

Session Overview: Forest Ecosystems¹

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The core assumption of this symposium is that science can provide insight to management. Nowhere is this link more formally established than in regard to the science and management of forest ecosystems. The basic questions addressed are integral to our understanding of nature; the applications of this understanding are crucial to effective stewardship of natural resources (Carpenter and Turner 1998, Christensen and others 1996). For example, the challenge of managing Sierra Nevada forests motivated an unprecedented ecosystem assessment of the entire bioregion with the explicit goal of generating management options (SNEP 1996). Yet despite the attraction of “the ecosystem approach” as both a fundamental ecological concept (Pickett and Cadenasso 2002) and a philosophical management paradigm (Rauscher 1999), the complexity of ecosystems perplexes scientists and managers. Ecosystems by definition are multidimensional (Pickett and Cadenasso 2002). They cross spatial and temporal scales, ignore political borders, and transcend the expertise of any one discipline. At the same time, ecosystems are real places where boundaries are defined, services are expected, and managers are held responsible.

The contributors in this session confront this multidimensionality head-on. On display are new insights about the linkages between the biotic and abiotic components of the Sierra Nevada ecosystem. The fundamental role of human impacts and interventions figures prominently in every presentation.

Allen Goldstein highlights recent findings from his work on biosphere-atmosphere interactions. He shows how emissions of nitrogen oxides from the Sacramento urban area contribute to upwind ozone pollution in forests of the Sierra Nevada. He also presents novel results that suggest forest operations may affect regional air quality. Goldstein and his colleagues found that precommercial thinning of a pine plantation dramatically increased biogenic hydrocarbon emissions from the stand. Such hydrocarbons are essential precursors of ozone and aerosol formation.

Dean Urban’s work in the southern Sierra Nevada focuses on the interactions between climate, forest process, and fire. He addresses the challenge inherent in the ecosystem approach: how to extrapolate information across spatial scales. He provides a compelling framework for a model-data dialogue designed to make tractable investigations of large and complex landscapes.

Dale Johnson examines the biogeochemistry of forested watersheds on the east side of the Sierra Nevada. In particular, he describes the annual patterns of nutrient flux associated with snowfall and snowmelt as well as the impact of a wildfire on carbon and nitrogen pools. In terms of snowmelt biogeochemistry, the function of east-side watersheds cannot be simply extrapolated from results derived from better-studied sites on the west side of the Sierra Nevada. Johnson and his colleagues (in these proceedings) also quantified losses and recovery of nutrient capital associated with wildfire. For example, the magnitude of nitrogen

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loss at a site affected by a wildfire and subsequent salvage logging dwarfed the nitrogen fluxes associated with atmospheric deposition and leaching.

Barbara Allen-Diaz summarizes findings from her research on meadow and wetland ecosystems embedded within Sierra Nevadan forests and woodlands. She notes that these grass-dominated communities exist within a context of historical grazing. Allen-Diaz demonstrates how grazing studies can enhance our understanding of ecosystem function and improve the management of these important ecosystems. As an example, she presents results from her studies of spring-fed wetlands nestled within blue oak woodlands. She and her colleagues convincingly show how light grazing in these wetlands can increase species diversity with no measurable impacts on water quality. Alternatively, heavy grazing or ill-timed grazing can degrade the health of these key wetlands.

Kevin O'Hara asks how forest management can be modified to fall more in line with the natural temporal-spatial dynamics of disturbances in the Sierra Nevada. He characterizes forest stand dynamics as a multidimensional, chaotic process and notes that past land uses in the Sierra Nevada have created a complex array of stand structures. O'Hara makes a compelling case that modern silviculture can not only accommodate this complexity but also exploit it. He and his colleague have demonstrated how uneven-aged, multi-cohort stands can simultaneously meet ecological and production goals.

The contributions to this session represent the extent, scope, and quality of ecosystem science focused on the Sierra Nevada, and they also reflect the broader questions facing environmental scientists and managers. For example, a recent conference on future directions for air-quality research identified the ecological aspects of tropospheric ozone and atmospheric nitrogen pollution as priority issues for investigation (Ginsburg and Cowling 2003). The contributors to this session also highlight the importance of conducting area-specific research in potential management areas rather than simply extrapolating research findings from other sites (*sensu* Veblen 2003).

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