall outside the scope of anthropocentric values and valuation methods" (Díaz et al. 2015, p.11). This is a particular theoretical position in the sense that it can be argued that that there can be an overlap between pure anthropocentric and intrinsic values in relation to some cultural ecosystem services (see for example Schröter et al. 2014). Finally, it is also clear that the conceptual framework is used to identify analytical priorities: according to Díaz et al. (2015) in the diagram solid arrows are used to show the principal influences between the elements of concern to IPBES, while the dotted arrows show those recognised as important, but not the main focus of the Platform.

In the context of an ecosystem assessment, the development of a conceptual framework is not therefore a trivial matter, or merely an emblematic task designed to communicate what is distinctive about the particular initiative. Their co-creation is, in a sense, part of the job of defining the scope of a study, and of defining and agreeing the 'boundary conditions' which is a necessary first step in any assessment process (see Figure 2). In this Chapter we have focussed on the work of IPBES, but there are many other assessments could be used to make the same point (see for example the case of the UK National Ecosystem Assessment, UK NEA; Mace et al. (2011). That they play such a key role in assessment exercises in fact clearly illustrates the trans-disciplinary, 'post-normal' character (cf. Funtowicz and Ravetz, 1993) of the 'science of ecosystem services', in which different experts ,

decision makers and publics come together to deal with a common set of issues. While success in this postnormal world depends on the attempt base decisions on evidence in rational ways, sustainable solutions are also dependent on the other types of relationships between the key actors, involving such things as consent, engagement and understanding (Figure 3).

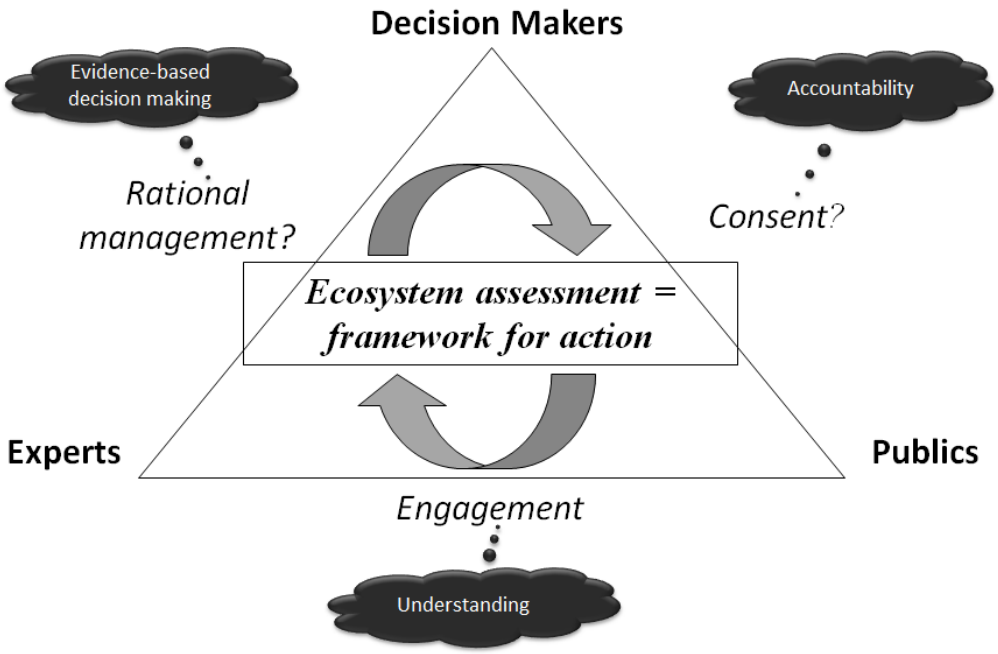


Figure 3: The 'post-normal' character of ecosystem assessments

[a] Operational approaches

Although we have argued that conceptual frameworks are the basis for action, in the sense that they bring experts, decision makers and publics of different kinds together to address a common issue, it is useful to make a distinction between conceptual frameworks themselves and the approaches actually used to 'operationalise' the analysis. While the large and still growing body of literature on the topic makes generalisation difficult, there are at least three generic 'lines of attack' that people have used in practice. For convenience we will describe them as involving a 'habitat', 'systems' or place-based' approach (Potschin and Haines-Young, 2013). While, in considering them, we are clearly focussing on the 'implementation' stages of an assessment (cf. Figure 2), the choice of an approach depends on how participants 'see the world', in terms of their conceptual understanding, and the emphasis they give to particular issues such as the analysis of the status and tends of ecosystem services, trade-offs and scale, and especially the ways people and nature are linked.

