

**SPECIAL FEATURE (REVIEW)****Marine ecosystem services: Ecological, socioeconomic and cultural sustainability**

Linking Ocean's Benefits to People (OBP) with Integrated Ecosystem Assessments (IEAs)

Andrea Belgrano^{1,2} | Sebastián Villasante³

¹Department of Aquatic Resources, Institute of Marine Research, Swedish University of Agricultural Sciences, Lysekil, Sweden

²Swedish Institute for the Marine Environment (SIME), University of Gothenburg, Gothenburg, Sweden

³Department of Applied Economics, University of Santiago de Compostela, Santiago de Compostela, Spain

Correspondence

Andrea Belgrano, Swedish University of Agricultural Sciences, Department of Aquatic Resources, Institute of Marine Research, Turistgatan 5, SE-453 30 Lysekil, Sweden.
Email: andrea.belgrano@slu.se

Abstract

The fundamental challenge of the inclusion of the human dimension of the oceans in the Integrated Ecosystem Assessments (IEAs) provides an opportunity for a transdisciplinary approach to create synergies between the current research by the International Council for the Exploration of the Sea (ICES) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). We have highlighted the importance of ocean inequality as a critical aspect to consider to unlock current barriers to integrate social sciences in marine integrated assessments. To create bridges between them, we develop an Ocean's Benefits to People (OBP) framework that embraces the blue economy, equity, the UN SDGs goals and support an Ecosystem-Based Management (EBM) for the oceans.

KEYWORDS

ecosystem functioning, Integrated Ecosystem Assessments (IEAs), marine social-ecological-systems (SES), ocean equity, Ocean's Benefits to People (OBP)

1 | INTRODUCTION

Human always has benefited from marine ecosystems, either obviously in the form of food resources, or more subtly in the form of cultural and recreational opportunities (Daily, 1997). Oceans provide benefits that humans obtain from ecosystems that support, directly or indirectly, their survival and quality of life on the Planet, which also contribute to the development of the global economy and societies (Peterson & Lubchenco, 1997; Rivero & Villasante, 2016; Steffen et al., 2015). Globally, the economic value of key ocean assets has been estimated at USD24 trillion and the value of derived services between USD1.5 and USD6 trillion per 5 years (OECD, 2016). Human coastal communities, native and non-native, around the world, often define their identities in relation to the sea (Chan et al., 2012). Cultural practices

reflect physical and cognitive interactions between humans and nature, enabling benefits provided by ecosystems and their services through the development of, for example, identities, capabilities and experiences (Garcia Rodrigues, Conides, Rivero Rodriguez, et al., 2017; Rodriguez & Villasante, 2016).

However, the human impact on the ocean has increased dramatically over the past decades (Belgrano & Fowler, 2013; Rocha, Ylteyinen, Biggs, Bleckner, & Peterson, 2014; Westley et al., 2011) driven by the demands of a global growing economy contributing to an unprecedented global decline of marine living resources, marine habitats and ecosystem functioning (IPBES, 2019). This resulted in the potential reduction of Nature's Contributions to People (NCP) as necessary benefits for sustaining life for future generations that are directly dependent on viable ocean resources (IPBES, 2019) and a

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global ocean biomass decline with climate change (Lotze et al., 2019). As a consequence, challenging social sciences in general and inequality, in particular, represent a direct threat to achieving global sustainability and prosperity (Hoegh-Guldberg et al., 2019). With a new narrative to heal the oceans and the UN Decade of Ocean Science for Sustainable Development set to begin in 2021 (Lubchenco & Gaines, 2019), an interdisciplinary approach that use social sciences to tackle ocean inequality, here defined as the way marine resources are distributed and the distribution of rights and capacity for participation in decision making, is critical to unlock current barriers to integrate social sciences in marine integrated assessments.

Ecosystem services assessments would be largely benefited by systemic analysis of long-lasting social and economic inequalities including structural (e.g., inequality difficult to change) and nonstructural (e.g., due to external shocks) that will contribute to the analysis of stability and resilience of marine social–ecological dynamics. An important challenge is to develop a framework which will use to guide research and answer the key research question about unequal distribution of ocean benefits in the context of increasing impacts of biodiversity loss, climate change, the unequal ownership of capital and concentration of capital assets which affect seafood market power (Villasante et al., 2017).

