

NEW ECOLOGY AND THE SOCIAL SCIENCES: What Prospects for a Fruitful Engagement?

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Key Words: nonequilibrium ecology, environmental change, environmental social science

■ **Abstract** This review asks the question: What new avenues of social science enquiry are suggested by new ecological thinking, with its focus on nonequilibrium dynamics, spatial and temporal variation, complexity, and uncertainty? Following a review of the emergence of the “new ecology” and the highlighting of contrasts with earlier “balance of nature” perspectives, work emerging from ecological anthropology, political ecology, environmental and ecological economics, and debates about nature and culture are examined. With some important exceptions, much social science work and associated popular and policy debates remain firmly wedded to a static and equilibrated view. This review turns to three areas where a more dynamic perspective has emerged. Each has the potential to take central elements of new ecological thinking seriously, sometimes with major practical consequences for planning, intervention design, and management. First is the concern with spatial and temporal dynamics developed in detailed and situated analyses of “people in places,” using, in particular, historical analysis as a way of explaining environmental change across time and space. Second is the growing understanding of environment as both the product of and the setting for human interactions, which link dynamic structural analyses of environmental processes with an appreciation of human agency in environmental transformation, as part of a “structuration” approach. Third is the appreciation of complexity and uncertainty in social-ecological systems and, with this, the recognition of that prediction, management, and control are unlikely, if not impossible.

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INTRODUCTION

The past decade or so has seen an explosion of interest in the area of environmental social science. This review asks what links are being forged between the natural and social sciences in this new domain, what conceptual and methodological common ground is being found, and what are the prospects for and challenges of new types of interdisciplinary interaction? It focuses in particular on the emergence of what has been termed the new ecology (Zimmerer 1994; see also McIntosh 1985, 1987; Bramwell 1989; Worster 1977; Botkin 1990) and the implications such thinking has for the way we understand the relationships between social, economic, and ecological processes. In the past, social science debates have often taken a static, equilibrational view of ecological systems, premised on assumptions about a balance of nature. This has led to a framing of issues that has tended to ignore questions of dynamics and variability across time and space, often excluding from the analysis the key themes of uncertainty, dynamics, and history. Such a selective view of ecological issues necessarily results in a partial and limited social analysis. This in turn may result in the exclusion of certain perspectives on ecological-social interactions that might be derived from alternative readings of ecological and social theory. This has both practical and political implications, as certain views of people-environment interactions become dominant in mainstream policy discourse while others remain unheard. A greater attention to the debates surrounding the new ecology, and an exploration of their social implications, leads potentially to a more pluralist stance on environmental issues, one where a diverse range of perspectives may contribute, beyond the limiting balance of nature view.

The first part of this chapter reviews the emergence of the new ecology, tracing a schematic history of key concepts and ideas. This is then related to debates within the social sciences. In discussions subsumed under a wide variety of labels—ecological anthropology, human ecology, ethnoecology, environmental and ecological economics, political ecology, and so on—we find a limited view of ecological dynamics, with debates remaining firmly wedded to an equilibrational perspective. Nearly 20 years ago, Orlove (1980) reflected on a similar lack of articu-

lation between the natural and social sciences. However, since that time, a number of developments have occurred that offer a greater potential for engagement. Concerns with history, variability, complexity, and uncertainty have emerged in both the new ecology and certain strands of social science work on the environment, and these are reflected on in the following sections. Finally, the conclusion highlights key conceptual, methodological and policy-practice challenges suggested by such an engagement.

This review is necessarily selective. A vast range of literature across a range of disciplines potentially speaks to these debates, and only a fraction can be incorporated here. In exploring the themes of this review, I have attempted to look beyond anthropology to discussions in other disciplines—ecology, geography, sociology, science studies, and others. An important convergence of debate is evident, potentially offering the prospect of new interdisciplinary collaboration.

THE IMBALANCE OF NATURE—THE EMERGENCE OF A NEW ECOLOGY

Notions of balance or equilibrium in nature have a long tradition in Western thought, being traceable to Greek, medieval Christian, and eighteenth century rationalist ideas (Worster 1993a). Ecology, a term first coined by Haeckel in 1866 (Goodland 1975), not surprisingly drew on such concepts as a way of explaining the structure and functioning of the natural world. In 1864 Marsh (see Marsh 1965:12) argued that “nature, left undisturbed, so fashions her territory as to give it almost unchanging permanence of form, outline and proportion, except when shattered by geological convulsions; and in these comparatively rare cases of derangement, she sets herself at once to repair the superficial damage, and to restore, as nearly as practicable, the former aspect of her dominion.” As discussed below, this long lineage of equilibrium thinking can be traced to the present in much popular environmentalist thinking, as well as in more academic strands of social science thought. Yet the debate in ecology that disputes this view has also spanned the past 70 years. In his famous textbook of 1930, Elton noted that “the balance of nature does not exist and perhaps never has existed” (Elton 1930:15). Fifty years later, Connell & Sousa (1983:789) came to a similar conclusion: “If a balance of nature exists, it has proved exceedingly difficult to demonstrate.” Despite such commentaries, however, the science of ecology, over much of this century, has been built on equilibrium notions, ones that assume stasis, homeostatic regulation, and stable equilibrium points or cycles.

A number of areas of ecological enquiry have dominated the science (for detailed historical reviews, see Bramwell 1989, McIntosh 1987, Worster 1977). Beginning early in this century with work by Clements (1916), vegetation ecologists have been interested in processes of “succession,” exploring how vegetation assemblages change toward a “climax,” where climax communities are sometimes seen to operate as “super-organisms.” From the 1930s, particularly following the classic work of Lotka and Volterra, another theme has centered on

population dynamics and, particularly, the regulation of animal populations through density-dependent limitation of numbers. Drawing on the work of Malthus, such approaches have often been based on simple population-growth models, describing the supposedly stable features of intrinsic growth rate and carrying capacity. By the 1950s, systems concepts formed the basis of ecosystem ideas, where closed, regulated, and homeostatic systems were defined (e.g. Odum 1953). Ecosystem concepts identified complex, yet well-integrated, trophic webs and nutrient and energy flows, which were both regulated and stable. Finally, conservation biology, based on the principles of island biogeography (cf MacArthur & Wilson 1967), represents another area of ecological theory where equilibrium assumptions—in this case of a stable relationship between species diversity and area—have dominated.