[b] Habitat or land cover approaches to ecosystem assessment

The habitat approach is probably one of the most widely used in the assessment community. Essentially it involves viewing the world in terms of ecological habitats and using these units as the basis for looking at the relationship between people and nature. Clearly many different systems for classifying habitats exist, and so the approach covers a broad range of practice. Some assessment exercises choose to think in terms of 'land cover' or 'land use' rather than habitats (see for example

Helfenstein and Kienast, 2014), but fundamentally all employ the same basic tactic, namely of basing the assessment on an 'ecological unit' of some kind.

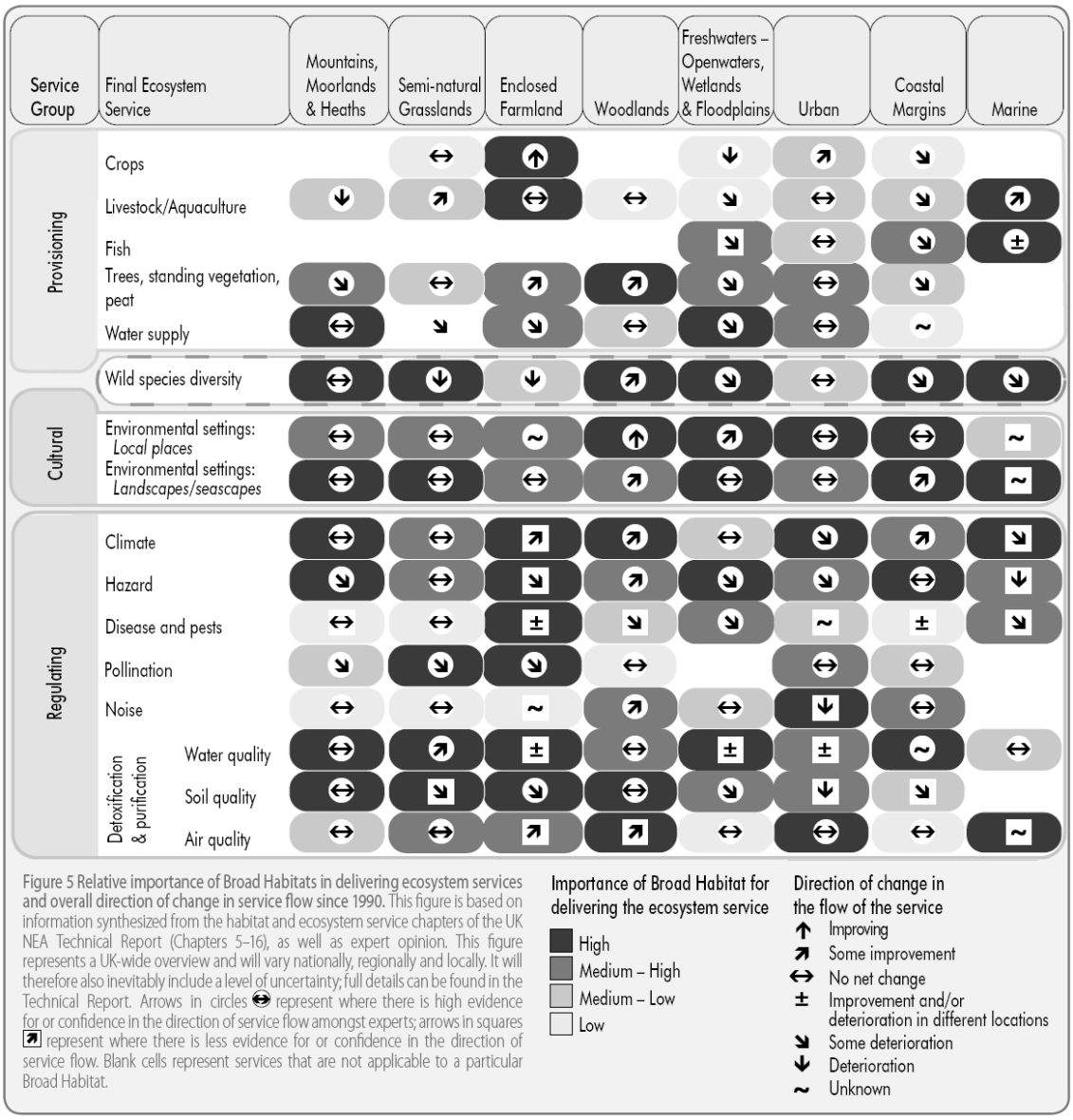


Figure 5 Relative importance of Broad Habitats in delivering ecosystem services and overall direction of change in service flow since 1990. This figure is based on information synthesized from the habitat and ecosystem service chapters of the UK NEA Technical Report (Chapters 5–16), as well as expert opinion. This figure represents a UK-wide overview and will vary nationally, regionally and locally. It will therefore also inevitably include a level of uncertainty; full details can be found in the Technical Report. Arrows in circles represent where there is high evidence for or confidence in the direction of service flow amongst experts; arrows in squares represent where there is less evidence for or confidence in the direction of service flow. Blank cells represent services that are not applicable to a particular Broad Habitat.

Figure 4: Example output based on a habitat approach to assessment from the UK NEA (Source: UK NEA, 2011)

The habitat approach was the one employed in the Millennium Ecosystem Assessment; in this instance the units were 'global biomes'. At the sub-global scale other assessments have begun by identifying biotope or habitat units that are more meaningful at regional, national or local scales. In the case of the UK NEA, for example, the so-called 'broad habitats' as defined by the UK Biodiversity Action Plan formed the basis of the analysis; the choice was determined partly on the basis of available data but also on the policy relevance of the analytical framework. A similar framework was used in Spanish (Spanish National Ecosystem Assessment, 2013); here the selection was based on such things as the need to represent the way 'nature was expressed' at the national scale, links to

