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Editorial

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Contributions of place-based social-ecological research to address global sustainability challenges

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Humanity depends on nature for life support, but human activities are changing ecosystems around the world in profound ways (Díaz *et al.*, 2019). In parallel, this enterprise has expanded into the Anthropocene and resulted in a highly interconnected world with cross-scale interactions linking human communities and ecosystems. In essence, this means that local events can escalate into global challenges and local places are continuously shaped by global dynamics. For example, we are now witnessing how the exploitation of wild species, the rapid expansion of urban settlements and the associated deforestation in one particular area have combined to produce the COVID-19 pandemic with unprecedented global health and socioeconomic impacts, all from a virus that once circulated harmlessly among bat species (Settele *et al.*, 2020).

Social-ecological research emerged 20 years ago with the goal of understanding the inter-linked and cross-scale dynamics of environmental and societal changes (Berkes & Folke, 1998). Since then, the concept of social-ecological systems has evolved into different analytical frameworks that are guiding the exploration of complex system dynamics and are contributing to the design of sustainable futures (Colding & Barthel, 2019; Folke *et al.*, 2016). The utility of the diagnostic potential of social-ecological systems frameworks has been recognized beyond academia and is increasingly contributing to decision- and policy-making. For example, on a global level, the conceptual framework of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (Díaz *et al.*, 2015) has been widely adopted as both a conceptual and an analytic framework for guiding IPBES assessments and for developing new national and global environmental policies.

To date, most social-ecological research has been conducted at the local to regional scale (typically spanning hundreds to thousands of square kilometres). However, achieving global sustainability targets such as the Global Agenda of Sustainable Development Goals (SDGs) or the future Convention on Biological Diversity (CBD) Post-2020 Agenda for biodiversity conservation requires better understanding of social-ecological interactions between regions and across spatial scales. For example, increasing the extent of protected areas in Europe may have resulted in the displacement of agricultural production to regions outside Europe from where food, biofuels and materials are imported (Martín-López *et al.*, 2018; Pascual *et al.*, 2017). In fact, the IPBES Global Assessment reported that demand for material benefits, such as food or biofuels, is predominantly from higher- and middle-income countries, while its provision tends to originate from land-use systems in middle- and lower-income countries (Díaz *et al.*, 2019). This mismatch between the locations of producers relative to the beneficiaries of material benefits not only highlights cross-place connections; it also lays bare issues of inequity and questions existing models of globalization. Moreover, the extraction and exchange of material benefits are often negotiated between powerful social actors and institutions, often leading to unequal distributions of economic and environmental benefits and costs among actors and between regions (Díaz *et al.*, 2019; Folke *et al.*, 2019; Martín-López *et al.*, 2019; Österblom *et al.*, 2015). Improving current understanding of cross-scale social-ecological dynamics in order to better identify those dynamics that lead to unsustainable and unjust futures and the governance systems that promote sustainability and justice are – arguably – two of the most salient challenges for sustainability science today. Yet, with an increasing appreciation of the connectedness of societies and material flows, it is possible to imagine a tendency to dismiss place-based research in favour of larger-scale studies.

The Programme of Ecosystem Change and Society (PECS; <https://pecs-science.org>), which is a core project of Future Earth (<https://futureearth.org>), aims precisely to gain such in-depth understanding of social-ecological systems in order to foster sustainable stewardship (Carpenter *et al.*, 2012). PECS aims to build a community of practice for place-based, long-

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term, social-ecological research that focuses on undertaking solutions- and transformation-orientated research through long-term engagement with local stakeholders and knowledge co-production (Balvanera *et al.*, 2017b). A PECS project might, for example, conduct social-ecological research on multiple local initiatives at different study sites in order to identify which values, knowledge and governance systems can foster equity and sustainability (Bennett *et al.*, 2016). When compared across sites, the insights gained can contribute to the development of new conceptual frameworks, to the identification of pervading sustainability challenges and their root causes and to new opportunities for mainstreaming place-based social-ecological research (Balvanera *et al.*, 2017a). Global cross-site comparisons can foster knowledge development about global social-ecological connections, which in turn can facilitate designing global-level approaches for managing social-ecological systems despite governance or cultural differences (Balvanera *et al.*, 2017b). Insights from such research can inspire alternative future pathways that contribute to global sustainability (Balvanera *et al.*, 2017a; Bennett *et al.*, 2016).

