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GUEST EDITORIAL

Allerton Park 1983: the beginnings of a paradigm for landscape ecology?

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Abstract In 1983, a group of incipient landscape ecologists met to discuss the nature and future directions for landscape ecology. The themes emerging from this conference—movement of materials, organisms, and energy through a landscape; the genesis of landscape patterns; the effects of landscape structure on the spread of disturbances; and the potential contributions of landscape ecology to resource management—established a foundation for the development of landscape ecology in North America over the following decades. I discuss these contributions in the light of where landscape ecology is today.

Keywords Principles · Disturbance · Heterogeneity · Scale

In April 1983, 25 individuals, most of them ecologists (and, as an unfortunate sign of the times, all of them white males; Fig. 1), met at a conference center at Allerton Park, Illinois, to discuss the status and direction of landscape ecology.[1] Although landscape ecology was already a recognized discipline in Europe, this conference marked the nascent beginnings of landscape ecology in North America. Now, 25 years later, it seems appropriate to look back at the themes and conclusions of that conference to assess whether and how things have changed. Did the ideas developed there gain traction? How have things changed?

There was a perception among the participants at the conference that landscape ecology had reached a "conceptual bottleneck." Landscape ecology in the early 1980s (in North America, at least) was characterized by:

- Extending island biogeography theory to landscape patches;
- A presumption that ecosystem-level characteristics could suffice to address landscape-level characteristics;
- A recognition of the need to address landscape issues in resource management;
- A belief that map-overlay methods could capture the key attributes of complex landscapes;
- A realization that human activities were part of landscapes; and
- A recognition that landscape ecology required knowledge from many disciplines.

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[1] The conference report (Risser et al. 1984) has been reprinted in a collection of foundation papers in landscape ecology (Wiens et al. 2007).

Fig. 1 Participants in the Allerton Park conference, 1983. From left to right: R.V. O'Neill, J.R. Karr, P.G. Risser, M. Wiley, S.A. Levin, W.G. Ruesink, M. Godron, H.H. Shugart, R.L. Rabb, F.B. Golley, R. Woodmansee, R. Costanza, J.A. Wiens, C. Steinitz, G.W. Barrett (back row), T. Hoekstra (middle row), W.J. Parton (middle row), D.B. Botkin (front row), J.W. Thomas (back row), G. Merriam, D.M. Sharpe, L.R. Iverson, G.C. Sanderson, C. Becker, R.T.T. Forman. From Risser et al. (1984)

A lot was "recognized," "realized," "believed," or "presumed," without much empirical support. This situation appeared to have "stalled the crystallization and communication of current understanding" of landscape ecology (Risser et al. 1984).

To break through this bottleneck, the conference participants posed four questions to guide future work in landscape ecology. First, "*How are fluxes of organisms, of material, and of energy related to landscape heterogeneity*?" The recognition here was that the composition and spatial variation of a landscape influence the movement of things through the landscape, and that this results in a *redistribution* of organisms, materials, or energy among places in the landscape. Second, "*What formative processes, both historical and present, are responsible for the existing pattern in a landscape*?" Noting that there was at the time no clear conceptual framework to organize thinking about such formative processes, the conference participants suggested categorizing them into three groups. "Conserving" processes tend to restrict change in landscape patterns, while "expanding" processes promote the growth and development of a landscape element that replaces or displaces other elements of the landscape. Other processes may be "resisting," protecting the landscape from external forces. This was a different way of thinking about the forces that shape landscapes, but it did not catch on, perhaps because of the difficulty of making the terms operational and quantitative.

The third question asked "*How does landscape heterogeneity affect the spread of disturbance*?" Disturbance was viewed as a destabilizing force in landscapes, something that altered the steady-state equilibrium of landscapes to produce "patch dynamics" (e.g., Pickett and White 1985). By producing barriers or filters to the spread of disturbance, a heterogeneous landscape could act as a stabilizing factor. And fourth, "*How can natural resource management be enhanced by a landscape ecology approach*?" Given that resource management is usually carried out over areas large enough to qualify as landscapes, there was an expectation that landscape ecology could make major contributions to management, particularly by drawing attention to the importance of habitat mosaics.

These questions remain relevant. Even more influential, perhaps, were the threads that ran throughout the discussions at the conference. *Heterogeneity* was the foundation—how it is generated, how it affects ecological processes and fluxes, and how it can be measured, analyzed, and modeled. *Scale*, particularly the scales at which organisms or ecological processes operate, was a recurrent theme. And there was an increasing recognition that landscapes are *dynamic*, changing as a result of redistribution of organisms and materials, disturbances, and human activities.