Each of these central areas of ecological theory has equilibrium characteristics at the core of its models and as fundamental to its assumptions and, not surprisingly, to its findings and applied management recommendations. Thus, succession theory, which emphasized the stable climax, became the guide for managing rangelands or forests; population models identified carrying capacities and maximum sustained yield levels for use in managing animal populations; ecosystem theory focused on system regulation of flows and thus how pollution loads or other impacts were assessed; and conservation biology provided a basis on which biodiversity policy could be created and protected areas designed.

Although there were disputes within each of these areas of theory, there was little departure from equilibrium thinking until the 1970s, when an explosion of interest occurred in mathematical ecology and the (in)stability properties of both model and real systems (e.g. May 1977, 1986; Pimm 1991). Subsequent decades saw the emergence of key concepts making up nonequilibrium theory. These concepts were based on the properties of nonlinear systems, especially those that were dominated by high levels of temporal and spatial variability (De Angelis & Waterhouse 1987). Three concepts provided important hypotheses and questions: the concept of multiple stable states—nonlinear systems with more than one equilibrium attractor (Noy-Meir 1973); the recognition of chaotic dynamics, where nonlinear interactions have sensitivity to initial conditions and lack long-term predictability (May 1989, Hastings et al 1993, Elner & Turchin 1995); and stochastically dominated systems that are truly nonequilibrium, without simple regulatory feedback mechanisms (Chesson & Case 1986).

A whole new language emerged describing various elements of the properties of such systems. Such terms as variability, resilience, persistence, resistance, sensitivity, and surprise all captured some element of such complex dynamics (Harrison 1979). Some of these terms have subsequently become widely used, informing broader debates about sustainability and adaptive management (Holling 1973, 1986; Conway 1987). Although this explosion of interest in nonequilibrium ideas produced a certain level of confusion, and a multitude of articles often full of arcane mathematics, it did provoke a new wave of empirical enquiry, focusing on ecosystem complexity, variability in time and space, and the implications of nonequilibrium dynamic change. Case examples in a wide range

of ecological fields of enquiry have begun to question equilibrium notions that framed the contours of debate within both pure and applied ecology. These include forests (Sprugel 1991, Dublin et al 1990), rangelands (Noy-Meir 1973, Westoby et al 1989, Walker 1993, Behnke & Scoones 1993, Ellis & Swift 1988), pest management (Holling 1978, 1986), marine resources (Larkin 1977, Wilson et al 1990, Acheson & Wilson 1998, Hilborn & Gunderson 1996), coral reefs (Knowlton 1992, Hughes 1994), and biodiversity conservation (Holling et al 1995).

So what does the new ecology look like? Three themes stand out, each of which has some important potential, yet often unappreciated, resonances with parallel debates in the social sciences. First, the understanding of variability in space and time has led to work that has moved the population dynamics debate beyond the simple assumptions of equilibrational regulation to a wider appreciation of complex dynamics, uncertainty, and surprise (Wiens 1976; Pickett & White 1985; Holling 1986, 1994). Second, the exploration of scaling in dynamic processes has led to work on nonlinear interactions across hierarchies in systems analysis, and to a wider understanding of the spatial patterning of ecological processes from small scale patches to broader landscapes (Allen & Starr 1982, Turner 1989). Third, a recognition of the importance of temporal dynamics on current patterns and processes has led to a wide body of new work in paleoecology, evolutionary ecology, and environmental history. These themes have cast new light on some perennial ecological problems. For example, new perspectives in rangeland ecology have challenged static notions of carrying capacity and climax vegetation as a basis for management. The more dynamic approaches that have taken their place feature state and transition models of vegetation change, key resource or focal-point management of spatially diverse grassland types, and livestock mobility as part of opportunistic herding strategies (Scoones 1995). Similarly, in forest ecology, a growing emphasis on disturbance regimes and patch dynamics in forest mosaics suggests alternative forest management strategies that accept variability in time and space (Sprugel 1991). The recognition of nonequilibrium dynamics in a variety of (although by no means all) settings challenges some basic, often deeply embedded, conceptions of naturalness, balance, and order and suggests new ways of thinking about resource management and policy that were often rejected by more conventional ecological perspectives.

ARTICULATIONS WITH THE SOCIAL SCIENCES

How have the social sciences attempted to articulate with ecological thinking over the past few decades? Too often, such social science analysis—whether in anthropology, sociology, geography, or economics—has remained attached to a static, equilibrational view of ecology, despite the concerted challenges to such a view within ecology over many years. Different disciplines have adopted different perspectives over time. Whether founded on the intellectual traditions of structural functionalism and functionalism in the anthropology and sociology of the 1950s

and 1960s, on structuralism in Marxist political economic thought, on the holistic analyses of systems analysts in branches of geography, or on the rational-actor individualism of neoclassical economics, the framings of ideas of environment as holistic, integrated, and regulated, and of environmental change as linear, stable, and predictable, have been surprisingly similar. The balance of nature has had a long shelf life in the social sciences, reinforced by functionalist models dependent on stable, equilibrium notions of social order. In the following sections, a number of overlapping fields of enquiry in the social sciences are discussed before turning to the question of why such balance of nature views have remained so persistent.