This themed collection draws from the community of practice built by PECS for place-based social-ecological sustainability research. Specifically, this themed collection highlights some of the key insights gained during PECS's second open science conference in 2017 (PECS II), which took place in Oaxaca, Mexico. The conference gathered 335 participants from 35 countries across all continents. The participants consisted of a wide diversity of researchers, students, policymakers, Indigenous leaders, representatives from research funding and development agencies, members of non-governmental organizations, producers, chefs and artists. Partially to support the travel costs and accommodation of up to 30% of participants, funds were put forward by many institutions. These include PECS, Future Earth, Swedbio, the Stockholm Resilience Center, UNESCO, GIZ (the German Cooperation Agency), the SocioEcos Mexican network, the Mexican Council for Science and Technology (CONACYT), the Oaxacan Council for Science and three Mexican universities and research centres (the National Autonomous University of Mexico (UNAM), El Colegio de México and Universidad Ibero Americana). A series of innovative sessions, debates, workshops and informal gatherings fostered the integration of different types of knowledge, values and practices. This themed collection reflects the unique insights gained from the melting pot created during PECS II, which range from the development of conceptual understandings to methodological developments and include deep reflections on the role of academia in transdisciplinary processes.

This themed collection contributes conceptual as well as methodological insights on how best to co-construct more sustainable and just realities and futures. By drawing on different disciplines, Masterson *et al.* (2019) claim that a more holistic understanding of the reciprocal relationship between nature and human well-being can contribute to the sustainable management of ecosystems and poverty alleviation. They argue that the ways in which humans derive well-being from nature, such as selling fish or developing physical experiences, feed back into how we behave towards nature. The authors conclude that those understandings of well-being that include experiencing nature are key to promoting positive relations between people and nature and to motivating environmental stewardship. In another study, O'Farrell *et al.* (2019) bring together multiple experiences of researchers working in South African cities that make visible the legacies of colonial histories in terms of inequalities, weak governance and reactive

responses to crises. They conclude that co-learning practices by which information is built and shared in networks of researchers and practitioners across African cities are essential for developing sustainable and just futures. The creation of spaces, both formal and informal, where people championing sustainable solutions share their experiences seems to be essential to amplifying the possibilities of building sustainable futures at larger than local scales.

This themed collection identifies the specific challenges facing food systems and the opportunities that are presented for social-ecological sustainability. Ibarrola-Rivas *et al.* (2020) provide evidence on telecoupled social-ecological dynamics that lead to the unsustainable and unjust realities of a hyper-connected global food system. By applying the telecoupling framework (Liu *et al.*, 2013, 2015) to the tomato market in Europe, Ibarrola-Rivas *et al.* (2020) show the hidden effects of tomato consumption in Germany (conceptualized as a receiving system) on the social, economic and ecological systems in Spain and The Netherlands (conceptualized as sending systems). The innovation of Ibarrola-Rivas *et al.* (2020) is that it considers the migration of agricultural workers from Morocco, West Africa and Poland and their socioeconomic conditions. The authors discuss the unsustainable and unjust model of current global markets of food production where "[t]he implications of imported goods are usually not evident to the consumer, and the consumer does not face the direct consequences of their consumer choice." The conclusion by Ibarrola-Rivas *et al.* (2020) that the global food system is a major driver of unsustainability is precisely the justification of the study by Pereira *et al.* (2019). Using examples from South Africa and Mexico, Pereira *et al.* (2019) argue that kitchens – the realm of cooks and chefs – can act as platforms for the transformation of unsustainable food systems. Pereira *et al.* (2019) show how kitchens, framed as socio-ecological spaces, can be used to reconnect people with their environment while supporting healthier lifestyles. Additionally, they find that social-ecological connectedness, Indigenous and local knowledge and trusting relationships among different actors can leverage sustainable transformations in food systems.

