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Vaz, AS, Selomane, O, Jones, L et al. (5 more authors) (2021) The journey to monitoring ecosystem services: Are we there yet? Ecosystem Services, 50. 101313. ISSN 2212-0416

https://doi.org/10.1016/j.ecoser.2021.101313

The journey to monitoring ecosystem services: Are we there yet?

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Abstract

The Group on Earth Observations Biodiversity Observation Network (GEO BON) was established to promote and provide guidance toward a global observation network on biodiversity and ecosystems for decision makers and the scientific community. Here we comment on three key challenges in the development and implementation of monitoring schemes and indicators of ecosystem services (ES): (1) combining ES observations, data and methods across scales; (2) identifying operational ES metrics that consider the interactions between people and ecosystems; and (3) integrating the diversity of socio-cultural values and knowledge into monitoring activities. We discuss these challenges with the goal to stimulate the ES research community to help tackle these focus areas in ES monitoring.

Keywords

Earth observations; Indicators; Local knowledge; Observation systems

1. Global monitoring of ecosystem services

The protection and sustainable use of ecosystem services (ES) are at the heart of human prosperity. This is the focus of national and international initiatives, including the 2030 Agenda for Sustainable Development, the Decade of Ocean Science for Sustainable Development, the Decade on Ecosystem Restoration, and post-2020 action on the Convention on Biological Diversity (Geijzendorffer et al. 2017; Wood et al. 2018). For these initiatives to succeed, effective monitoring (*sensu* Chapman 2012) is needed to assess condition and trends of biodiversity and ES in all their dimensions.

The Ecosystem Services group within the Group on Earth Observations Biodiversity Observation Network (GEO BON ES) seeks to contribute to a standardised, interoperable indicator platform linking databases and information resources to advance ES science and policy implementation. Considerable conceptual progress has been made in designing monitoring schemes for ES (Karp et al. 2015; Tallis et al 2012; Cord et al. 2017). However, difficulties remain in developing the functional indicators necessary to make this vision operational. In this commentary we outline three key challenges to stimulate the ES research community to tackle those focus areas.

2. Monitoring ecosystem services: a challenge of three tales

2.1. Challenge 1 – Combining observations and data across scales

Advances in satellite sensors and computing power have improved our ability to quantify many aspects of ecosystem functioning at the global level (such as primary production on land and water; Baccini et al. 2017). Nonetheless, there are disparities between satellite and model-derived data at global scales and the ES experienced at local scale (Ramirez-Reyes et al. 2019). Management actions are often made locally, and the resulting changes in ES are not easily assessed at larger scales. Some ES indicators (e.g., use of non-timber forest products) are only meaningful at specific scales, and depend on social information at those scales (see Challenge 2). Also, data are often collected with different protocols, lack minimum metadata requirements, or are not publicly available. It is therefore necessary to assess the temporal and spatial scales at which data are most useful for decision-making. Devising protocols that facilitate harmonised data collection is essential to achieve greater use of local data for benchmarking and validation of regional and global ES data products.

2.2. Challenge 2 – Identifying indicators that expand ecological considerations to include people

ES have both ecological and social dimensions (Jones et al. 2016; Potschin-Young et al. 2018), which broadly include: (1) ecosystem supply or provision, i.e., the capacity of ecosystems to provide ES; (2) anthropogenic contribution to ES flows, including knowledge, time, capital, materials, and technology; (3) human demand or needs for ES; and (4) the actual benefits and values of nature to people (see Challenge 3). ES monitoring has typically taken a biophysical approach (i.e., focused on supply), and efforts are needed to make the social dimension more prominent. Socio-economic and health data, from population census or global observatories (e.g., those promoted by the World Bank), are increasingly applied to quantify ES demand and use (e.g., Balbi et al. 2019). It is essential to raise effort in identifying essential social metrics of ES and improve socio-ecological links (Olander et al., 2018). This requires harmonisation (and often anonymisation) of data through collection and reporting procedures.

2.3. Challenge 3 – Integrating socio-cultural values and local knowledge to guide applications

Social and cultural values, including the preferences and principles that groups or individuals hold in relation to ecosystems are central to ES (Chan et al., 2018; Kenter et al. 2015). Indigenous and local knowledge, as the cumulative and place-based body of knowledge about nature tied to local communities and transmitted through generations, is increasingly prominent in the ES agenda (Lam et al. 2020; Díaz et al. 2018). However, reconciling socio-cultural values and local knowledge in a coherent framework that is useful for ES monitoring represents a challenge (Scholte et al. 2015). Socio-cultural values and local knowledge are context-specific and can be difficult to quantify and hard to upscale (Kenter et al. 2015; Lam et al. 2020). Driving interdisciplinary collaboration would facilitate greater understanding of ES socio-cultural meanings and guide the collection of necessary information at appropriate scales, to derive generalisable and scalable socio-cultural metrics for ES monitoring.

3. Moving forward with a global monitoring platform for ecosystem services

The idea of a global monitoring platform for biodiversity and ecosystem services has long inspired research efforts and initiatives (e.g., Global Biodiversity Information Facility/GBIF; Ocean Biodiversity Information System/OBIS). Before this idea can become operational, we emphasise the need for: (1) harmonising the plethora of ES initiatives, data and methods through tools, guidelines, and workflows that improve interoperability across scales; (2) identifying essential metrics for ES that capture biophysical and human dimensions and their links; and (3) including socio-cultural values in monitoring activities through generalisable and scalable procedures. We call for the ES community to develop guidelines and protocols to enable holistic, interoperable, and useful monitoring of ES as this is needed to stimulate fair, efficient, and sustainable development.

Acknowledgements

This work contributes to the GEO BON Working Group on Ecosystem Services. The authors thank the participants of the hands-on meeting on “Monitoring Ecosystem Services: From local to global” of the GEO BON Open Science Conference 2020 who inspired the ideas in this manuscript. Funding: ASV acknowledges support from Ministerio de Ciencia, Innovación y Universidades (Spain) through the 2018 Juan de la Cierva-Formación program [reference: FJC2018-038131-I] and from FCT - Foundation for Science and Technology through the program Stimulus for Scientific Employment - Individual Support (reference 2020.01175.CEECIND); FMK and EM acknowledge support of the NASA Applied Sciences Office, Biodiversity & Ecological Forecasting Program [NASA Grant: 80NSSC20K0017], and of the NOAA US Integrated Ocean Observing System [IOOS; NOAA/ONR Grant: NA19NOS0120199], to support for the Marine Biodiversity Observation Network (MBON). FMK and EM also received support from the National Science Foundation (NSF Award No. 1728913) and the Gulf of Mexico Coastal Ocean Observing System (GCOOS).

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