Ecological Anthropology

In anthropology, for example, an interest in ecological issues was stimulated in the fields of ecological anthropology, cultural ecology, and human ecology around questions about how (principally) non-Western societies live with nature (Vayda & McCay 1975, Orlove 1980, Butzer 1989, Moran 1990, Zimmerer 1996a). A significant body of work emerged from the 1950s, including cultural ecology (Steward 1955), the ecosystems approach (Rappaport 1967), and cultural materialism (Harris 1979). Most of it argued that just as natural environments are homeostatically regulated, so too are societies that rely on nature. Thus, Conklin on the Philippines (1954), Sahlins on Fiji (1957), Lee on the !Kung (1972), Geertz on Indonesia (1963), and Rappaport on New Guinea (1967), among many others, argued for the close interaction of natural and social systems as a functional whole.

The systems approach, and particularly the focus on energy flows (cf Rappaport 1971), was firmly linked to the ecosystems concepts current in the ecology of the time (Odum 1953). This was hailed as a way of linking the social and natural sciences (Brookfield 1964, Stoddart 1965). However, Vayda & McCay (1975) provided an early attempt to shift the focus of ecological anthropology away from an equilibrium, ecosystem-society-based research agenda toward individual responses to hazards, following an influential body of work in geography (Kates 1971, Burton et al 1978; but see Watts 1983).

Although the extreme circular versions of a functionalist position in cultural ecology have long been rejected, elements have persisted in perspectives linked to concepts of evolutionary adaptation (Diener et al 1980). Some of the early literature in this vein drew from long-discredited group selectionist ideas, although more recent work takes a more individualist stance, drawing on the concepts of the rational actor and natural selection to describe patterns of human behavior in relation to environmental resources, an approach that Orlove (1980) terms the processual approach in ecological anthropology. Such work has echoes in Darwinian evolutionary approaches, transactional analysis (Barth 1966), and, more recently, actor-based approaches (Vayda 1983). A significant strand followed the influential work of Boserup (1965) and has looked at the interactions of demography, household structure, and technology change (Bennett 1976, 1993; Lees & Bates 1990, Hardesty 1986). Others meanwhile concentrated on decision-making

models of individual behavior, prompted in part by the growth in interest in socio-biology (e.g. Dyson-Hudson & Smith 1978).

Often in parallel to this work, other studies have highlighted the close fit between indigenous knowledge and practice in a wide range of environmental settings. The literature on ethnoecology and so-called indigenous technical knowledge is vast (cf Warren et al 1995). However, with some important exceptions (e.g. Richards 1985, Denevan 1983, Sillitoe 1998), much of this work fails to interrogate the complexities of both ecological and social dynamics, and it retains a static view of both environment and knowledge. The consequence has been the collection of much data—classically in the form of lists and classifications—that remain poorly situated in the complexities of environmental and social processes.

Political Ecology

The fundamentally political issues of structural relations of power and domination over environmental resources have been seen by a variety of scholars as critical to understanding the relationships of social, political, and environmental processes (e.g. Blaikie & Brookfield 1987, Bryant 1992, Bryant & Bailey 1997, Greenberg & Park 1994). In early work in this field, the environment was seen as an additional structural feature of the analysis, often portrayed as fixed, or subject to major, disruptive change due to the capitalist penetration of peasant societies. As Peet & Watts (1996:5) explain, by the late 1970s concern with “market integration, commercialisation, and the dislocation of customary forms of resource management—rather than adaptation and homeostasis—became the lodestones of a critical alternative to older cultural or human ecology.” Although some of the pitfalls of adaptationist and systems approaches were avoided, much of this work still accepted that—at least in the past—balanced, harmonious, and traditional systems existed, but that these had been disrupted by the forces of modern change.

These themes became the defining features of political ecology, a term first coined in 1972 (Wolf 1972). Often heavily influenced by Blaikie & Brookfield (1987) and the chains of causation model, a range of case studies emerged that showed how, for example, debates about soil conservation (Blaikie 1985), agriculturalist-pastoralist interactions (Bassett 1988), deforestation (Durham 1995), or land use in Amazonia (Hecht & Cockburn 1990) were influenced by the interaction of political and ecological processes.

This work has appropriately attempted to link the understandings of micro-processes, more the domain of ecological anthropology, with broader structural political and ideological processes. Clarification by Harvey (1974) of the notion of resources as socially and politically constructed has been central to this discussion and has resulted in important work on how perspectives on environmental change must be gauged from the viewpoints of different actors (Blaikie 1995). This theme has been taken up by more recent formulations of political ecology, which attempt to move beyond a structuralist perspective (Peet & Watts 1996, Rocheleau et al 1996) (see below). Yet, although understandings of knowledge, power, and politics in relation to the environment have moved apace, this discus-

sion has not taken on new understandings of ecology, a gap that is increasingly commented on (Zimmerer 1996a).

Environmental and Ecological Economics

Three strands of economics literature have been enormously influential in the past decade or so. For environmental economists, natural resource issues have largely been discussed in terms of the market failure problems arising from externalities and the rational allocation of scarce resources (Markandya & Richardson 1992). For ecological economists, a coevolutionary systems approach is adopted whereby economic and ecological systems are seen to emerge together (Norgaard 1994). Finally, for institutional economists, a significant concern has been the collective action issues central to the management of common pool resources (e.g. Ostrom 1990, Bromley 1992).

In each of these areas of discussion, a static view of environment and natural resources is offered. A major focus is that of limits and carrying capacity (Arrow et al 1995). The “economics of the coming spaceship earth” (Boulding 1992) and analogies with biological processes in “economics as a life science” (Daly 1992) are part of a recurrent emphasis on what Daly argues to be the defining features of “finitude, entropy and complex ecological interdependence...[that] combine to form fundamental biophysical limits to growth” (Daly 1992:37). More recently, Barbier commented that “through natural succession, ecosystems develop complex feedback mechanisms to ensure their stability” (1989:40).

