Intermediate and Supporting Ecosystem Services: Empty Concepts?

Marion Potschin-Young[1] (Fabis Consulting Ltd., UK); Bálint Czúcz (MTK OK, Hunagry), Camino Liquete (JRC, EC); Joachim Maes (JRC, EC); Garciela Rusch (NINA Norway) and R. Haines-Young (Fabis, UK)

Introduction

The terms 'intermediate' and 'supporting' ecosystem services are widely used in the literature as ways of indicating specific ecological characteristics that in one way or another underpin the output of a 'final' ecosystem service. Such usage is consistent with some widely-used definitions of what ecosystem services are, including, for example, that of TEEB[2]; use of the term 'intermediate' is also in line with the observation that what constitutes a final service may be context specific. In this note we consider whether the conceptus of supporting and intermediate ecosystem services are useful in describing the phenomena that underpin ecosystem services, and suggest some alternative perspectives that are now evident in the literature.

By way of illustrating the notion of an intermediate service, a classic example; is provided by Boyd and Banzaf (2007). They cite the case of the quality of a water body, which could be regarded as a direct, final service if the water is used as drinking water. However, from the perspective of *recreational angling*, clean water is an 'intermediate' component that contributes to this benefit through the final service of *fish population* that more directly contribute to the activity of fishing.

Analysis and a discussion

That ecosystem services are underpinned by a number of ecological components is not in dispute here. Rather, the issue concerns the difficulty of using the concepts of intermediate and supporting services *analytically*. For example, those using the terms rarely specify what makes a service 'supporting' or 'intermediate', and since both make 'indirect' contributions it is difficult to really see the difference between them. Moreover, since all ecological structures associated with a particular ecosystem can probably be said to contribute to a number of services 'indirectly' there seem to be no more than catch-all terms for the characteristics and behaviours associated with a particular ecological situation. Thus, one may ask what characteristics and behaviours of ecosystems would not be covered by the terms 'supporting' and 'intermediate' services? We suggest the terms are perhaps more to do with economists avoiding the problem of 'double counting' in valuation than of describing real ecological phenomena.

In terms of defining 'intermediate ecosystem services' more tightly, and as explained in the example by Boyd and Banzaf (2007), it could be argued that these are services which can either have a final or underpinning role, depending on the circumstances. However, the problem here is not simply one of

[1] Email contact: Marion.Potschin@fabisconsulting.com

[2] http://www.teebweb.org/resources/glossary-of-terms/

labelling, because the specifics of the ecological phenomena apparently covered by the same term change, depending on whether they have an intermediate or final role. In the case of water quality, for example, the physical and chemical characteristics of the water body that makes it suitable for drinking purposes are not necessary the same as those that contribute to the benefit of angling. To say that we are somehow looking at the 'same thing' in a different context (as in Figures 2-5 of Saarikoski et al., 2015, for example) seems to obfuscate our understanding of the biophysical conditions necessary for different kinds of service.

The case of 'pollination' further illustrates the importance of making the distinction between a 'final' service and what underpins it ecologically. Boyd and Banzaf (2007) argue that pollination is an ecosystem function and the final service is the *delivery of sexually viable pollen to the crop each season*. In other words, there is a distinction between the population and community dynamics of the service providing fauna (pollinators) and their activities (pollination) in relation to crops that contribute to human well-being in particular contexts. Pollination is therefore not something that can be a 'final' or 'intermediate' service depending on circumstances, rather its status as a final service depends only on whether it benefits people in terms of sustaining or increasing yields. In fact, the case of 'pollination' is especially interesting to consider since some would argue that the final service is actually the increase in *crop yield* brought about by the activity of pollinators through the delivery of sexually viable pollen. We would suggest that whatever position is taken, the same point emerges, namely that what is construed to be the final output from the ecosystem is *fundamentally different* from the ecological phenomena that underpins it; we are not looking at a 'final service' in some kind of underpinning role.

