

Landscape Ecology – A Concept for Protecting Park Resources

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The Southwest Region has been supporting Resource Basic Inventory (RBI) efforts to establish baseline data for comparisons with long-term monitoring results to be conducted in the future. This "pulse taking" is a part of the Servicewide initiative being fostered so that resource managers, scientists, and park managers will be able to track the health of park resources by determining changes and trends. The RBI work is being linked with the development of Geographic Information Systems (GIS) at Bandelier, Big Thicket, Big Bend, Padre Island, and Guadalupe Mountains. Many of the parks in the Southwest Region have only partially completed RBIs. This informational shortcoming is a pervasive threat to the parks because without detailed knowledge of the parks' respective resources the Service cannot protect them adequately.

To overcome this deficiency, the SWRO's Division of Natural Resources Management and Science has fostered at Bandelier a pilot research effort, which started in FY '87 and utilizes a **landscape ecology paradigm**. This concept links the RBI, GIS, and research activities in a park to present an overall picture of the park in its regional ecosystem setting. The flowchart diagrams this project's concept. The results have been encouraging. A final report was recently completed (Allen 1989). This concept may now be applied to other Southwest Region parks.

What is the Landscape Ecology Paradigm Used in this Study?

1. Spatial scales are important. Landscape ecology is based upon a spatial hierarchy of ecosystems (Urban et al 1987). A *landscape* is an area at least several kms wide where a recurring pattern of relatively homogeneous ecosystems (patches) is identifiable (Forman and Godron 1986). *Landscape ecology* is concerned with the spatial distribution and interactions between ecosystem patches at the landscape level.

2. Temporal scales also are important, as landscapes change through time. Since landscapes are dynamic, landscape ecology considers changes in landscape structure and function through time (Delcourt and Delcourt 1988).

3. Disturbance regimes of various sorts are recognized to be ubiquitous and important processes that drive the interactive dynamics of landscapes and their component patches (Pickett and White 1985).

4. Landscape ecology strives for integrative, interdisciplinary, and holistic perspectives and approaches to research and management issues (Risser 1985).

5. Landscape ecology shares the perspective that has developed in the emerging field of *conservation biology* that all reserves are islands set within and linked to larger landscapes (cf. Soulé 1986). Parks are thus subject to a variety of problems related to habitat fragmentation and isolation from the surrounding landscape. Further, as reserves become increasingly insularized they are found to be threatened with disruption from numerous external sources. Boundary considerations are important (Schonewald-Cox 1988). Effective management of the local ecosystems of parks requires attention to the landscape context in which they are embedded (Agee and Johnson 1988).

This pilot research project was set in the Jemez Mountains of north-central New Mexico, which rise as a large, island-like, volcanic landmass at the southern edge of the Rocky Mountains. Relatively homogeneous local ecosystems can be distinguished within the Jemez Mountains based on site-specific vegeta-

tion, landforms, and soils. These local ecosystems range from open shrublands of juniper (*Juniperus*), saltbrush (*Attriplex*), sagebrush (*Artemisia*), and rabbitbrush (*Chrysothamnus*) in Aridic Ustochrept soils on the alluvial floodplain of the Rio Grande at 1550 m in elevation, to spruce-fir forests (*Picea engelmanni*, *Abies lasiocarpa* var. *arizonica*) in Typic Cryoboralf soils on the highest, north-facing, mountain slopes at 3500 m.

When spatially aggregated, the local ecosystems of the Jemez Mountains form a repeated mosaic pattern that may be considered to compose a single landscape. Bandelier NM comprises a complete altitudinal transect in the southeast flank of the Jemez Mountains, including examples of most of the ecosystems present in this landscape. Yet Bandelier (13,300 ha) is only a small fragment of the overall Jemez Mountains landscape (543,500 ha) in which it is set.

Past ecological work in the Jemez Mountains has focused on the level below local ecosystems, on studies of ecosystem parts; there has been a conspicuous absence of landscape-level work. Resource management and land-use planning activities in the Jemez Mountains have been hampered by this lack of landscape-level ecological information.