The themed collection also reflects on how key concepts such as biocultural diversity play a vital role in the search for sustainability. Merçon *et al.* (2019) illustrate how the biocultural diversity paradigm has been taken on beyond Indigenous and local communities. Over the last several decades, environmental movements have embraced the practices, values and knowledge developed under the biocultural umbrella, including those related to the rights of Indigenous people and the co-management of protected areas. They are also increasingly guiding urban grassroots movements and contributing to science-policy interface programmes, such as IPBES. Merçon *et al.* (2019) argue that stronger collaboration between actors and their knowledge systems representing different biocultural discourses is needed for a broader transformative impact that yields both local and global sustainability.

This themed collection highlights the essential roles that different sources of knowledge play in the co-production of transformations towards sustainability, with an emphasis on the increasingly recognized role of Indigenous and local knowledge systems (Lam *et al.*, 2020; Norström *et al.*, 2020; Tengö *et al.*, 2014; Wyborn *et al.*, 2019). The leverage potential of knowledge co-production for sustainability transformations relies on the fact that the knowledge generated is actionable and solutions-orientated, and that it is constructed by diverse voices,

contributing to legitimate solutions (Clark *et al.*, 2016; Mauser *et al.*, 2013; Norström *et al.*, 2020). Yet, this is precisely the ‘Achilles heel’ of knowledge co-production, since structural power inequalities derived from social-cultural biases can reinforce inequity and injustice (Turnhout *et al.*, 2020). The challenge of knowledge co-production across different cultural settings is the focus of Ramenzoni *et al.* (2020). By describing the transnational collaborations between researchers from Cuba and the USA to conserve coastal wetlands in the Caguanes National Park (Cuba), Ramenzoni *et al.* (2020) reflect on the language and cultural barriers that challenge knowledge co-production processes and how these can affect sustainability. These authors conclude that, in order to move towards sustainability, scientists should foster cooperation mechanisms that are truly inclusive and engage with dissent and contestation, while being aware of cultural inequalities.

This themed collection also reflects on the role of scientists and the ways in which our engagement can contribute to more sustainable and just decision-making processes and futures. Alonso-Yanez *et al.* (2019) argue that, in order to mobilize knowledge co-production and transdisciplinary collaboration, we (scientists) need to challenge and transform the institutional structures in which we are embedded and collectively engage in processes of *unlearning* well-established scientific organizational processes. Collective academic *unlearning* can open up spaces whereby we (scientists) *decentre* the academic privilege and *deconstruct* our power that is often exerted in knowledge co-production. Alonso-Yanez *et al.* (2019) conclude that collective academic *unlearning* and *decentring* academic privileges may enable radical positive change.

In an effort to address inequalities in whose values of nature are considered in science and decision-making, a collective vision and mission to practice plural valuation of nature is presented by Jacobs *et al.* (2020). Reflecting on whose voices and whose values are heard and elicited through valuation processes lies at the heart of Jacobs *et al.* (2020). These authors argue that scientists, as actors in sustainability thinking and acting, need to become aware of their own positionality, normative stance, relative power in society and responsibility to build sustainable and just worlds. In order to amplify their mission and vision, Jacobs *et al.* (2020) coin the term ‘*occupy*’ as the process that individuals and groups can undertake in order to transparently and collaboratively realize transformations towards the integration of plural valuations of nature in research and practice.

By applying the lessons learned in diverse sites where place-based social-ecological research has been applied, this themed collection fosters a synthesis of experiences and knowledge about social-ecological systems and their dynamics that allows us to delineate pathways towards sustainability transformation. The community of practice of the PECS programme grows richer, more diverse and stronger by fostering rich cross-cutting explorations across sites, scales and knowledge systems. In doing so, local understandings, worldviews and multiple perspectives can all contribute to defining pathways towards sustainable and just futures.

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