

Research Support for Land Management in the Southwestern Borderlands

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Abstract.—The Malpai Borderlands Group, Animas Foundation, other private organizations, and federal and state agencies are concerned about landscape fragmentation, declining productivity, and loss of biological diversity related to encroachment of woody species. In response, they are attempting to implement ecosystem management on almost 1 million acres of grasslands and woodlands in southeastern Arizona and southwestern New Mexico. Reintroduction of natural fire is an important component for achieving ecosystem sustainability. A number of government and private organizations are supporting or conducting research on ecosystem and landscape ecology and management techniques. The research covers several general areas including information syntheses, resource inventories, historical environmental changes, fire and Borderlands ecosystems, range restoration, and the relationship between species ecology and land management.

Introduction

The Southwestern Borderlands region of southeastern Arizona and southwestern New Mexico covers a unique, relatively unfragmented landscape of approximately 1 million acres including the San Bernardino, Upper San Simon and Animas valleys, and the southern Peloncillo and Animas mountains. Elevations range from about 3,800 to 8,500 feet. The area contains exceptional biological diversity with natural communities extending from desert shrub and tabosa (*Hilaria mutica*) grasslands to high elevation mixed conifer stands dominated by Arizona pine (*Pinus ponderosa* var. *arizonica*) and Douglas fir (*Pseudotsuga menziesii* var. *glauca*). The mountains and valleys are home to diverse plant and wildlife populations including species that are rarely found within the United States. The

region is also home to a viable ranching community that recognizes that maintaining the health and productivity of these natural communities are critical in maintaining their local ranch economies. Property and ecosystem fragmentation, which exists in adjacent valleys, has not reached the Borderlands region. Land ownership and administration is diverse; 53% is in private ownership, 23% is owned by Arizona or New Mexico, 17% is administered by the Coronado National Forest, and 7% is administered by the Bureau of Land Management.

In 1990, a group of ranchers met at the Malpai Ranch, east of Douglas, Arizona, to discuss the ranching situation in the West and the future of the natural resources that they depend on for their livelihood (McDonald 1995). Some concerns expressed at this gathering were the encroachment of trees and shrubs on grasslands, the subsequent decline of the herbaceous cover, and the unnecessary suppression of potentially beneficial wildfires. Two years later the Malpai Borderlands Group was formally organized with the goals of reducing the threat of landscape fragmentation and increasing the productivity and biological diversity of the area's rangelands (McDonald 1995). The group's goal is to restore and maintain the natural processes, including fire, that create and protect healthy unfragmented landscapes and their component species within the Borderlands region. The members believe that their efforts should be based on good science, contain a strong conservation ethic, be economically feasible, and be initiated and led by the private sector with the federal and state agencies as partners.

Land management based on good science has been a key part of the efforts in the Borderlands region. The Malpai Borderlands Group and affiliated organizations, such as The Nature Conservancy and the Animas Foundation, have sponsored many research and inventory activities. The USDA Forest Service, Rocky Mountain Research Station became involved in 1994 when the Station was awarded one of the 19 national ecosystem management research grants. The formation of the Southwestern Borderlands Ecosystem Management Research Project is the result of a successful proposal by Dr. Leonard DeBano (Supervisory Soil Scientist, Rocky Mountain Research Station, retired) and Larry Allen (Malpai Borderlands Project Coordinator, Coronado National Forest). One major factor for the proposal's success was the unified support of

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the Rocky Mountain Research Station, Coronado National Forest, the Malpai Borderlands Group, the Animas Foundation, The Nature Conservancy, the Natural Resources Conservation Service, the Bureau of Land Management, the School of Renewable Natural Resources, University of Arizona, and the University of New Mexico.

Information from research efforts in the Borderlands region should be applicable to natural resource management in the larger Madrean Archipelago Biogeographical region, which includes southern Arizona, southwestern New Mexico, west Texas, and northeastern Sonora and northwestern Chihuahua in Mexico.

Southwestern Borderlands Ecosystem Management Research Program

The Southwestern Borderlands Ecosystem Management Research Program objective is to contribute to the scientific basis for developing and implementing a comprehensive ecosystem management plan for the Borderlands area (Edminster and Gottfried 1999). The plan includes strategies for restoring natural processes, improving the productivity of grasslands and woodlands, providing wildlife habitats, maintaining an open landscape, and sustaining a viable rural economy and social structure.