This is not to say that all economics arguments are bound up by simplistic homeostatic systems models or approaches that do not take into account variability and uncertainty in environmental settings. Some authors clearly take variability seriously, incorporating stochastic elements into models (e.g. Costanza et al 1993). Fruitful interactions between ecologists, economists, and other social scientists convened by the Beijer Institute, for example, have set a research agenda that attempts to develop a theory of the dynamic properties of interdependent economic, social, and ecological systems, including attention to issues such as resilience properties, scaling and hierarchy, discontinuous and complex dynamics, and path dependence (Berkes & Folke 1998).

Nature-Culture Debates

An important theme of recent anthropological debate has been the critique of the nature-culture divide, what Descola & Palsson (1996:12) see as “the key foundation of modernist epistemology” (see also Benton 1991, Simmons 1993, Smith 1996, Soper 1996, Braun & Castree 1998). Ethnographic work has highlighted how the nature-culture distinction is untenable in a variety of contexts (Croll & Parkin 1992). In conjunction, arguments drawing on alternative evolutionary (Levins & Lewontin 1985) and biological (Ingold 1990) perspectives suggest that nature and culture must be seen as co-created. With the emergence of biotechnology, new forms of nature are created, and due to the globalized reach of such “regimes of nature” (Escobar 1999), new articulations with social and cultural

processes are becoming evident. Equally, investigations of the practice of science suggest that the nature-culture divide cannot be sustained, as “hybrid networks” of humans, nonhumans, and artifacts are seen to be engaged in the processes of scientific investigation (Haraway 1991, Latour 1993). This, in turn, requires the renegotiation of the boundaries of the social and natural sciences (Harding 1991) or, most radically, the creation of a “symmetrical anthropology” (Latour 1993), where nature-culture divisions disappear altogether.

Comparable discussions have occurred elsewhere. For example, environmental sociologists (e.g. Catton & Dunlap 1978, Hannigan 1995, Benton & Redclift 1994, Buttel & Taylor 1992, McNaghten & Urry 1995, Woodgate & Redclift 1998) have argued (in a variety of ways) for the appreciation of multiple natures, constructed socially and accorded a range of meanings and interpretations. McNaghten & Urry conclude that “a major task for the social sciences will be to decipher the social implications of what has always been the case, namely, a nature elaborately entangled and fundamentally bound up with social practices and their characteristic modes of cultural representation” (1998:30).

Such a perspective recognizes the situated and necessarily plural and partial knowledge about the natural world (cf Haraway 1991). An analysis of the competing nature of various kinds of knowledge in the context of complex, shifting, multi-layered and multi-sited relationships of power offers the potential to highlight both the material and the discursive effects of different narratives on environmental change. Newer strands of political ecology, labeled ‘liberation ecologies’ by Peet & Watts (1996), has this focus as a central theme (see, for example, Escobar 1996, Moore 1996, Demeritt 1994a).

With the dissolution of nature-culture distinctions, such analyses, however, run the danger of adopting either limiting forms of universalist determinism (as many applications of sociobiology) or simplistic types of cultural relativism (as in some more extreme constructivist positions). For example, in criticizing the ‘landscape as text’ arguments of some proponents of new cultural geography (e.g. Cosgrove & Daniels 1988), Demeritt observes that “in moments of metaphorical extravagance, the material ‘reality’ of landscape disappears altogether” (1994b: 172). By adopting a broadly defined critical realist approach (cf Dickens 1992, Sayer 1993), Gandy argues that in order to “avoid the political and philosophical quagmire of relativism in environmental research,” there is a need for “a subtler appreciation of the inter-relationship between ontological and epistemological basis of knowledge through a greater sensitivity to the agency of nature in social and scientific discourse” (1996:35).

Many anthropologists take a similar stance. Arguing against an unhelpful cultural relativist position (e.g. Milton 1993, 1997), new general frameworks that go beyond simplistic dualistic models are proposed (e.g. Ellen 1996, Palsson 1996). Such frameworks at least allow the potential for comparative analysis, but they maintain a firm link to ethnographic contexts and emic perspectives. Descola is upbeat about the future prospects of such an approach, arguing that “once the ancient nature-culture orthogonal grid has been disposed of, a new multi-dimensional anthropological landscape may emerge” (1996:99).

However, despite the emphasis on historical contingency, complexity, and open-ended processes in poststructuralist analyses, the focus has remained almost exclusively on issues in the social realm. The lack of attention to ecological issues and to the dynamics of environmental change remains a significant gap, resulting in the exclusion of a range of important strands of enquiry (see below).

ENVIRONMENTALISM AND THE APPLICATION OF ECOLOGICAL CONCEPTS

Despite the more nuanced reflections on ecological dynamics mentioned above, the vast majority of social science thinking continues to make use of metaphors of balance, regulation, and harmony in framing the discussion. The idea of “harmony with nature not as a human desire but as a nature-imposed necessity” (Harvey 1993:14) has a large hold on academic discourse and popular thinking about human-environment relationships.

Environmental movements around the world emerging from the 1970s have, not surprisingly, taken on these metaphors and their associated rationales for particular forms of action. Popular environmentalism has many guises. But whether in variations of technocentric, ecocentric, managerialist, or ethical/spiritual forms (cf Grove-White 1993), the balance of nature theme is never far from the surface. According to Porritt & Winner (1988), radical green thinking aims “to create a new economic and social order which will allow human beings to live in harmony with the planet” (cited in Dobson 1990:9). Although in many ways environmentalist discourse presents itself as hostile to modern science, at the same time it often depends on the social authority of a particular stream of ecological science and its apparent neutrality and objectivity when making claims about the destruction of nature, the upsetting of balanced ecosystems, or the exceeding of carrying capacities.