The impacts of human activity on marine biodiversity, linking Ecosystem Services (ES) and their social and economic consequences, needs to be evaluated and assessed to understand and highlight the trade-offs between conservation measures and policy actions aimed to reverse the current marine biodiversity loss and pressures on ecosystems function. Previous assessments linking the state and trends of biodiversity and ecosystem services (MEA (Millennium Ecosystem Assessment), 2005, Lucas, Kok, Nilsson, et al., 2015) have pointed out the urgency of this knowledge gaps necessary for the implementation of sustainable and holistic management actions to conserve biodiversity. In the light of competing economic interests from different sectors (e.g., industrial, commercial artisanal and recreational fisheries, aquaculture, coastal tourism, etc.), marine and coastal ES can be valued in quantitative terms using metrics such as monetary value or health value or in qualitative terms, which will always be nonmonetary and usually have some consideration of health, sociocultural, or conservation value including Indigenous and Local Knowledge (ILK) perspectives. In the current implementation of policy decisions, the valuation of ecosystem from a multi-stakeholders' perspective is lacking despite the many available ways to assess this aspect also considering the ILK perspective.

The Integrated Ecosystem Assessments (IEAs) approach provides an opportunity for transdisciplinary integration of knowledge that embraces the NCP concept (Díaz, Demissew, Carabias, et al., 2015; Díaz, Pascual, Stenseke, et al., 2018) to provide a link to the human dimension of marine ecosystems, in particular, with ocean equity. Inequality is one of the key major social challenges of our time, with far-reaching implications for human well-being (Piketty & Saez, 2014). Concerns also arise because income and wealth inequality, having largely fallen from the 1920s until the early 1980s, have since then been rising. The most recent World Social Science Report also identified rising inequality as a major concern for the sustainability of economies, societies and communities and called for urgent research to improve our understanding of inequality (UNESCO, 2016).

There is overwhelming evidence that current access, use and distribution to marine resources are distributed inequitably (Wynberg & Hauck, 2014). Although some researchers have explored ocean equity (Bennett, Cisneros-Montemayor, Blythe, et al., 2019; Bennett, Roth, Klain, et al., 2017; Friedman, Law, Bennet, et al., 2018; Kittinger, Teh, Allisson, et al., 2015), there are significant gaps. First, interdisciplinary approaches incorporating ecological and social sciences are fundamental to address transformative adaptation to ocean inequality, but lacking. Second, there is a large vacuum of data on different inequalities at seas both in small-scale and industrial fisheries. Third, more than 4.3 billion people globally, especially in the developing world, rely on fish as their major source of protein (Da Silva, 2014), but social, cultural and health factors which explain oceans inequalities remain largely unknown.

2 | LINKING OCEAN'S BENEFITS TO PEOPLE TO INTEGRATED ECOSYSTEM ASSESSMENTS

The International Council for the Exploration of the Sea (ICES) is currently engaged in developing IEAs for several ICES ecoregions in Europe, to synthesize and evaluate information on different ecological, economic and social drivers and pressures affecting marine ecosystems functioning (ICES, 2016). It is also recognized the need to integrate the human dimension in IEAs as part of the ongoing development and implementation of an Ecosystem-Based Management (EBM) for the oceans. Recently, the work developed by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) provides a novel approach for the integration of a wide range of knowledge around biodiversity (IPBES, 2019), and the importance to integrate social

drivers with the provision of ecosystem services (Robards, Schoon, Meek, & Engle, 2011). For example, Díaz et al. (2018) perspective on how to assess NCP suggests the need to embrace a transdisciplinary approach that takes into account diverse source of knowledge and cultural background including ILK, necessary for improving our capacity to understand the trade-offs between conservation measures, policy and governance. To illustrate the integration of the social sciences in IEAs, here we provide, for the first time, an example for the Bay of Biscay and Iberian Waters ecoregion (Figure 1), on how current IEAs approaches can be further developed to embrace the human dimensions of marine ecosystems by linking the NCP concept (Díaz et al., 2015, 2018) for promoting synergies and transformative changes (Díaz et al., 2019) and valuing NCP (Pascual et al., 2017) toward ocean equity. The important pressures in the Bay of Biscay and Iberian coast ecoregion are the selective extraction of species, abrasion, smothering, substrate loss and nutrient and organic enrichment. These pressures are linked mainly to human activities such as fishing, aquaculture, coastal construction, land-based industry,

maritime transport, agriculture, dredging and offshore structures (ICES, 2019).

In recent years we have observed the implementation and operationalization of IEAs approaches (DePiper, Gaichas, Lucey, et al., 2017; Levin et al., 2014), progressing the transition towards sustainable European fisheries, in line with the Common Fisheries Policy (CFP), the Marine Strategy Framework Directive (MSFD), the Maritime Spatial Planning directive (MSP) and UN Sustainable Development Goals as required by the 2030 European Agenda for sustainability (EU, 2019). However, there is an urgency to integrate the IEAs concept with the conceptual framework of NCP proposed by the recent IPBES Global Assessment (IPBES, 2019).