The need to understand the particular ecological capacities that give rise to a final service, and how variations in these capacities affect the level of service output, is captured in the notion of an 'ecological function' in the cascade model (Potschin and Haines-Young, 2016). While the concept of an ecological function has been challenged because of the different meaning associated with the term (e.g., Jax, 2016; Wallace, 2007), it does at least have the merit of encouraging people to identify the *pre-conditions* required for a service (or a set of services) to be generated. Jax and Wallace both feel that the term 'function' is unnecessary, and that we simply need to understand the ecological structures and processes that characterise a given ecosystem. Whatever set of labels is used, however, we would argue that it is helpful to identify the sets of ecological components and their associated states that are associated with particular services because we might then be better placed both to manage them and understand how synergies and trade-offs arise within bundles of services (Berry, P., 2016; Rusch et al., in press). It is also important practically to recognise the distinction between these functional characteristics and the more general ecological structures and processes that give rise to them. Consider, for example, the case of woodlands. The ecological characteristics that determine the capacity of a forest stand used for timber are not necessarily the same as those that affect its suitability for the regulation of mass movements or its use as a cultural setting for recreation. None of these characteristics are 'services' in the sense implied by the notion of 'intermediate services', nor are they some general set of ecological structures and processes associated with a particular ecosystem, as implied by the notion of 'supporting services'. We suggest that to understand how services arise, then it is useful to distinguish between what determines these capacities as clearly as we can, and that the notion of an 'ecological function' is helpful in this respect. The richness of the literature on functional traits and the insights it provides on the capacities of ecosystems to generate different ecosystem services (e.g., de Bello et al., 2010; Lamarque et al., 2014; Lavorel et al., 2011) further illustrates the need to be clear about what constitutes these 'underpinning' elements.

The science of ecosystem services is clearly more than an argument about definitions and terms. Labels are, however, important insofar as they help us distinguish things in ways that provide insights into the mechanisms that underpin ecosystem services. They are also important to consider in situations where different disciplines come together – because they might denote quite different ideas. In the case of ecosystem accounting, for example, 'intermediate ecosystem services' specifically denote the flows *between ecosystem assets*, that is when the outputs of one ecosystem accounting unit is an input to another (UNSD, 2017). The analogy here is with the intermediate production of goods and services in the economy as opposed to those consumed or enjoyed by people or households. The ecological equivalent might be the example of migratory species which breeds in one location but provides a cultural service elsewhere (cf. Semmens et al., 2011); in accounting terms pollinators could also be seen as providing 'intermediate ecosystem services' if the move between ecosystems. However, in the accounting context, the term does not include the underpinning elements *within* an ecosystem, which is described by the ideas of 'capacity' or 'condition', which refer to the various structures processes that determine the ability of an ecosystem to generate services (European Commission, 2016). Although the concept of ecosystem condition and how to measure it is still an active area of debate[3], the focus of thinking is sufficiently well aligned with ideas about the functional characteristics that underpin ecosystem services to suggest that they are largely congruent. Significantly, we suggest, these ideas have more content than the loosely framed notions of intermediate and supporting services as currently used outside the accounting literature.

Recommendations

The lesson we draw from current general usage is that terms such as 'intermediate' and 'supporting' ecosystem services tend to obscure rather than clarify issues about the capacities and preconditions necessary for service output. In a strict sense, all ecosystem services are final – otherwise they would not be a service – and notions of intermediate and supporting services are simply misnomers. We suggest, therefore that they are best avoided as rather empty concepts – or at least used in a more qualified and specific way. As the field of ecosystem services enters a mature phase where applications need to be rigorously grounded on evidence, it is important that we are precise about what we measure and how those metrics inform our understanding of the ways ecosystem services are generated and sustained (Czúcz et al., submitted, manuscript ECOSER_2017_230). As we test and hone our concepts, terminology has to move on.

References

Boyd, J. and S. Banzhaf (2007): What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics* 63(2): 616-626.

de Bello, F., Lavorel, S., Díaz, S., Harrington, R., Cornelissen, J. H., Bardgett, R. D., ... and P.A. Harrison (2010). Towards an assessment of multiple ecosystem processes and services via functional traits. *Biodiversity and Conservation* 19(10): 2873-2893.