Metaphors from equilibrium ecology are used both to establish moral or ethical positions and to justify particular technocentric or managerial projects. For example, Mies & Shiva (1993) argue for a close link between women and a harmonious nature as part of an ecofeminist argument about gender relations and environmental destruction. Similarly, in explaining the concept of sustainable development and the rationale for intervention, Redclift (1987) draws on systems ecology to justify his position: “The homeostatic controls that exist within natural communities, and that enable them to achieve succession are only effective if these ecosystems are protected from rapid change” (Redclift 1987:18). Such arguments, of course, have been extensively critiqued (e.g. for ecofeminism, see Jackson 1993, Leach & Green 1997; for sustainable development, see Adams & Thomas 1995), but the appropriation of particular perspectives in popular thinking now has a global reach, well beyond the confines of academic debate, in the context of environmental movements worldwide (Yearley 1994, Jamison 1996). Thus, equilibrium thinking, as reflected through such diverse perspectives as deep ecology, ecofeminism, or sustainable development movements, has a wide

range of practical effects. Globalized definitions of nature, often drawing from such essentially northern environmentalist debates and reinforced by media imagery (Burgess 1990), become central to how policies are framed and solutions discussed (Taylor & Buttel 1992, Schroeder & Neumann 1995, Leach & Mearns 1996).

Thus, in the “development narratives” (cf Roe 1991) informing policy and practice, a range of concepts central to equilibrium thinking in ecology becomes central to the dominant discourses of intervention. The way the natural world is counted, classified, labeled, and interpreted emerges from particular traditions in the ecological sciences and, in turn, becomes embedded in management and administration regimes of state agencies, non-government organizations (NGOs), and development projects (cf Rangan 1995, Rocheleau & Ross 1995, Robbins 1998a, Scott 1998). Notions of what is a forest, what is overgrazing, what soil loss is, and what a wilderness is like, derived from a particular view of ecology, become wrapped up in the constructions of particular people—forest-dwellers, pastoralists, small-scale farmers, or indigenous peoples—who are often seen as the causes of environmental problems (cf Neumann 1995, Brosius 1997). Interventions that follow from analyses framed in such ways may have negative consequences for local people. For example, studies of environment-friendly (agro)forestry interventions in the Gambia (Schroeder 1995, 1997), the Republic of Guinea (Fairhead & Leach 1996), and the Dominican Republic (Rocheleau et al 1997) show the “deeply ambiguous results of local environmental intervention plotted at a global level” (Schroeder & Neumann 1995:324).

NEW CHALLENGES?

So why have new ecological perspectives had such limited impact on both academic and popular commentaries? Perhaps it is simply a consequence of the lag times of cross-disciplinary communication: Different languages, frames of reference, and methodological approaches are clearly evident across the disciplinary divides. Certainly much of the new ecological debate can appear insular and obscure to the uninitiated outsider, despite some excellent attempts at more popular treatments (e.g. Botkin 1990). But, as discussed earlier, within the social sciences, the theoretical framings—whether rooted in various forms of functionalism, structuralism, economic individualism, or even poststructuralism—have cast the discussion in a particular way, often premising discussions of environment on an equilibrational view, thus excluding the chance of engagement with newer debates in ecology. This conceptual exclusion becomes reinforced by interactions with popular and policy framings, both firmly embedded in an equilibrium view, generated as part of an ongoing mutual construction of ideas. On occasion, this exclusion goes hand-in-hand with almost a denial of environmental influence on social, economic, or political spheres for fear of being trapped in a determinist position. Such thinking, Williams (1994:9) argues, “froze the critical mind” to the extent that Stoddart (1987:336) complained that some persuaded themselves that “the physical world does not exist.”

This unhelpful impasse appears to be coming to an end. In recent years, a growing body of work—both explicitly and implicitly—has set the agenda for a more productive engagement between debates in new ecology and the social sciences. This new work has important precedents. Whether in the fields of ecological anthropology, political ecology, ecological economics, or poststructuralist analysis surrounding the nature-culture debate, as discussed earlier, a variety of clues to the new challenges can be found.

In this section, I highlight selectively three themes around which this new work seems to coalesce. No doubt others could be added or different configurations suggested, but space limits the full exploration of all options. Each has the potential to take central elements of new ecological thinking seriously and explore the implications in important and interesting ways, sometimes with major practical consequences for planning, intervention design, and management. First is the concern with spatial and temporal dynamics developed in detailed and situated analyses of “people in places,” using, in particular, historical analysis as a way of explaining environmental change across time and space. Second is the growing understanding of environment as both the product of and the setting for human interactions, which link dynamic structural analyses of environmental processes with an appreciation of human agency in environmental transformation, as part of a structuration approach. Third is the appreciation of complexity and uncertainty in social-ecological systems and, with this, the recognition of that prediction, management, and control are unlikely, if not impossible.

Environmental Histories: Understanding Spatial and Temporal Dynamics

The growth in interest in various types of environmental history (cf Williams 1994, O'Connor 1997) has afforded important opportunities for a firmer articulation with the concerns of both spatial and temporal dynamics in new ecology. With attention being paid to the processes of landscape change over time and across space, environmental historians and historical geographers have begun to unravel key features of the complex interaction between social and environmental change. Williams famously noted that “the idea of nature contains, though often unnoticed, an extraordinary amount of human history” (1980:67). Yet Worster (1984:1) complained that “there is little history in the study of nature...and there is little nature in the study of history.” However, in the 15 years since that comment, things have changed.

Drawing on the traditions of landscape studies established by Carl Sauer and colleagues associated with the Berkeley school of geography (Price & Lewis 1993, Rowntree 1996), as well as on broader concerns with the interactions between landscape and history (cf Glacken 1967, Schama 1995), environmental historians, particularly in the United States, have undertaken a number of influential analyses of the interaction of environmental, social, political, and economic change (e.g. Worster 1979, 1985; Cronon 1983, 1990; Silver 1990; White 1990; Hurley 1995), each taking nature as a significant historical actor (Merchant 1989:7). Elsewhere, historians of colonial environmental science and policy in a

range of contexts (e.g. Grove 1995, Beinart 1989, McCann 1995, Griffiths & Robin 1997) have taken up the challenge of documenting the historical contexts for environmental change.