the well-being and the 'influence of human control', as well as the need to integrate the classification used into the broader European framework. As a result, this kind of approach generally provides a cross-tabulation of services against the different types of habitat units as a way of expressing the importance of the links between them, as well as such things as the status and trends of services either historically or with respect to some set of scenarios. Figure 4 provides an example of output from the UK NEA.

The habitat approach is clearly an efficient way of organising data and presenting the status and trends of services. The assessment of the links between the assessment units and the services can be based on empirical data or, in the case of the UK NEA, expert judgement informed by the available evidence. The approach is also easily extended in the context of the need to map services, because spatially explicit habitat and land cover data are often widely available. Matrix approaches have been widely employed for mapping and modelling ecosystem services based on land use or land cover data and expert opinion (see for example Maes et al., 2016 and Kienast and Helfenstein, 2016, both in this volume). Jacobs et al. (2015) have made a number of suggestions about how the quality of such methods can be assured by including the confidence of opinions in the matrix, and being clear about whose view is included and what assessment methods were used, as well as information on testing and the reliability of assessments.

Table 1 provides a summary of some of the main advantages and disadvantages of the habitat approach. On the one hand it is valuable methodology because it can emphasise the link with existing nature frameworks and so strengthen the arguments for conserving particular habitats; it is also helpful because it can emphasise their multifunctional character and hence help in understanding the kinds of trade-off between ecosystem services that might arise if habitat change occurs. Such approaches are also useful because they often also make use of existing data resources and add value to them by linking them to other information about the importance to people. The disadvantages of using habitats as assessment units is that, for services that depend on whole landscapes, it is unclear how the different scales relate to each other or how the contributions of that each habitat make to overall output can be determined. In the past a disadvantage of the approach has been that this kind of analysis tends to emphasise the capacity of ecosystems to supply services rather than the societal demand for them, although as Burkhard et al. (2012) have shown this may no longer be the case. These demand-side issues are especially important because one of the major drawbacks of the habitat approach is the difficulty of communicating the ideas to 'the public' who may be unfamiliar with the habitat units used and simply do not 'see the world' in these ways.

