

## Reply to Romero and Agrawal: Unpacking the specific links between biodiversity, ecosystem services, and social diversity is an essential first step

Romero and Agrawal (1) question the usefulness of our framework to link functional diversity with social actor strategies (2), arguing that it oversimplifies the complexity of the social dimensions of socioecological systems. We agree on the crucial importance of such dimensions, and we repeatedly highlighted this in our article, as is obvious from figure 1, the text, and the examples. While focusing on functional diversity, ecosystem services, and their role in different social actor strategies, we situated these in a broader setting that can be analyzed with the tools and concepts of social sciences, including institutional analyses.

Rather than replacing major existing overarching frameworks for understanding the sustainability of socioecological systems, we aimed to “unpack” the specific links between biodiversity, ecosystem services, and the strategies of different sectors of heterogeneous societies. In fact, the cross-cutting questions identified in the text and in figure 1 underscore the significance of institutional and cross-scale analysis and offer specific directions for moving forward in deepening our understanding of functional biodiversity and ecosystem service dynamics (directly in questions 1–3 and indirectly in question 4).

Thus far, biodiversity has been identified as important for societies but still in a very general way. Improving this understanding has been identified as a priority for ecosystem service and human well-being assessments (3). Our article rose to this challenge by connecting functional diversity components and priorities of social actors using land use decisions and ecosystem services as the main links between these ecological and social components. In doing so, our framework does not detail institutional analysis or a whole suite of other social or political determinants of local decisions. Neither does it detail the complexity of the natural dynamics that is an integral part of the system, such as evolutionary processes, extreme climatic events, or changes in species

ranges (e.g., in response to climate change). All these factors are likely to have an influence on at least some socioecological systems, and we acknowledged this in figure 1 and in the text, both conceptually and in several examples (e.g., p. 898).

Romero and Agrawal (1) mention an inattention to the knowledge of different actors, yet heterogeneity in this knowledge is at the core of our approach. This was emphasized in several places in the text. In fact, the social information stream of figure 3 (*Left*) is all about social actor knowledge. In practice, our framework requires that social actors be identified, but an appropriate strategy of social actor mapping is not at the core of the paper, in the same way that we did not discuss the best sampling methods for measuring ecosystem properties, such as carbon or water retention.

Ostrom (4) has urged dissecting and harnessing the complexity rather than eliminating it. Far from oversimplifying socioecological systems, our approach provides a concrete way to start harnessing an essential yet still poorly understood component, biodiversity and its contribution to ecosystem services, in the context of heterogeneous societies.

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