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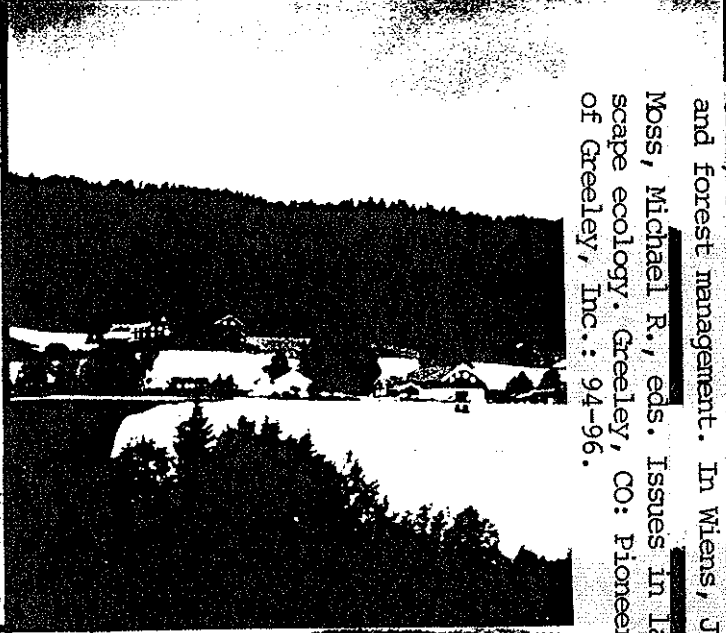
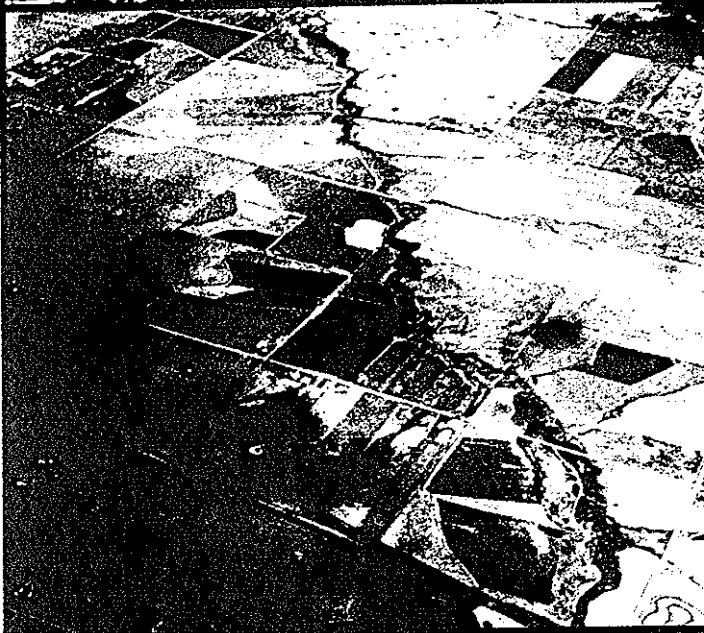
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Issues in Landscape Ecology

Edited by John A. Wiens &
Michael R. Moss

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John A. Wiens
Michael R. Moss

Editors

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PREFACE

In a broad sense, landscape ecology is the study of environmental relationships in and of landscapes. But what are "landscapes"? Are they heterogeneous mosaics of interacting ecosystems; particular configurations of topography, vegetation, land use, and human settlement patterns; a level of organization that encompasses populations, communities, and ecosystems; holistic systems that integrate human activities with land areas; sceneries that have aesthetic values determined by culture; or arrays of pixels in a satellite image? Depending on one's perspective, landscapes are any or all of these, and more. Landscape ecology is therefore a diverse and multifaceted discipline, one which is at the same time integrative and splintered.

The promise of landscape ecology lies in its integrative powers. There are few disciplines that cast such a broad net, that welcome – indeed, demand – insights from perspectives as varied as theoretical ecology, human geography, land-use planning, animal behavior, sociology, resource management, photogrammetry and remote sensing, agricultural policy, restoration ecology, or environmental ethics. Yet this diversity carries with it traditional ways of doing things and different perceptions of the linkages between humans and nature, and these act to impede the cohesion that is necessary to give landscape ecology conceptual and philosophical unity.