Table 1: Characteristics, strengths and weaknesses of three assessment approaches (modified from Potschin and Haines-Young, 2013)

Approach	Characteristic	Advantages	Disadvantages
Habitat based	Assessment of services made on the basis of stock and condition of components of biodiversity, usually habitat, ecotopes or biomes, land cover etc., and potentially their change over time	• Clear links with exiting conservation frameworks and approaches • Multi-functional character of 'ecosystems' evident • Can often make use of existing biodiversity or habitat monitoring data • Focuses more easily on potential (capacity) of ecosystem units to supply a service, although demand orientated methods are now being developed.	• Unclear how different habitats should be weighted to make some overall assessment of services for a region. • Unclear how habitat combinations influence overall service output across whole landscape or land cover mosaics • By focussing on supply side issues, may be difficult to look at societal demand for the service, but methods are being developed to overcome this • Communication of key messages to publics may be difficult because habitats units are unfamiliar
Systems or process-based	Assessment of services is based on structural and functional relationships that determine service output, usually for some defined dynamic process-response unit (e.g., catchment, aquifer etc. or some defined 'service providing unit' that captures key elements of social-ecological system)	• Allows overall assessment of service state and trend to be made • Impacts of alternative assumptions explored easily allowing tests of sensitivity to assumptions and potentially scenario modelling • Generalisation easier, assumptions simpler to test Depending on how process-response unit is defined, may be possible to look at demand and supply balances	• Unclear how issues of multi-functionality can be addressed • Systems modelling is complex and present understandings may be limited—especially in the context of predicting spatial pattern • May be difficult to calibrate and test models at local scales due to lack of data • Not quick… Not cheap…Often assumptions not transparent
Place-based	Services assessed as a bundle across units that have strong social relevance or resonance. Deliberative and temporally sensitive by giving attention to past change.	• Allows better understanding of local contexts, and therefore priorities and values • Can be used to look at patterns of use and demand as well as adequacy of supply of service • Allows issues of trade-offs and any associated conflicts to be identified and potentially resolved, and local scenarios to be examined as part of developing management visions • Allows implications of alternative management of policy options to be tested easily through participatory methods; can support adaptive management approaches • Stimulates social learning • Local buy-in	• Difficult to generalise results because of the uniqueness of place • Difficult to measure or model services at local scales because of uncertainties and lack of base-line data • Needs many different kinds of skills and competences to be combined to accomplish the inter- and transdisiplinary challenges required by the analysis of place • Time consuming • Expensive

[b] A systems approach

In contrast to the habitats approach, more system- or process-orientated methods can be used to make assessments. While the habitat framework seeks to identify way services are generated or used this is often done in an implicit or indicative way and the processes that underpin the service

relationships are often not fully specified. A systems approach generally seeks to provide a more complete picture. Since the topic of modelling ecosystem services is covered elsewhere in this Handbook we will not attempt to provide a complete review here, but mainly to highlight the importance of the general approach as an assessment tool.

A systems approach often involves modelling some quantitative 'ecological' and 'economic' production functions that expresses the way service outputs and benefits vary with changes in the various direct and indirect drivers of change. Jonsson et al. (2015) provide an example of how production functions can be constructed for predicting the impact of land-use impact on biological control of pests by natural enemies. These kinds of tool can be especially helpful in understanding the changes in value that might result from modifications to the different factors that influence service supply and demand, and eventually of characterising 'Service Providing Units' (SPUs) and of identifying and understanding 'Ecosystem Service Providers' (ESPs) (Luck et al. 2003, 2009; Kremen 2005); both broadly refer to the species or other ecological entities that generate services. Model-based approaches are also especially useful in the exploration of future scenarios.

