

Social–Ecological Systems

J. STEPHEN LANSING¹ AND THÉRESE DE VET²

¹Complexity Institute of Nanyang Technological University, Singapore; Santa Fe Institute, United States; and Stockholm Resilience Centre, Sweden

²University of Arizona, United States

Human domination of the earth's ecosystems is accelerating. Already, more atmospheric nitrogen is fixed by humanity than by all natural terrestrial sources combined; more than half of all accessible surface fresh water is used by human societies; and between one-third and one-half of the land surface has been transformed by human action (Barnosky et al. 2012). Recognition of these changes, which has crystallized in the concept of an "Anthropocene" era, has intensified interest in humanity's relationship to the natural world. The concept of social–ecological systems implicitly suggests that the relationship between them is more complex than simple exploitation of the earth's resources. But there is as yet no consensus as to how this relationship should be approached as a scientific question.

Anthropology's engagement with ecology, unique in the social sciences, has a long history. In "Primitive Classification," Durkheim and Mauss (1903) argued that the relationship between nature (macrocosm) and culture (microcosm) is the primordial foundation for both human cognition and social organization. This insight was taken up by generations of ethnographers. In the initial Durkheimian formulation, social categories are projected onto environments, giving them universal significance, and the resulting system of thought is encoded in religion. But this raises the question of whether environments are merely *tabulae rasae*. This question has been addressed by many ethnographers, perhaps most famously by E. E. Evans-Pritchard (1940) in his study of the Nuer. Evans-Pritchard argued that the Nuer adapt to their savanna environment by apprehending relevant ecological processes and integrating "ecological time" with the "structural

time" intrinsic to their kinship system. In this way, the Nuer conception of time expresses the salient connections between ecology and social life in a pastoralist society. Elsewhere, ethnographers have found more examples of Durkheimian functional integration in the calendrical systems of tribal and agrarian societies.

In the 1960s, Roy Rappaport sought to expand the scope of such studies by linking rituals and beliefs to the ecological imperatives of swidden agriculture. As Rappaport discovered, there were intriguing parallels between the Durkheimian tradition in ethnology and the dominant Clementsian paradigm in community ecology. At a time when Darwinian theory focused on competition between individuals, Frederic Clements sought to understand the emergence of stable, cooperative webs of relationships in diversified ecological communities. For Clements, ecological communities were more than random assemblages of species. Instead they evolved into climax communities through a process of ecological succession in which competition gave way to cooperation. Rappaport adapted this model to analyze ecological succession in the gardens of Maring communities in highland New Guinea. Rappaport (1968) argued that Maring rituals are more than expressions of cosmological ideas, because they enable communities to develop effective strategies for collective action in response to both environmental and social processes. This idea neatly dovetailed with Durkheim's stress on the congruence of natural and social classification systems and also added an ecological dimension.

Rappaport's approach was soon criticized for focusing on small-scale communities, leaving out power and the state, and emphasizing the self-regulating aspects of Maring rituals. These criticisms partly echoed critiques of the climax community concept in ecology, which emphasized the functional integration of stable, mature ecological communities. In ecology, this view was challenged by the neutral theory of biodiversity, which emphasized the role of chance in the composition of ecological communities (Hubbell 2001). In anthropology, cultural ecology and ecological anthropology were largely sidelined

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by the emergence of political ecology, which focused on exploitation. But, in ecology, the concept of developmental succession in communities did not disappear. Instead it was reframed as the comparative resilience and stability of ecosystems. Ecologist C. S. Holling proposed a model of adaptive cycles to describe the dissolution and renewal of what were formerly known as climax communities (see Gunderson and Holling 2001). Soon, Holling extended this idea to social-ecological systems with a model he called “panarchy”: a structure in which systems, including those of nature (e.g., forests) and of humans (e.g., capitalism), as well as combined human-natural systems (e.g., institutions that govern natural resource use, such as the United States Forest Service), are interlinked in continual adaptive cycles of growth, accumulation, restructuring, and renewal. Holling’s models of resilience and adaptation were taken up by researchers interested in how local and regional drivers can generate intertwined global-scale challenges such as climate disorder, ocean acidification, declining fisheries, the spread of zoonotic diseases, and crises in energy, food, and water. These questions were given impetus by climate scientists, who are interested in large-scale processes of anthropogenic change that might have the potential to drive the earth system into a new state (Steffen et al. 2015). They examine the critical unrecognized, ignored, and missing social-ecological links and feedbacks at the global scale, and the kinds of economic and governance structures that can create long-term conditions for human development (Galaz 2015).

With roots in classic Darwinian theory, behavioral ecology provides another way to frame social-ecological interactions at very small scales (typically local interactions of individuals). Most research in this field is carried out among foragers or small-scale communities. The analytical framework focuses on how humans respond to environmental conditions. Niche construction models also take an evolutionary approach, and shift the focus to the effects of human activity on environments. These studies expand the time frame from decision making by individuals to historical phenomena such as the origins of agriculture. However, while the concept of niche construction directs our attention to the interactions between societies and anthropogenic

landscapes, it offers no analytical framework for analyzing these processes.

The need for an analytical framework that can encompass dynamic interactions in social-ecological systems that may occur at varying temporal and spatial scales has led some researchers to begin to draw on complex adaptive systems and nonlinear dynamics. Rebecca Bliege Bird (2015) argues that the putative weaknesses of behavioral ecology in explaining complex phenomena such as these can be overcome by an approach that addresses variation in spatial scales and considers the dynamic feedbacks between subsistence, ecological structure, and social organization. Of particular interest are “tipping points,” critical transitions when qualitative changes occur in social-ecological systems. Both natural and social systems occasionally undergo rapid transitions. Thus, microcredit in the form of a loan may enable a family to escape a poverty trap; foragers can become farmers; and civilizations such as the Khmer and Maya can collapse in the space of a couple of generations (Scheffer 2009). Contemporary studies of social-ecological systems by anthropologists draw from these disparate research traditions and so far lack a common theoretical framework. But they share a firm empirical foundation, and they often champion indigenous perspectives on environmental issues.

SEE ALSO: Durkheim, Émile (1858–1917); Mauss, Marcel (1872–1950); Cultural Ecology; Environmental Anthropology; Climate Change; Historical Ecology; Cultural Adaptation; Resilience and Complex Adaptive Systems; Rappaport, Roy (1926–97); Behavioral Ecology, Human; Ecological Anthropology; Evans-Pritchard, E. E. (1902–73); <DRAFT: Anthropology and conservation>

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ABSTRACT

Anthropology's engagement with ecology, unique in the social sciences, has a long history. In 1903, Durkheim and Mauss argued that the relationship between nature (macrocosm) and culture (microcosm) is the primordial foundation for both human cognition and social organization. Cultural ecologists later added an ecological dimension to this perspective, linking sociological theory to community ecology. More recently, the concept of an "Anthropocene" era has intensified interest in humanity's relationship to the natural world. The concept of social-ecological systems implicitly suggests that the relationship between them is more complex than simple exploitation of the earth's resources. But there is as yet no consensus as to how this relationship should be approached as a scientific question.

KEYWORDS

ecology; Émile Durkheim; human ecology; nature