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Social learning for resilience in social–ecological systems

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Fostering of social learning is generally considered an important governance instrument to build resilience in social–ecological systems. Empirical studies addressing the contribution of social learning to resilience are scarce however, and do not provide direct evidence but infer this contribution from the impacts of social learning on system governance and management. These impacts are found more frequently at the local level than at higher, regional or national levels, probably depending on the overlap between participants in social learning and actors in governance and management. Recent studies have shown that at higher levels a connection between social learning and policy can be achieved through bridging actors or organizations, and vertical linkages between governance levels. Conceptually and methodologically the study of social learning and its relation with resilience has advanced sufficiently to enable more rigorous and detailed empirical research. This should focus on how attempts to foster social learning within social–ecological governance systems can be made more effective and efficient, for example, through the use of new technologies to support the learning process or through the creation of permanent, informal multi-stakeholder learning spaces within formal policy structures.

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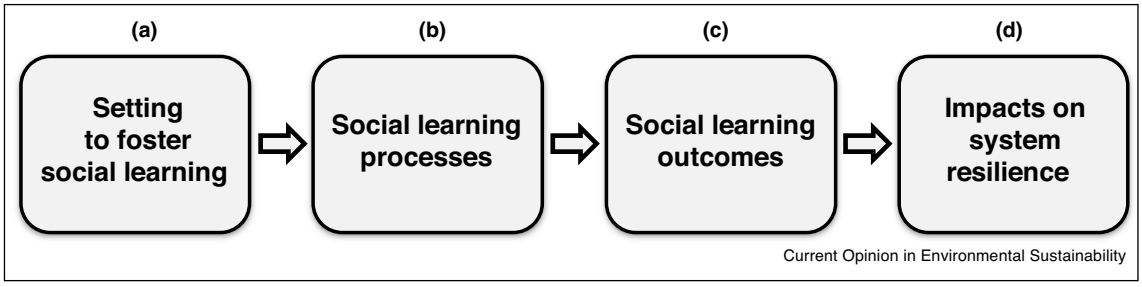
Introduction

Attention for the role of learning in building resilience can be traced back to the early stages of resilience thinking [1,2•]. The relationship between learning and resilience is conceptually simple. Social–ecological systems are characterized by a close, dynamic interaction between social groups and their natural environment [3]. Learning about undesirable environmental changes is a pre-condition for responding to these changes, and the ability of social groups to respond to change generates resilience [4,5], which is the capacity of a system to experience shocks while retaining essentially the same identity [6,7]. More recently, resilience has also come to include transformability, the capacity to create a fundamentally new system when the existing system has become unsustainable [8]. The central role of learning is reflected in Folke's [9] definition of resilience of social–ecological systems which includes the capacity for learning and adaptation.

Learning is a change in knowledge, skills or attitudes, that may result in changes in behavior, or even institutions [1,10•]. Social learning is learning by social groups, resulting in changes at group level, through social interaction [11]. History provides many examples from traditional societies adapting to environmental change, presumably through social learning [12]. In these examples, social learning emerged from a form of social self-organization [4]. Yet, their success has inspired scholars to consider organized settings to foster social learning as an important adaptive governance instrument for building resilience in contemporary social–ecological systems [8,13,14]. Adaptive governance is a multi-actor, multi-level decision-making approach with the aim to adaptively negotiate and coordinate management of social–ecological systems, with demonstrated positive effects on natural capital [15•].

A recent review on the role of learning in building resilience of ecosystem services concluded however, that there is a need for greater conceptual clarity on what social learning is and how it contributes to resilience [2•]. Furthermore, the authors considered the evidence about the importance of social learning and the mechanisms by which it enhances the resilience of social–ecological systems to be unclear. The aim of this paper is first to present an integrated conceptualization of how social learning may contribute to resilience of social–ecological systems, and, second, to assess the empirical evidence for the contributions of social learning to resilience. The focus is on social learning *for* resilience, that is, on the intentional, instrumental use of social learning processes as a mechanism to build resilience in social–ecological systems. Throughout

Figure 1



From interventions fostering social learning to impacts on system resilience: **(a)** a setting is organized for communicative interactions between a heterogeneous group of actors, with the intention to foster social learning among these actors; **(b)** this may result in social learning processes taking place, interactions that bring about cognitive or relational changes at group level; **(c)** possible outcomes of social learning include a common understanding of a problem or more trust among the actors; **(d)** finally, these outcomes may translate in enhanced system resilience through real-world changes in management and governance of social–ecological systems.

the paper a distinction is made between the settings to foster social learning, social learning processes, social learning outcomes, and social learning impacts (Figure 1) [10•,11]. Wider outcomes and impacts beyond the group involved in the social learning processes are considered here as (in part) contributions of social learning, but the activities by which they are achieved (e.g. mass media dissemination, lobbying) are not considered to be part of the social learning process.

Conceptualizing social learning for resilience

Although learning in general is since long an important concept in resilience thinking, there are only a few publications from before 2000 that make an explicit connection between resilience and social learning. The earliest sources that mention both concepts in the context of social–ecological systems, portray social learning as an emergent, self-organized process of corrective societal change in response to unsustainable resource management [16,17]. Not until 1999, it was suggested that social learning could be intentionally fostered as an adaptive mechanism to build resilience [18]. Since then, fostering social learning has received increasing attention as a governance instrument, in particular in participatory natural resource management (e.g. [19–21]), adaptive management of ecosystems (e.g. [5,22,23]), and adaptation to climate change and natural hazards (e.g. [24,25]).

As the concept of social learning became more popular, the confusion about its meaning also increased [10•]. A major step in reaching more conceptual clarity has been the proposal by Reed *et al.* [11], to define social learning as a change in understanding, that goes beyond the individual and occurs through social interactions. Ideally, this definition functions as a baseline and depending on the study the definition of social learning may include additional criteria, for example, learning must be convergent towards a common understanding [26,27], or encompass a wider set of outcomes, for example, changes in relations among the group members [28]. As Cundill and Rodela [28] observed, a broad distinction in this respect can be made between the literature on adaptive (co-)management, where social learning is mostly about cognitive changes in understanding and coping with uncertainty, and the literature on participatory natural resource management, where it often also includes relational changes, such as more trust and better working relations among the participants to enable collective action. The major type of social interaction through which all these changes may occur is by joint, discursive reflection on information about the system to be managed [29,30•]. The sources of information may range from collective experiences, experiments, monitoring data, computer simulations, and external experts, to the knowledge, views and experiences of other members of the social group [1,2,29]. Here again a distinction can be observed between the literature on adaptive (co-)management, with an emphasis on experimentation, and the literature on participatory natural resource management, emphasizing deliberation and dialogue [28].

In resilience thinking, learning is given a central role in the adaptive cycle (Figure 2) [31,32•]. The adaptive cycle is a conceptual model of the dynamics and resilience of ecological, social and social–ecological systems. In different stages of the cycle, learning plays different roles: in the 'front loop', learning is associated with incremental, optimization-type innovation to enable further growth, whereas in the 'back loop', it is associated with more radical types of innovation in response to crises in the system. A third, 'transformational' type of learning occurs when learning outcomes, innovations developed during the back loop at lower levels of the social–ecological system, are taken up in the front loop at a higher level. These three forms of learning match a common typology in learning which distinguishes single-loop learning (incremental change, improvement of the effectiveness of actions to meet