In Figure 1, we extend the central concept of IEAs, linking drivers, enabling conditions of marine social-ecological systems (SES), human activities (e.g., aquaculture, fisheries, tourism, etc.) to pressures and state by including the need to develop the IEAs concept to include specific multiple drivers and to the ocean benefits, including intrinsic, relational instrumental values of ES and the ILK perspective (Díaz et al., 2019; Pascual et al., 2017).

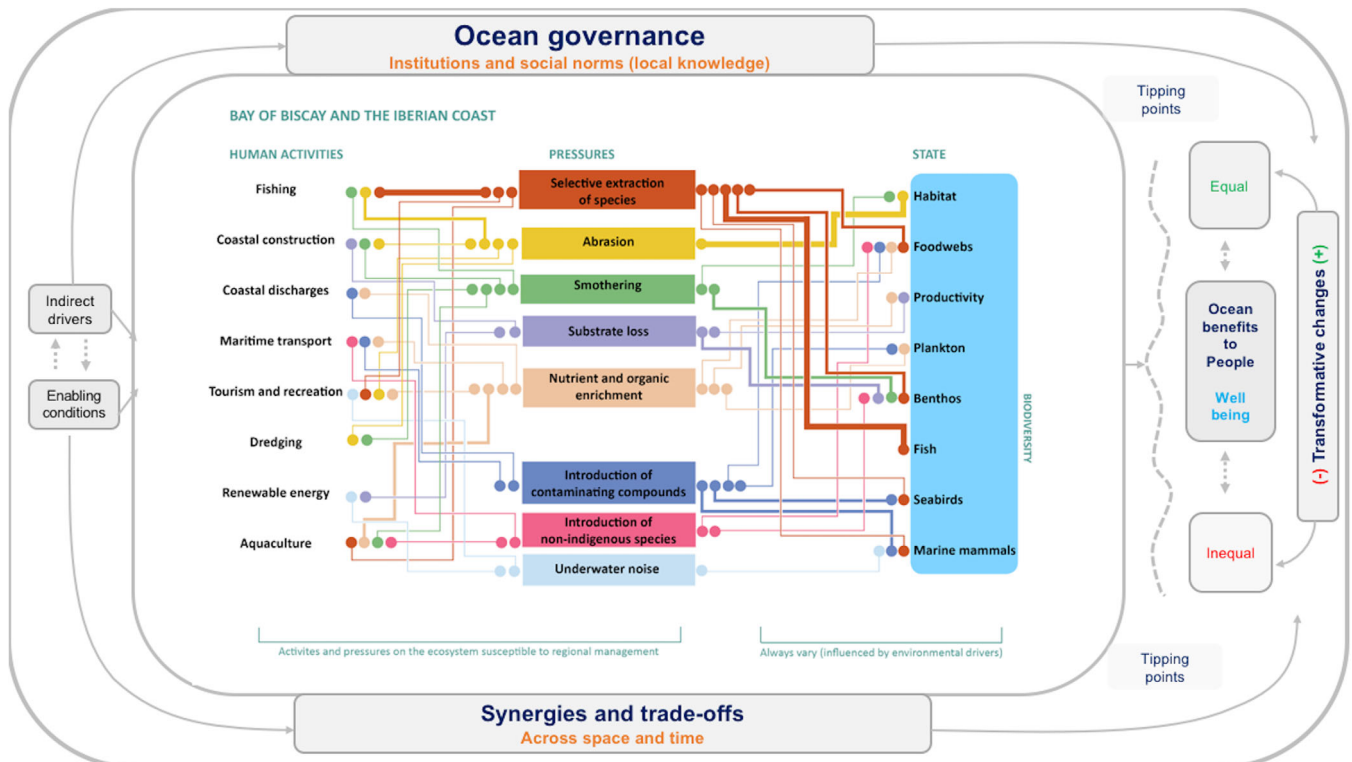


FIGURE 1 A transdisciplinary conceptual framework for an Integrated Ecosystem Assessment (IEA) for the Bay of Biscay and the Iberian Coast ecoregion—Ecosystem overview, indicating the major regional pressures, human activities and ecosystem state components. The solid gray arrows indicate the needs to establish links to multiple indirect and direct drivers, enabling conditions and to the Ocean's Benefits to People (OBP) and human well-being linked to transformative changes, the dashed gray arrows indicate the importance to consider tipping points and the resilience of the marine ecosystem. The OBP concept is part of a dialogue for moving towards ocean governance and sustainability based on the IPBES Nature's Contributions to People (NCP) concept (Adapted from Díaz et al. (2015) and ICES (2019)) [Color figure can be viewed at wileyonlinelibrary.com]