This work has had a varying engagement with ecological thinking. Worster, in particular, has maintained a strong allegiance to equilibrium, balance-of-nature thinking, as a way of explaining the type of disturbances wrought by different types of colonist and capitalist expansion (e.g. Worster 1979). By contrast, others have embraced new ecological thinking more enthusiastically. Cronon (1990), for example, comments on how ecologists' attention to history has challenged many of the assumptions central to environmental historians' narratives: "Ironically, their [ecologists'] efforts to understand ecosystems in more historical terms have made them suspicious of the very models of ecological 'community'—stable, self-equilibrated, organic, functionalist—on which our own balance-of-nature arguments rely. We [environmental historians] need to grapple with their arguments, since so many of our analyses conclude that human communities (especially capitalist ones) have often radically destabilized the ecosystems on which they depend.... We can no longer assume the existence of a static and benign climax community in nature that contrasts with dynamic, but destructive, human change" (Cronon 1990:1127–28).

An interest in the complex intersection of social, political, economic, and environmental change has provoked a wide range of new work in recent years (cf Headland 1997). While building on the environmental history tradition, some new methodological directions are evident. Using a variety of "hybrid," interdisciplinary methods (cf Batterbury et al 1997, Rocheleau 1995), which place special emphasis on understanding contemporary social and ecological processes in an historical context, important new perspectives that counter conventional Malthusian and balance-of-nature views have emerged.

Such approaches do not simply rely on the authority of an abstract and detached science to speak for nature, with a constructed narrative of change that follows a particular view of ecology (cf Demeritt 1994b). Instead, a range of methods—quantitative, qualitative, textual—drawing from both the natural and social sciences inform a more integrated type of study, which investigates real processes of environmental and landscape change; the social, political and economic processes that influence and are conditioned by environmental change; as well as the cultural symbols, interpretations, and meanings of such change. Such approaches draw inspiration from a range of what conventionally might be deemed anthropological approaches, but are judiciously and eclectically combined with methodologies derived from other social science traditions, including environmental history and historical, political, and cultural geography.

Drawing inspiration from the now classic studies by Netting (1968, 1993), Richards (1985), and others, recent work on agricultural change (e.g. Tiffen et al 1994, Amanor 1994, Stone 1996, Batterbury 1997, Nyerges 1997, Brookfield & Padoch 1994, Zimmerer 1996b), drylands and desertification (Little 1994, Dahlberg 1994, Mortimore, 1998), forest dynamics (Peluso 1994; Moore & Vaughan 1994; Padoch & Peluso 1996; Fairhead & Leach 1996; Rocheleau et al 1997;

Cline-Cole 1998; Dove 1992, 1993; Sivaramakrishnan 1999), soils management (Scoones 1997, Sillitoe 1996, Wilson 1995), livestock and rangelands (Warren 1995, Sullivan 1996, Homewood & Rodgers 1991, Roe et al 1998), mountain systems (Ives 1987, Forsyth 1998, Price & Thompson 1997), national parks and wildlife issues (Adams 1997, Brockington & Homewood 1996), and water management (Mehta 1998, Mosse 1997) has provided important new, historically informed insights into processes of environmental change in a variety of settings.

A number of these studies have demonstrated, for example, how landscapes have been created through human action, including environmental features as legacies of past action, both intended and unintended. Whether these are patches of highly fertile soil, islands of distinct vegetation types, or areas of land degradation, an understanding of land-use histories and the intersection of social, institutional, political, and economic processes over time is essential. Such studies emphasize diversity and complexity in patterns of spatial and temporal change, which resonate strongly with the themes of nonlinear dynamics, multiple limits, and the importance of social-ecological interaction in the new ecology. Such historical approaches have been an important basis for a reconceptualization of the dynamics of human-environmental change, a subject that, as discussed next, offers some fruitful new directions.

Structure, Agency, and Scale in Environmental Change

New ecological thinking suggests that there is no straightforward relationship between people and environment in processes of environmental change. Environments are dynamically and recursively created in a nonlinear, nondeterministic, and contingent fashion. Social, political, economic, and ecological processes interact dynamically, requiring analysis to be sensitive to the interaction of structural features and human agency across a range of scales from the local to the global. Such perspectives require analysis to move beyond the simple functionalist, adaptationist, and deterministic models that have dominated ecological anthropology and similar approaches used in the social sciences in the past.

That population-resource interactions are problematic has long been recognized in social science commentaries. For example, work informed by Marxist analysis has highlighted the importance of a dialectical relationship between the natural environment and people's action (Collins 1992). Change is seen as an "internally generated necessity" (Harvey 1974:235), where contradictions are exposed. Thus, "the very design of the transformed ecosystem is redolent of its social relations.... Created ecosystems tend to both instantiate and reflect...the social systems that gave rise to them" (Harvey 1993:27). Similarly, coevolutionary approaches (e.g. Norgaard 1994, Redclift & Woodgate 1994) see environment and human action as mutually constitutive, as part of a process of longer-term evolutionary adaptation.

Although such debates have provided an important backdrop to current discussions, new challenges for social science investigations are posed by an appreciation of nonequilibrium thinking in ecology. For different reasons, both dialectical

and coevolutionary positions, for instance, give little room for the fundamental issues of complexity, difference, and unexpected contingent change so important in new ecological thinking. Nevertheless, the broader argument remains that an appreciation of the interaction of structure and agency across scales must be the centerpiece of a dynamic understanding of people-environment interaction. In this regard, Giddens' structuration concept (1984) is useful, as it points to the continuous dynamic interplay between structure and agency, sedimented in space and time. Scale questions, in particular, are critical to this discussion (Gibson et al 1998), as such interactions may occur across scales between the local and the global, with dynamics operating at different rates across scales (Driver & Chapman 1996). Such "nested hierarchies" of system interaction (cf Gunderson et al 1995) are of particular importance given the spatial reach and complexity of global processes of environmental change confronted today.