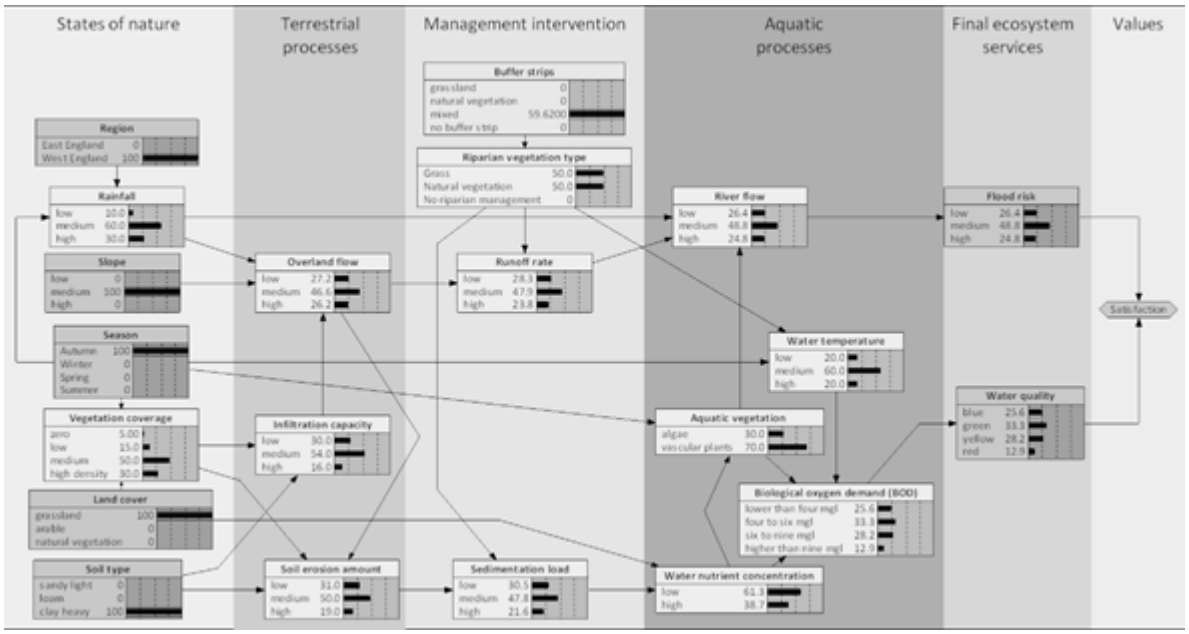


Figure 5: A Bayesian Belief Network model for riparian buffer strip management (McVittie, et al. 2015

Examples of system-based assessments ranging across different scales and issues include the global modelling work done in the context of the scenarios developed during the Millennium Ecosystem Assessment (see for instance Alcamo et al. 2005), the national-scale integrated modelling work done as part of the UK NEA (Bateman et al. 2013, 2014), and the more service specific work illustrated by Lonsdorf et al. (2009) who applied the 'mobile-agent-based ecosystem service' model for modelling pollinators in proposed by Kremen (2007). The work by McVittie et al. (2015) provides an interesting application of modelling approaches based on Bayesian Belief Networks to regulating services provided by riparian buffer strips (Figure 5), which also illustrates the growing trend of recent work

towards more participatory styles of working with systems concepts. The network, which was based on the cascade model (see Potschin and Haines-Young, 2016 this volume), was developed with a range of stakeholders who, through workshops, helped characterise the links between policy objectives, ecosystem services and ecological processes.