Berry, P., Turkelboom, F., Verheyden, W. and Martín-López, B. (2016): Ecosystem Services Bundles. In: Potschin, M. and K. Jax (eds): *OpenNESS Ecosystem Services Reference Book*. EC FP7 Grant Agreement no. 308428. Available via: www.openness-project.eu/library/reference-book

[3] We suggest that while the terms have a degree of congruence, measures of ecosystem 'condition' should be used to refer to general descriptors of the status of an ecosystem (what some have called 'supporting services', e.g. biomass production, nutrient cycling), whereas 'capacity' measures are used more specifically to denote the functional characteristics of the system that underpins a particular ecosystem service (and what are sometimes confusingly referred to as 'intermediate' services).

Czúcz, B, Arany, I, Potschin, M, Bereczki, K, Kertész, M, Kiss, M, Aszalós, R, and R Haines-Young (submitted): Where concepts meet the real world: a systematic review of ecosystem service indicators and their classification using CICES. Ecosystem Services, submitted.

European Commission (2016): Report on phase 1 of the knowledge innovation project on an integrated system of natural capital and ecosystem services accounting in the EU (KIP-INCA Phase 1 report). Public version: 15 September 2016. Available from: http://ec.europa.eu/environment/nature/capital_accounting/index_en.htm

Jax, K. (2016): Ecosystem functions: a critical perspective. In: Potschin, M., Haines-Young, R., Fish, R. and R.K. Turner (eds): *Routledge Handbook of Ecosystem Services*. Routledge, London and New York, p. 42-44.

Lamarque, P., Lavorel, S., Mouchet, M. and F. Quétier (2014): Plant trait-based models identify direct and indirect effects of climate change on bundles of grassland ecosystem services. *Proceedings of the National Academy of Sciences* 111(38): 13751-13756.

Lavorel, S., Grigulis, K., Lamarque, P., Colace, M. P., Garden, D., Girel, J., ... and R. Douzet (2011): Using plant functional traits to understand the landscape distribution of multiple ecosystem services. *Journal of Ecology* 99(1): 135-147.

Potschin, M. and R. Haines-Young (2016): Defining and measuring ecosystem services. In: Potschin, M., Haines-Young, R., Fish, R. and R.K. Turner (eds) *Routledge Handbook of Ecosystem Services*. Routledge, London and New York, pp 25-44.

Rusch, V.E., Rusch, G.M., Goijman, A., Varela, S., and L. Claps (in press): Ecosystem services to support environmental and socially sustainable decision-making. Ecología Austral.

Saarikoski, H., Jax, K., Harrison, P. A., Primmer, E., Barton, D. N., Mononen, L., ... and E. Furman (2015): Exploring operational ecosystem service definitions: The case of boreal forests. *Ecosystem Services* 14: 144-157.

Semmens, D.J., Diffendorfer, J.E., López-Hoffman, L. and C.D. Shapiro (2011): Accounting for the ecosystem services of migratory species: quantifying migration support and spatial subsidies. *Ecological Economics* 70(12): pp.2236-2242.

UNSD (2017): SEEA Experimental Ecosystem Accounting: Technical Recommendations. Consultation Draft. V4.1: 6 March 2017. Prepared as part of the joint UNEP / UNSD / CBD project on Advancing Natural Capital Accounting funded by NORAD. Available from: https://unstats.un.org/unsd/envaccounting/eea_project/TR_consultation/SEEA_EEA_Tech_Rec_Consultation_Draft_II_v4.1_March2017.pdf

Wallace, K. J. (2007): Classification of ecosystem services: problems and solutions. *Biological Conservation* 139(3): 235-246.

Note: The paper has been submitted as a short communication to the Journal of Ecosystem Services (Manuscript number ECOSER_2017_262) and is at the time of publishing the Synthesis Paper under review.

Suggested Citation: Potschin-Young., M.; Czúcz, B.; Liquete, C.; Maes, J.; Rusch, G. and R. Haines-Young: Intermediate and Supporting Ecosystem Services: Empty Concepts? In: Potschin, M. and K. Jax (eds): OpenNESS Ecosystem Services Reference Book. EC FP7 Grant Agreement no. 308428. Available via: http://www.openness-project.eu/library/reference-book

Acknowledgements: The research leading to these results has received funding from the European Commission Seventh Framework Programme under Grant Agreement No. 308428 (The OpenNESS project; Operationalisation of natural capital and ecosystem services: from concepts to real-world applications). We also acknowledge the input from all participants from the session on "Classification of Ecosystem Services" held at the OpenNESS project Meeting in Leuven, October 2015.