By combining the enabling conditions, the characteristics of marine SES, local and distal direct (e.g., changes in sea use, direct exploitation of organisms, climate change, pollution and invasion of alien species) and indirect (such as rapid human population growth, unsustainable production and consumption and associated technological development) drivers affecting ecosystems (IPBES, 2019), our Ocean's Benefits to People (OBP) framework allows understanding how a SES might evolve from original state to another across space and time. Enabling conditions, in the form of social norms, program of measures and legal regimes, need to be supported by national and municipal governance, to empower community-based successful management actions, both in time and space, toward sustainability, as, for example, in small-scale fisheries (SSF) where identified as key factors (Villasante et al., 2017). On the contrary, inhibiting conditions usually hinder transformative changes and act as barriers to avoid social transformations. For example, inadequacies associated with using MPAs as a fisheries management tool can also be exacerbated by a failure to successfully manage surrounding fisheries (Villasante et al., 2017).

In addition, identifying tipping points and transformative changes are extremely useful to detect early signals of marine regime shifts, traps or collapses, which in turn help to create windows of opportunities to successfully navigate into new safe and equal transitions and states of marine SES before tipping points are crossed (Biggs, Carpenter, & Brock, 2009). Considerable efforts to reverse such changes are usually made, but most of them are highly expensive since they are taken after regime shifts or collapses take place, which also help to create new windows of opportunities to successfully navigate into new safe and equal transitions and states of marine SES before tipping points are crossed (Grafton, Doyen, Béné, et al., 2019).

A distinction is also usually made between adaptation and transformation understood as different responses to uncertainty and change in SES (Folke, Carpenter, Walker, Scheffer, et al., 2010). Given that conventional adaptation may not be always effective at protecting people and ecosystem to reduce their vulnerabilities to anthropogenic pressures, transformation is required when there is a need to create a fundamentally new system because ecological, economic, or social structures make the existing system untenable, that is, to embark on a new trajectory refers to these changes (Bennett, Peterson, & Gordon, 2009; Walker, Holling, Carpenter, & Kinzig, 2004; Westley et al., 2011). For example, transformative adaptation aims to reduce the root causes of vulnerabilities to climate change (Adger, Dessari, Goulden,

et al., 2009, Future Earth, 2015, Kates, Travis, & Wilbanks, 2012.). In the reviewed literature, transformative adaptation has been mainly described with specific terminology and different emphasis depending on the social or ecological disciplinary perspective used (Fedele, Donatti, Harvey, Hannah, & Hole, 2019). To simplify, a transformative change from one state (equal) to another (inequal) (or vice versa) is represented (Figure 1), but marine SES are constant cycles of social innovations, adaptations and transformative changes. Cycles length will depend on several factors such as the duration of the presence of a driver, the time needed to users and governance system to respond and adapt to changes and the characteristics of species targeted (Selig et al., 2017).

3 | OUTLOOK

The fundamental challenge of the inclusion of the human dimension of the oceans (Link, Thébaud, Smith, et al., 2017) in the IEAs provides an opportunity for a transdisciplinary approach to create synergies between the current work of ICES and IPBES to specifically develop an OBP framework that embraces the blue economy, equity and the UN SDGs goals (notably 1–5, 8–15, 16 and 17). The rhetoric of a “Blue Economy” that would combine economic growth with sustainable uses of marine resources is increasingly finding its way into the national and international agendas and policies (Claudet et al., 2020). Yet this is unfolding in a complex and uncertain governance seascape, and concerns have been raised over conflicting interpretations of what the blue economy really entails, and who it is supposed to benefit (Cisneros-Montemayor et al., 2019). The OBP framework we propose here presents significant advances that go far beyond the state of the art by (a) defining a set of unifying enabling conditions and multiple drivers which helps to catalyze governance strategies and transformative changes towards safe and equal marine SES, (b) analyzing aquaculture, industrial and small-scale fisheries and (c) providing the conditions for which quantitative and qualitative information (e.g., catches, prices, number of vessels, etc.) can be used to help policy makers to monitor short and long-term trends of marine SES over time.

From a science-policy perspective, the OBP framework can provide robust new evidence for marine SES in Europe and the globe regarding the inequal distribution of ocean benefits (food, recreation and human health). The suggested OBP framework allows to promote public engagement by giving a voice to local communities and will also provide recommendations for policy makers, research institutions, international organizations, NGOs,

business leadership and civil society to address systemic aspects of inequities along a spectrum of ambitions, from basic to transformative. Finally, the OBP framework can be easily scalable and operationalized to be used in different geographical areas at local and international levels to promote blue economy and ocean equity (Caswell, Klein, Alleway, et al., 2020).

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