The example of the BBN highlights an important issue that is arising through these novel styles of participatory modelling work being done in the context of ecosystem assessments. As McVittie et al. (2015) observe, while the approach is promising we need to better understand the consequences of the trade-offs between realism and precision, on the one hand, and the advantages that collaborative work of this kind brings in terms of shared understandings. Indeed, as we look at the relative advantages and disadvantages of the systems-based approach to ecosystem assessment it is transparency and ease of understanding that probably stands out as one of the major issues (Table 1). While model-based approaches are richer theoretically, than say the habitat approach, and allow the impacts of different assumptions and management options more easily to be explored and modelling is often demanding in terms of time and resources. Key disadvantages are that systems modelling is complex and usually depends on particular skill sets – thus it may not be possible to apply such approaches in every situation – not least because the data needed to calibrate models may not be available at local scales. In addition, unless the models used are complex, then the problem of trade-offs between services may be difficult to address. However, it is interesting to note that integrated approaches are emerging; the example of McVittie et al. (2015) includes both flood and water quality regulation, while that of Bateman et al. (2014) looked at the implications for land cover change for food, timber, greenhouse gas emissions, recreation, water quality and biodiversity.

[b] Place-based approaches

The key assumption of our third approach to ecosystem assessment is that ***context matters***. Thus a place-based assessment is one which seeks to looks at 'bundles' of services in an integrated way, for an area that has some a strong social relevance or meaning. It aims to create an understanding of that place, usually through a deliberative process involving the people who know or use the area. The claim is that by articulating the visions and values of the different groups the significance of past and future change in the ecosystem services associated with that place can be more fully gauged.

As we have argued elsewhere (Potschin and Haines-Young, 2013) the emergence of a place-based approach to ecosystem assessment reflects the increasing emphasis given to trans-disciplinary styles of working, and the need to focus on achieving 'solutions' that are sustainable in social and economic terms, as well as being ecologically sound. It also reflects the need to look at ecosystem services at broader landscape scales. The convergence of thinking from landscape ecology about 'multi-functionality', and that of the assessment community about the ways that within heterogeneous habitat mosaics, trade-offs can occur within bundles of ecosystem services, is a particularly helpful outcome of taking a place-based approach.

The assessment literature contains a growing body of case-study material that illustrates the power and contribution of a place-based approach. For example, Plieninger et al. (2013) have demonstrated the importance of a place-based approach for assessing, mapping, and quantifying cultural ecosystem services at community level for an area of Saxony in Germany, while Palomo et al. (2013) used participatory approaches to map ecosystem service flows to the areas surrounding two protected areas in Spain. Kopperoinen et al. (2014) show how a placed-based approach can be used to look at the contribution that green infrastructure makes to the provision of ecosystem

services around two cities in southern Finland. A further interesting feature of the emerging literature is an acknowledgement of the importance of the place-based approach in the context of marine studies. Kain et al. (2014) for example, has argued that interviews used in conjunction with maps can help identify the 'meaning of place' and greatly facilitate value articulation by stakeholders on North Island, Vancouver, while Levin, and Möllmann (2015) have argued for the importance of a place-based approach within ecosystem based management, in understanding regime shifts in marine systems. These studies suggest that the development off participatory mapping is often a key component of a place-based approach (Brown and Fagerholm, 2014) and offers important entry-point for the analysis of stakeholder perspectives (Raymond et al., 2009). Important operational outcomes include a better understanding of where to target management interventions (Bryan et al. 2010), given the inevitable trade-offs that are likely to occur when dealing with a set of ecosystem services associated with a particular area.

Table 2: Framework and rationale for developing a place-based assessment of ecosystem services (after Potschin and Haines-Young, 2013)

	Question	Rationale
1.	What are the ecosystem services associated with this place that matter to peoples' well-being?	Helps in setting the conceptual and spatial boundaries to the assessment; defines the place of concern
2.	How are these services generated? Do they arise locally or are they generated outside the place or area being considered?	Identification of dependencies and cross-scale issues in relation to the supply of services; helps explore the links between the place of interest and other places
3.	How important is each of these services, to which individuals or groups, and for what reasons? Do people outside the area also depend on these services?	Helps to identify who has a stake in the deliberations about the place and their needs, and develops understanding of the spatial relationships between one place and other places
4.	How can the importance of these services be prioritised or valued?	Opens up discussions about how values should be assessed and compared (e.g., using individual vs community values; monetary vs non-monetary)
5.	Do we expect to have enough of each of these services either here or elsewhere in the future?	Highlights the issues surrounding the notion of living with environmental limits and questions about sustainability of natural capital
6.	What, if anything, could replace or substitute for each of the benefits obtained from these services, either here or elsewhere?	Links to question 4, and further explores the nature of criticality, compensation and substitutability of benefits.
7.	What kinds of management or policy actions are needed to protect or enhance these services and in particular how might actions directed towards one service impact or enhance another?	Helps in understanding the acceptability of management or policy interventions to different stakeholder groups and the identification of potential trade-offs and conflicts and how they might be resolved