In retrospect, it shouldn't be too surprising that these themes continue to guide a good deal of landscape ecology today. Many of the participants in the conference went on to redefine themselves as landscape ecologists and several of them played major roles in influencing how the field developed in North America and internationally (spend a moment perusing Fig. 1). Their thinking was shaped, or at least catalyzed and reinforced, by the discussions at Allerton Park. Many of these individuals had also been involved in the ecosystem studies that were part of the International Biological Program, which may have primed them for thinking about landscapes in terms of flows and fluxes, energy and materials, and management implications.

The Allerton Park conference established something of a "new paradigm" for landscape ecology, at least in North America. How has it developed from this foundation? It turned out that the initial focus on heterogeneity *per se* was overly simplistic and ill-defined, and the scope of heterogeneity has expanded to place greater emphasis on the explicit spatial arrangement of elements in a landscape (e.g., Hutchings et al. 2000; Lovett et al. 2005). In particular, substantial advances have been made in documenting and modeling *how* things move through complex spatial mosaics (e.g., Turchin 1998; With 2002; Reiners and Driese 2004), although less attention has been given to the patterns that result from redistribution and how these may create feedbacks to influence subsequent movements and redistributions. Scale permeates landscape ecology, with many empirical studies now documenting how patterns and processes change with changes in scale (e.g., Peterson and Parker 1998; Wu et al. 2006). Nonetheless, we are still waiting for that elusive (and perhaps unattainable?) "theory of scaling" (Meentenmeyer and Box 1987; Wiens 1989) that would give broad coherence to these studies. Disturbance has become integral to our thinking about landscape processes, at multiple scales (e.g., Turner et al. 1997a), although the focus remains primarily on how landscape structure directs or filters the spread of disturbances. Less attention has been given to the potential role of landscape structure in generating disturbances (e.g., where forest fires start as well as how they spread; Turner et al. 1997b).

Part of any paradigm, of course, is the toolbox. The Allerton Park conference devoted fully as much attention to the methodologies of landscape ecology as to the guiding questions, addressing ways of measuring spatial heterogeneity, data acquisition tools, and modeling approaches. In a broad sense, these are all driven by available technologies, and the capacity to detect, analyze, portray, and model landscape patterns and (to a lesser extent) processes has expanded dramatically. Remote sensing provides images and information at a level of detail that could scarcely be imagined in the early 1980s; computational capacity has expanded exponentially, spatial statistics has developed into a coherent subdiscipline (e.g., Fortin and Dale 2005), and spatially explicit modeling is now routine (e.g., Costanza and Voinov 2004). Landscape ecologists have a much larger toolbox, with a greater variety of sophisticated tools to apply to the questions they ask.

There are other areas, however, in which the relevance of landscape ecology would not have been anticipated a quarter-century ago. For example, the effects of climate change on landscapes, or of landscapes on climate change, are just beginning to be explored. Increasingly, land managers are asking how landscapes can buffer populations and ecosystems against climate change or provide avenues to facilitate distributional shifts or refugia to shelter biota unable to move. The need to make landscape ecology more relevant to management emphasized in the Allerton Park conference has influenced thinking and practices in public and private natural resource entities (Liu and Taylor 2002; Bissonette and Storch 2003). Despite some notable efforts (e.g., Gutzwiller 2002), however, the incorporation of landscape ecology into biodiversity conservation, particularly in moving thinking beyond a preoccupation on protected areas, has been slow to develop. Land use and land-use change (e.g., Lambin and Geist 2006) have immediate and profound effects on biodiversity. Understanding the factors that determine land uses, the scales over which they operate, and how these can be managed to retain the conservation values as well as the economic values of a landscape is critical to achieving lasting conservation results. Landscape ecology has much to offer, as work in Europe has demonstrated (e.g., de Jong et al. 2007).

The Allerton Park conference was remarkable for its articulation of questions and approaches that established much of the direction that has led North American landscape ecology, and landscape ecology more broadly, to where it is today. Landscape ecology now has a surfeit of principles (see Wiens and Moss 2005; Wu and Hobbs 2007; Lindenmayer and Hobbs 2007), and these serve to guide and focus research and applications of landscape ecology. Yet the complexities and contingencies of landscapes make generalization difficult, and such generalities as do emerge are often trite or operationally useless. A search for general principles may be unrewarding. We should heed the call of a more recent gathering of landscape ecologists and conservation biologists at Bowral, NSW, Australia in March 2006. Although the participants offered plenty of principles, they also recognized that such principles are not likely to apply everywhere. Landscape ecologists instead need to develop *contingent* principles and theories, ideas that may apply to a suite of landscapes that share common features or to particular domains of scale, but not more generally (Hobbs and Lindenmayer 2007).

Over a decade ago, Richard Hobbs (1994) observed that landscape ecology was a "science in search of itself." This is no longer the case. Yet it would be a mistake to think that landscape ecology is now a unified discipline with agreed-upon aims and a well-developed and widely accepted body of theory, much less a paradigm in the Kuhnian sense (Kuhn 1970). Landscape ecology is still a work in progress. That is why it is so vibrant.

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