

Applying social–ecological systems science to complex mountain landscapes

Today, for the first time in human history, the world is so interconnected that both social and ecological impacts coupled with environmental mismanagement have the potential to initiate a global cascade of events with profound and potentially serious consequences. Complex, constantly adapting systems, such as human settlements, are in a state of perpetual flux: ranging from dynamic stability, to gradual reorganization of interactions and actors, to sudden and catastrophic reorganization. Small changes can reverberate through multiple systems, resulting in surprises, and no place exhibits the potential for this better than the mountain landscapes of the American West, where resource abundance is still viewed as relatively limitless. However, resilient communities are better able to adapt to these outcomes, provided they can have at their disposal a diverse toolbox of responses. These include adaptive management, accurate decision making, and flexible infrastructure. In this Special Issue, we address some of the challenges that face mountain landscapes of the American West in order to highlight the types of changes occurring therein.

The mountain landscapes of the American West share several features, including: (1) low but rapidly expanding human populations relative to their land areas; (2) relatively large populations of indigenous residents (ie Native Americans) as well as local, multi-generational subsistence residents (ie ranchers and farmers); (3) an influx of high-amenity land buyers who modify local economic conditions; (4) the potential for downstream impacts due to the landscapes' position in the headwaters of river basins; (5) large extents of land governed by federal agencies, including designated wilderness and recreation areas, monuments, and parks; and (6) vast reserves of valuable natural resources (ie water, fossil fuels, timber, fish, wildlife, and open space for recreation). These characteristics must be considered in the resolution of disputes in natural resource management and decision making. For example, emerging demands resulting from increased in-migration and resource speculation have drastically increased stress on freshwater resources and are driving changes to ecosystems. These demands are primarily a consequence of two activities: the development of energy resources (such as oil and gas, coal, biofuels, and hydroelectricity), and the re-allocation of water resources to the American Southwest and California to support urban expansion and agricultural production.

The challenges in managing mountain landscapes are diverse, including rapid urban expansion on highly productive agricultural land, increased vulnerability from forest fires, and re-establishment of once plentiful species such as buffalo (*Bison bison*). Because many of these issues are neither only ecological nor only social in nature, their successful management will require a holistic social–ecological system (SES) science-based approach that includes a thorough understanding of the dynamics of and interactions between their various components.

The articles in this Special Issue demonstrate the importance of interdisciplinary, team-based collaboration and the value of using multiple sources of knowledge to improve ecological resilience and community sustainability within complex mountain landscapes. We offer the following recommendations for practitioners, researchers, and stakeholders: (1) embrace the diverse perspectives and knowledge of team members no matter how different they may seem to your own; (2) learn from the successes and failures of other interdisciplinary, team-based efforts; (3) ensure that problem identification and characterization occurs after participants with different academic backgrounds, practical experience, and worldviews have joined the team; and (4) include or recruit to the team (as early as possible) so-called “system thinkers” and colleagues who can synthesize social, ecological, and other diverse strands of knowledge.

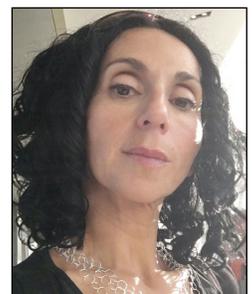
SES teams and networks contribute to solutions and offer a means to address some of the major problems that surround complex mountain landscapes. They can improve resource management, better inform socioeconomic development, and suggest proactive responses to potential hazards and chronic risks. Furthermore, these networks provide the capacity to improve community responsiveness to change, through the development of resilient infrastructure and promotion of greater security for livelihoods. In addition, SES networks not only enhance current investments in interagency environmental monitoring by strengthening data interoperability, but also develop tools so that communities can better appreciate environmental change at finer scales, and ensure that observation networks and the data they collect both engage and are relevant to broad user groups. Indeed, SES teams and networks build community capacity with residents in mountain regions by focusing on place-based knowledge and contexts. In sum, collaborative SES science-based approaches are critical to the effective management of natural resources and the environmental issues within complex mountain landscapes, because they are developed and owned by the people who live in and experience them every day.



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