Environments at different scales are therefore both the product of and the template for human action. Such a perspective implies that broader social-ecological systems are necessarily the result of a context-specific mix of both continuous and discontinuous change, characterized by complex, path-dependent, yet usually nonlinear dynamics. Below I highlight two significant strands of work that adopt this type of perspective, increasingly explicitly incorporating perspectives from new ecology.

Studies of the processes by which local practices—farming, soil management, tree cutting, wetland management, burning, grazing, hunting, and so on—influence environments over time reveal how the combination of intentional and unintentional actions of different social actors may culminate in significant shifts in environments and ecological dynamics. Concerns similar to those highlighted by environmental historians around anthropogenically created landscapes are raised, although this line of work emerges from a much more focused ethnographic and ecological analysis of local knowledge and practices. By drawing on theories of practice (cf Bourdieu 1977, Ortner 1984), and by going beyond the descriptive, often decontextualized, approaches of ethnoecology, such "ecology of practice" approaches (cf Nyerges, 1997) reveal important aspects of the contingent and dynamic nature of environmental change and how this is intimately bound up with social and cultural processes. As Nyerges (1997:11) comments, "the methodological implications of the ecology of practice are to distinguish actors according to social status, to examine access to and control over the means of production, and to show how conflict over control has consequences for the exploitation and management of specific resources as they are incorporated into individual social lives." A wide range of studies have adopted approaches of this sort, increasingly with a sophisticated and well-grounded understanding of ecological, as well as social and cultural, issues (e.g. Richards 1986, Amanor 1994, Leach 1994, Fairhead & Leach 1996, Sillitoe 1996, Nyerges 1997).

Such largely micro-level studies are usefully complemented by a wider appreciation of the institutional and political processes that mediate the relationship between agency and structure across multiple scales in the processes of environmental and social change. Much institutional literature focusing on natural

resource management and environmental change, however, has adopted a limited formalized approach to analysis, which sees institutional outcomes as the product of the repeated interactions of individual rational actors, for example as in the game theoretic formulations of common property theory (cf Berkes 1989, Ostrom 1990, Bromley 1992, Hanna et al 1996). Although this line of work has provided an important counter to the “tragedy of the commons” perspective (Hardin 1968), it has perhaps not paid enough attention to how institutional arrangements—both formal and informal—arise in the context of the variable and uncertain settings described by the new ecology. Here again, anthropological perspectives offer important insights. Institutions, seen as the product of contested social practices that are culturally and historically embedded, often with symbolic associations and meanings attached, are shown in a different light to the decontextualized representations—often of fixed organizations—offered by the mainstream institutional literature.

Institutional analysis of this sort (e.g. Berry 1989, Peters 1994, Mosse 1997, Leach et al 1999, Schroeder 1997, Robbins 1998b, Agrawal & Sivaramakrishnan 2000) shows how different institutional arrangements associated with different networks of local and nonlocal actors lead to different landscapes and ecological dynamics. Patterns of authority are therefore inscribed in landscapes and reflected in ecological pattern and process; physical spaces and biophysical features become socialized and institutionalized over time, and localities are produced (cf Appadurai 1997) through the institutional and political interconnections across space and time. Through such a lens, therefore, ecological patterns and processes are seen as deeply embedded in social and institutional ones, as part of a continuous, yet highly differentiated, interaction.

Complexity and Uncertainty: Implications for Perceptions, Policy, and Practice

The new ecology provides important insights into complexity and nonlinearity in ecological systems. This has a number of important consequences for environmental perceptions, policy, and practice. Uncertainty, indeterminacy, and surprise in ecological dynamics are central (Ludwig et al 1993, Hilborn & Ludwig 1993). As Holling (1993:553) argues, “knowledge of the system we deal with is always incomplete. Surprise is inevitable. Not only is the science incomplete, the system itself is a moving target.”

This recognition has prompted the emergence of a different type of ecological science, one that moves beyond the Newtonian tradition of mechanistic explanation based on reductionist, controlled experimental analysis toward a science that is integrative and holistic and that focuses on variability and uncertainty as absolutely fundamental, instead of as “noise” to be excluded from the analysis (Holling et al 1998). This is what characterizes the new ecology, but increasingly also other areas of scientific enquiry where complexity and nonlinear dynamics are key (cf Hilborn & Ludwig 1993, Funtowicz & Ravetz 1994). Holling argues (1993:553) that it is “this stream that has the most natural connection to related

ones in the social sciences that are historical, analytical and integrative. It is also the stream that is most relevant for the needs of policy and politics.”

Issues of risk, uncertainty, and indeterminacy have also been of concern to sociologists exploring epistemological issues surrounding the process of scientific enquiry and public and policy responses to environmental issues (e.g. Wynne 1994). This work in particular highlights some important areas where our understandings of environmental perceptions, policy, and practice are challenged by an alternative perspective on questions of complexity and uncertainty in science. If scientific understandings are necessarily incomplete and fragmentary, couched as they are in fundamental issues of uncertainty, then perceptions of environmental questions are key to policy and action. With scientific expertise always provisional, the arenas for contestation and negotiation are increased, giving rise to what Wynne (1996:77) terms “the wider epistemic negotiability of reliable knowledge of nature.” In such settings, multiple expertises—both scientific and lay public—become important in the processes of deciding what to do. Such processes of opening up discussion about environmental issues may act to challenge orthodoxies or conventional wisdoms, which, in the past, have dominated understandings of environmental issues (Leach & Mearns 1996) and formed the basis for development narratives that link assumptions about environmental problems with policy and action (Roe 1991).