The essays we have collected here do not produce that cohesion, but they demonstrate with remarkable clarity the elements from which we must forge this unification. The essays were invited as part of the Fifth World Congress of the International Association for Landscape Ecology (IALE), and were intended to relate in one way or another to the theme of the Congress: linking the science and the action of landscape ecology. We asked the contributors to consider current and emerging issues in various aspects of landscape ecology, and we solicited essays from individuals in many countries and with many backgrounds. The resulting essays therefore express a diversity of perspectives, approaches, and styles. We have edited the contributions sparingly, believing that it is in the spirit of essays to be somewhat idiosyncratic. Readers looking for stylistic consistency or an overarching central theme to this collection will be disappointed, but those who wish to sample the varied flavors of landscape ecology and obtain a glimpse of the future of the discipline will, we hope, be rewarded.

Production of this collection was aided by financial support from the United States Geological Survey, the University of Massachusetts, Colorado State University, and IALE. The assistance of Cynthia Botteron and Vicki Fogel Mykles was instrumental in converting an array of individualistic manuscript files into a finished product. We thank them, and especially the essayists, for making this possible.

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LANDSCAPE ECOLOGY AND FOREST MANAGEMENT

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Almost all forest management activities affect landscape pattern to some extent. Among the most obvious impacts are those associated with forest harvesting and road building. These activities profoundly affect the size, shape, and configuration of patches in the landscape matrix. Even-age management such as clearcutting has been applied in blocks of uniform size, shape, and distribution, as strip cuts with alternating leave and cut strips or as progressive cutting of strips, and as patches with variable sizes, shapes, and distributions. In contrast to the coarse-grain patterns produced on the landscape by even-age management, uneven-aged regeneration techniques produce small openings in the canopy where individual trees or small blocks of trees are harvested. Roads, another important landscape feature associated with forest management, are essential for access and for extracting forest products. Once built, however, they greatly alter the character as well as the use of the landscape.

Other impacts of forest management on landscape pattern are common. For example, altering historic disturbance regimes through fire suppression has significantly changed the composition and structure of many forested landscapes throughout the world. In addition to management activities, or more generally, land-use activities, landscape patterns reflect the physical environment and natural disturbances such as wind and fire, as well as the interaction among these factors (Crow et al. 1999). Regardless of the source of spatial variation, the type and number of patches, their size, and their spatial arrangement strongly influence the benefits and the values that can be derived from the landscape.

There is a reciprocal relationship between landscape pattern and forest management as well – that is, landscape composition and structure strongly affect forest management. The ability to move from a pattern of dispersed harvesting to a pattern of aggregated harvesting, for example, is difficult when small, dispersed harvest units dominate the forested landscape (Wallin et al. 1994). Furthermore, small, widely dispersed patches of forest are more costly to manage than large, aggregated patches. Another example relates to opportunities for conducting intensive forestry operations (e.g., whole-tree harvesting, establishing plantations of fast-growing trees, or applying herbicides to control competing vegetation) in landscapes where human densities, defined in terms of people or houses per unit area, are high. Opportunities for intensive management are greatly diminished even when people and their housing are widely dispersed throughout a forested landscape.

A landscape perspective is useful when applying the common management paradigm of multiple use. Foresters believe that multiple products and benefits can be derived from forests through the wise and careful application of scientifically-based management practices. In the United States and elsewhere, such beliefs are codified into public policy, e.g., the Multiple Use-Sustained Yield Act of 1960. In practice, however, the multiple-use paradigm has failed to provide an integrating framework for managing for diverse resource benefits and values. As recognized in the language of the Multiple Use-Sustained Yield Act of 1960, “some land will be used for less than all of the resources.” That is to say, all multiple uses can not and should not be practiced on every unit of land to the same degree or intensity; instead, managers need to utilize the different capabilities and potentials that exist within a landscape. Yet, a formal framework for evaluating opportunities in time and space is rarely applied as part of forest management (Crow and Gustafson 1997).