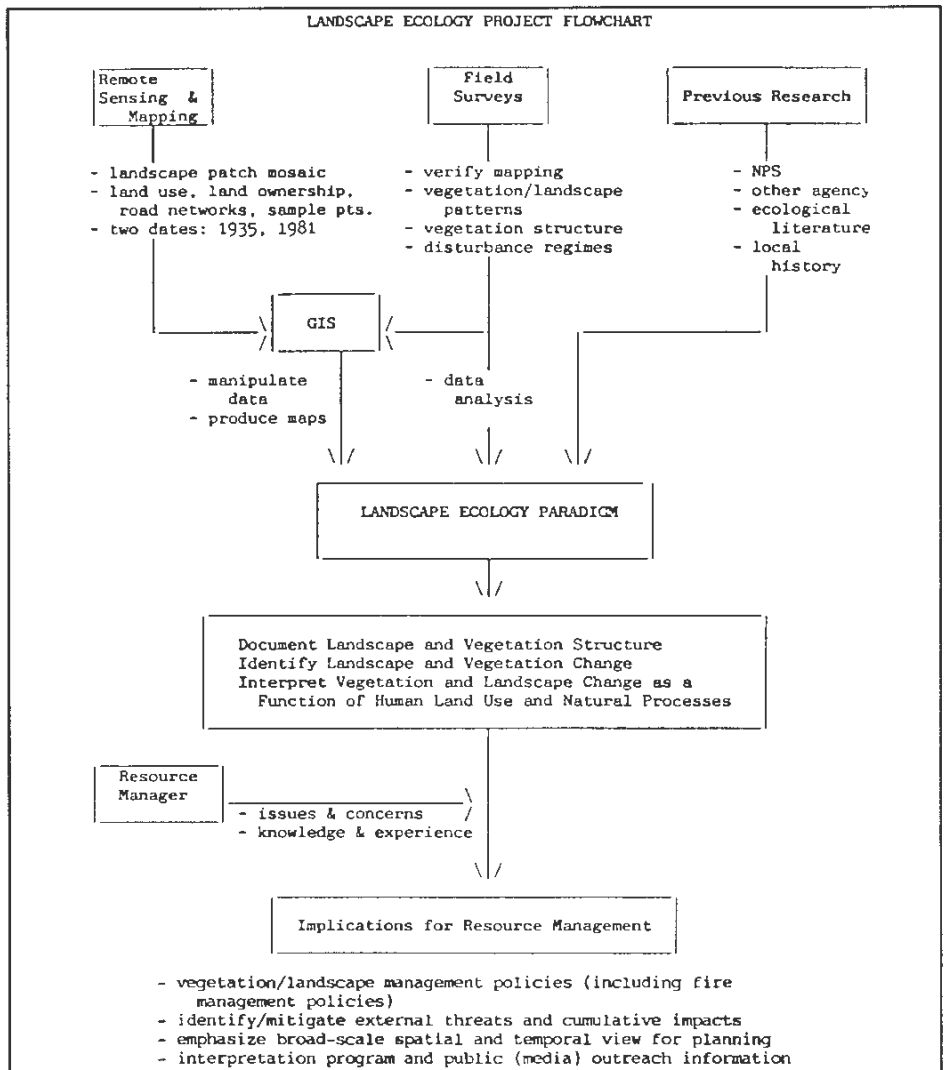
The Jemez Mountains are subject to an increasing variety and intensity of stresses from human activities,

with uncertain cumulative impacts on individual species, ecosystems, and the landscape as a whole. Especially worrisome are impacts from logging, grazing, mining, recreational activities, air and noise and water pollution, fire suppression, highways, reservoirs, powerline corridors, and human settlements. External impacts to park resources represent a major set of management issues for Bandelier. In the absence of a landscape vision of the Jemez Mountains many opportunities to mold a desirable landscape by conscious choice and awareness of tradeoffs have been lost to piecemeal "development."

In summary, this project developed a landscape-level framework for describing the structure of the Jemez Mountains landscape in which the ecosystems of Bandelier NM are embedded. This design allowed landscape-level changes to be noted and their implications assessed, thereby helping the NPS meet its goals for effective, long-term management of "our" ecosystems. An integrative landscape ecology framework also provided a context to organize and improve the management usefulness of past ecological studies. The methodology developed here is applicable to other NPS units.

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Bibliography

- Agee, J.K., and D.R. Johnson. (eds.) 1988. *Ecosystem management for parks and wilderness*. Univ. of Washington Press, Seattle, WA.
- Allen, C.D. 1989. *Changes in the landscape of the Jemez Mountains, New Mexico*. Ph.D. Thesis, Univ. of Calif., Berkeley, CA.
- Delcourt, H.R., and P.A. Delcourt. 1988. Quaternary landscape ecology: Relevant scales in time and space. *Landsc. Ecol.* 2(1):23-44.
- Forman, R.T.T., and M. Godron. 1986. *Landscape ecology*. John Wiley and Sons, New York, NY.
- Pickett, S.T.A., and P.S. White. 1985. *The ecology of natural disturbance and patch dynamics*. Academic Press, New York, NY.
- Risser, P.G. 1985. Toward a holistic management perspective. *BioScience* 35(7):414-418.
- Schonewald-Cox, C.M. 1988. Boundaries in the protection of nature reserves. *BioScience*:38(7): 480-486.
- Soulé, M.E. (ed.). 1986. *Conservation biology: The science of scarcity and diversity*. Sinauer Associates Inc., Sunderland, Mass. 594 p.
- Urban, D.L., R.V. O'Neill, and H.H. Shugart. 1987. Landscape ecology. *BioScience* 37(2):119-127.