With “no stable, asocial nature which can tell us what to do” (Szerszynski 1996:113), the standard managerial approaches to intervention that follow the conventional models of ecology are clearly inappropriate. Thus, the applied management fields of ecology, with their static, prescriptive models of carrying capacity, maximum sustained yield, and so on, look increasingly inappropriate with this new perspective. In a similar way, the broader managerialist discourse surrounding much of the “sustainable development” debate (Redclift 1992, Worster 1993b) appears suspect. So, what is the alternative to such a managerialist approach? A number of suggestions have been made. They generally converge around what has been termed “adaptive management” (Holling 1978, Walters 1976). This approach entails incremental responses to environmental issues, with close monitoring and iterative learning built into the process, such that thresholds and surprises can be responded to (Folke et al 1998).

A number of key challenges arise from this analysis, amenable to anthropological enquiry in various ways. Of major importance is the understanding of the processes of interaction of various kinds of knowledge about environmental issues under conditions of scientific uncertainty. Understanding the negotiation of expertises—both scientific and lay—requires insights into the framing and construction of environmental knowledge and the modes of discourse that emerge during discussions (Apthorpe 1996, Grillo & Stirrat 1997). This requires moving beyond the reification and analytical separation of either scientific or local, lay or indigenous knowledge (Agrawal 1995) and a concentration on the complex processes of epistemic negotiation in different settings (Wynne 1996).

Such insights point to the need to investigate “science in action” (Latour 1987), including the practices of scientists in their laboratories, but also extension

agents, field managers, project assistants, and local people in the process of implementation. The classic anthropological approach, so effectively applied at the local level to farmers and other resource managers, can fruitfully expand its scope to a wider range of actors and their interactions (see, for example, Cussins 1996, Sivaramakrishnan 1996). For it is usually as part of the everyday practice of adaptive management—or what Richards (1989) in the context of farming terms “agricultural performance”—that the key negotiations over knowledge in uncertain settings must take place, whether at local, national, or international levels.

Questions of complexity and uncertainty in ecological science also suggest avenues of enquiry relating to the institutional and organizational context for environmental management. Again, this remains an underexplored area of anthropological enquiry. Some commentators, drawing from systems analysis, argue for adaptive, coevolutionary approaches to what have been termed learning organizations as a response to complex and uncertain ecological systems (Lee 1993). Others, drawing from management and organization theory, point to the need to design high reliability institutions and organizations (Rochlin 1996, as cited in Roe et al 1998). But much of this work underplays the important informal and cultural basis for institutions and organizations (Wright 1994) and, in particular, how relations of trust within organizations are underpinned by social relations and networks. Here, insights from more anthropological approaches may help relate a more nuanced micro-level understanding of social processes to wider debates about the challenges of “discursive” and “deliberative” democracy (Drysek 1990), the changing nature of expert institutions (Jasanoff 1992), and their relationship to what has been characterized as the “risk society” (Beck 1992) in postindustrial contexts.

CONCLUSION

The three themes discussed above—environmental history; structure, agency and scale; and complexity and uncertainty—present significant challenges for future work and the real potential to move toward a more extended engagement between the natural and social sciences, one that perhaps did not exist to such an extent when Orlove complained of the lack of interaction in 1980. Within each theme, concerns regarding history, variability, dynamics, complexity, and uncertainty, now long established in new ecological thinking, have also emerged as important foci in social science debates on environmental issues, offering the potential for a more varied range of insights into social and ecological interactions, insights that go beyond the limiting balance of nature view that has dominated both academic and policy discussions in the past.

A consideration of each theme points to the need to look broadly across the social science disciplines—to anthropology, geography, history, institutional economics, political science, science studies, sociology, and other areas—if a fuller engagement with the issues raised by new ecological thinking is to be realized. With this interdisciplinary challenge in mind, I conclude with a reflection on some of the core conceptual, methodological, and policy-practice issues that emerge.

First, on more conceptual issues, the increasing recognition of the need to go beyond the restrictive nature-culture divide pushes us to challenge other unhelpful dichotomizations and so encourages a more integrative style of enquiry. Such an approach, for instance, joins structural and agency-focused analysis, looks at scientific and local knowledge together, and integrates the natural and the social in exploring environmental change. Such a perspective also allows for the simultaneous appreciation of issues of representation of landscape and nature and the material processes of environmental change. For it is the interaction between these two perspectives—socially constructed perceptions and representations and real processes of biophysical change and ecological dynamics—that is key to policy and practice.

A range of methodological issues follow. Hybridity, innovative eclecticism, and interdisciplinarity all describe the necessary approach that combines understandings of ecological change with historical analyses and more qualitative ethnographic and interpretative approaches as part of multi-sited (cf Marcus 1995) and multiple actor approaches (Long & Long 1992) to enquiry. Although operating in the interstices of academic departments and outside the mainstream of the conventional journals, a lot of interesting and innovative work is going on that is fast pushing the conceptual and methodological frontiers forward in this area.

This new work has significant implications for policy and practice that are only beginning to be explored. For example, the consequences of complexity and uncertainty in ecological and social systems have major implications for new fields of applied enquiry into policy processes, institutional and organizational design, and implementation approaches that take on board the principles of adaptive management, learning, and inclusive deliberation.

On all fronts, then, a wide range of new areas is opening up for some fruitful interaction between new ecology and the social sciences, the products of which will hopefully become central features of future reviews in this important field.

ACKNOWLEDGMENTS

The themes discussed in this review have been central to the work of the Environment Group at the IDS over the past few years. I would like to thank Andrea Cornwall, Tim Forsyth, James Keeley, Melissa Leach, Lyla Mehta, K Sivaramkrishnan, Sally Anne Way, and Will Wolmer for comments on earlier drafts. In addition, I would like to thank the following for their generous contributions to a request for information during the preparation of this paper: Bill Adams, Simon Batterbury, Gordon Conway, Carl Folke, Janice Jiggins, Ray Ison, James McCann, Michael Mortimore, Charles Perrings, Michel Pimbert, Jules Pretty, Diane Rocheleau, Emery Roe, Paul Sillitoe, Sian Sullivan, Andrew Warren, and Graham Woodgate.

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