Although mapping is an important tool for undertaking a place-based study, as we have emphasised elsewhere, such work has to be undertaken systematically, and is perhaps best done by considering a series of questions that might be explored with stakeholders in any discussions about a particular locality (Table 2). Although these questions will need to be rephrased to take account of the

different languages and understandings in any particular study, and even broken down into simply sub-ask, we suggest that taken as a whole they capture many of the key issues that need to be considered when trying to use ecosystem services to identify what connects people to their environment in a particular place in an holistic way. The rationale for the suggested questions are also set out in Table 2.

The questions shown in Table 2 are designed to elicit both what ecosystem are important and to whom as well as generate an understanding about where they come from. In this respect question 2 is important because it helps establish the spatial context of the particular place being investigated. Clearly maps can be a valuable tool in gathering different stakeholders views on these issues. However, the exploration of the questions about the importance that different individuals or groups attach to services, and whether people feel provision of services is sufficient at present and likely to be so in the future (questions 3, 4 and 5) probably require other deliberative techniques such as monetary and non-monetary valuation and scenarios; the co-construction of a conceptual framework for the assessment may also have a role. Question 6 is designed to examine the values of stakeholders further, by looking at the question of substitutability, while question 7 explores the implications of any management interventions, and especially those that might arise in the context of trade-off and synergies between services.

The advantages of a place-based approach (Table 1) arise from the way it starts from a social perspective rather than a biophysical one, and so allows a better understanding of local contexts which often determine people priorities and values (Kenter, 2016, this volume). There is an explicit focus on looking at the bundle of service provided by a particular locality and so discussions about the implications of trade-offs between service might more easily be had. Such a deliberative approach can stimulate social learning amongst those involved in the discussion and 'buy-in' to the recommendations arising from the assessment. As Haines-Young and Potschin (2014) have shown, agreement on what constitutes evidence and indeed the generation of that evidence by joint-working amongst stakeholders can be an important dimension of building trust in a place-based context. The problems associated with the approach are that while the analysis may work for a particular locality, conclusions are often difficult to transfer to other areas or to develop into generalisations that other might use. Moreover, while it recognised that a focus on a particular place can stimulate stakeholder involvement, lack of local data may undermine the credibility of any outcomes. It is also clear, that even if such data can be found or generated by the place-based process, the approach can be time-consuming and potentially expensive because it may require the involvement of a range of skills and competences to make it successful (see for example, Fish et al., 2016, this volume).

[a] Conclusion

Ecosystem assessments can be undertaken at a range of geographical scales. Whether they are global or local in scope, however, they generally require a conceptual framework of some kind to serve as a platform for discussion and analysis, because assessments are fundamentally a 'social processes'. As this Chapter has shown, conceptual frameworks provide the basis for developing a common understanding of the problems and issues that need to be explored, types of evidence about services and benefits that is relevant, and the way changes in service supply and demand might be valued. Such frameworks show how the science of assessments is done in a social context.

Although there is no single way of doing things, because all assessments are unique, there is a growing body of literature that suggests that some broad generalisations about assessment methods can be made. In this Chapter we have, for example, outlined the 'habitat', 'systems' and 'place-based' approaches to assessment. While they are not mutually exclusive, and can be combined in the context of any particular study, they do start to map out some distinct routes through to understanding of how people and the nature are linked via the concept of ecosystem services. Most importantly, they identify some important strategies for ensuring that, when working with decision makers and publics, the science underpinning ecosystem assessments is not only seen as relevant to people's needs, but also accepted as a credible and legitimate source of evidence in public debates.

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