Obviously some forest uses are in direct conflict, and when presented with this dilemma, forest managers tend to partition the land into different uses in order to meet specific management goals. When a wilderness area is designated, for example, land is taken out of timber production. If a natural area is

established, no trees will be harvested and it may be necessary to limit recreational use of the area in order to sustain the qualities for which the natural area was designed. Protective buffers are often placed around areas populated by rare or endangered species, resulting in numerous, small, but widely distributed management units that are difficult to administer and difficult to integrate with other land uses. Independently, each of these actions may be justified, but collectively the result is the compartmentalization of the land through a series of separate decisions instead of through a comprehensive plan that is spatially and temporally explicit.

Multiple use works best when the land base is large and demands for outputs and benefits are small. Yet in reality, just the opposite is true. On a global scale, the land base available for resource management is finite and the demands for both commercial products and intangible values are growing dramatically. The results are increasing conflicts and seemingly intractable problems related to forest management. A spatial and temporal framework should be added to the multiple-use paradigm. Clearly, the application of any management system will benefit from evaluating the spatial and temporal context in which decisions are made and treatments occur so that potential conflicts might better be minimized and so that unintended and undesirable cumulative impacts from multiple actions can be better anticipated.

A landscape perspective fosters a multi-scale approach to forest management. Foresters have historically applied their management at local spatial scales, i.e., the forest stand, and applied their treatments as if each stand was independent and existed in isolation of every other forest stand. An alternative approach to managing a forest is to consider first the broader landscape in which the forest exists. It is important to recognize that ecosystems comprising a landscape interact by exchanging energy, materials, and organisms. The context in which an ecosystem exists can profoundly affect the content of that ecosystem.

The hierarchical organization of ecological systems relates to both context and scale. This concept, in which local ecosystems are viewed as being nested within larger ecosystems, enables managers to evaluate large-scale influences on conditions and processes at smaller spatial scales.

Among various activities associated with forest management, none cause greater concern than the impacts of timber harvesting. Franklin and Forman (1987) have demonstrated the importance of evaluating the spatial consequences of forest harvesting in the Douglas-fir region of the Pacific Northwest. They suggest a two-point guide for forest harvesting. First, harvesting should feature progressive or clustered harvest units instead of dispersed harvest units to reduce forest fragmentation. Approaches featuring progressive or clustered harvesting reduce the risks of disturbance associated with forest edges, and these spatial configurations also reduce the amount of maintained road systems necessary compared to more dispersed harvest patterns. The size of a cluster of cuts depends on management objectives and landscape characteristics. Retaining networks of corridors and small forest patches within the clustered harvest areas provides additional cover and edge for game species, reduces wind fetches and soil erosion, and enhances movement of species among forest patches (in this case, primeval forest). Large forest patches should be maintained in the landscape to maintain amenity values and critical habitat for interior species.

The tools needed for applying a landscape perspective to forest management – aerial photography, satellite imagery, laser technology, airborne radar, geographic information systems (GIS), mathematical models – are available and, in some cases, already familiar to foresters. Spatially explicit models that combine remote sensing with GIS offer great promise to land managers because they consider the arrangement of landscape elements in time and space. Furthermore, their visual and geographic nature facilitates the comparison of alternative management strategies and their associated landscape patterns (Gustafson 1996, 1998; Gustafson and Crow 1996, 1998). Ecosystem management of landscapes is accomplished using a combination of custodial management (e.g., wilderness, natural areas) and active management to produce a variety of benefits, including commodities. Spatial models provide the means for incorporating both custodial and active management into real landscapes to create a variety of uses and benefits.

Providing an array of benefits and values representing multiple social expectations will continue to be an important part of forest planning and management. More attention is needed to the spatial and temporal distributions of these allocations and more attention should be given to their cumulative impacts. These needs can best be met by complementing a stand approach to management with a landscape perspective. Landscape ecology confronts us with the realities of connections and of interdependencies that characterize our relationship with nature (Nassauer 1997). A landscape perspective facilitates an integrated, holistic approach to resource management and conservation.

Human activities are transforming landscapes to a greater extent and at a faster rate than at any time in human history. New and improved collaborations for developing land-use policies and for managing our natural resources are needed among scientists, planners, managers, and the public. The science of landscape ecology attracts people from many different fields. And perhaps therein lies its strength – in bringing together

people from many disciplines who have a common interest in the landscape in its broadest sense and who recognize the value of the working collectively to solve problems that are beyond their individual capability.

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