The broad goals of the research program are to:

1. Provide the scientific basis to establish the desired future conditions based on the highest quality biological science integrated with desired future social and economic conditions within the context of private and agency partnerships.
2. Plan and implement a long-term systematic program of basic and applied research, coordinated monitoring to integrate past and future research findings, and contribute to developing guidelines for sustaining a viable economy and open spaces.

Research Strategy

The program focuses on: summarizing and synthesizing existing information, developing a comprehensive landscape inventory and monitoring system to serve research and management needs, and identifying specific research studies to fill priority knowledge gaps. The following discussion identifies topics within each focus area. The research program was described in detail, including

current results, in January 1999 at a conference in Douglas, Arizona (Gottfried et al. 1999). The conference proceedings contain 34 contributions by scientists and land managers and notes from a panel discussion on future directions for research and management in the Malpai region. Many of the studies are continuing, however, some of the completed research has been or soon will be published by either the Rocky Mountain Research Station, by scientific journals, or will be presented in master degree theses and doctoral dissertations.

First Focus Area

Basic and applied research within the Madrean Archipelago region, including the Southwestern Borderlands, began before the 20th century. The Santa Rita Experimental Range, the first experimental area established by the Forest Service, was established south of Tucson in 1903. The initial focus of the Borderlands program was to summarize and synthesize existing information on topics having significant implications for management and research planning. It was important to learn what had already been done to prevent duplication and to establish a foundation for future research and management activities.

These efforts included a review of the knowledge about the role and importance of human and natural disturbances on plant communities in the Borderlands of the United States and Mexico. A second review of wildlife information in the Borderlands project area, which included a proposed experimental design to address future wildlife research and management needs in the region (Morrison et al. 1997) was also a focus of the research efforts. Other scientists conducted an archeological synthesis of the prehistory and early history of the Borderlands ecosystem and made recommendations for future research. Hydrological information is unavailable for most of the Borderlands region, but the neighboring Walnut Gulch Experimental Watersheds near Tombstone have a long history of hydrological research. The data from Walnut Gulch and neighboring watersheds in Arizona and New Mexico were compared to determine if they could be used as proxies to describe hydrological conditions on Animas Creek. One large task was to develop an annotated bibliography for the northern Madrean biogeographic province. General information about the bibliography has been published (Ffolliott et al. 1999), and the full bibliography is available at www.rms.nau.edu/publications/madrean/.

Second Focus Area

The second focus area is development of a comprehensive landscape inventory and monitoring system to serve research and management needs. The ongoing or concluded studies include mapping current vegetation of the

Borderlands ecosystem management area using thematic satellite imagery with intensive ground validation and delineation and interpretation of geomorphic surfaces and surficial and bedrock geology of the Borderlands area. These studies, along with soil survey data collected by the Natural Resources Conservation Service, will provide a basis for developing vegetation management strategies. Information on land-use history and historical landscape changes is being collected, often using photographic monitoring techniques. A digital archive for studies at the Santa Rita Experimental Range has been developed that will create a geo-referenced archive of research records and will provide a basis for data management in the Borderlands.

Third Focus Area

The third focus area includes specific research studies needed to fill priority knowledge gaps. The role of natural fire and its reintroduction into the Borderlands is a major emphasis. A number of program studies are related to natural fire and prescribed burning. Historical fire regimes in several of the ecosystems within the region and northern Mexico have been reconstructed. Scientists also are working to understand the spatial pattern of fire regimes and fire behavior at landscape scales including comprehensive fire regime reconstructions. These studies are regional in scope and are being conducted in cooperation with national forests throughout the Southwest. The concerns about the impacts of different fire frequencies on grassland ecosystem components, such as nutrient budgets and vegetation composition, are being evaluated. A number of studies are concentrating on the impacts of natural or prescribed fire on vegetation dynamics and animal populations, including selected threatened and endangered species. Techniques are being developed for fuels visualization, mapping, and fire-spread modeling in selected areas of the Chiricahua and Huachuca Sky Island mountain ranges.

Two studies have been established to determine techniques for reestablishing and maintaining native grasses on mesquite (*Prosopis glandulosa* var. *glandulosa*) dominated grasslands. Experimental vegetation and livestock management strategies, including mechanical treatments or intensive grazing and prescribed fire, have been designed to improve composition and productivity of perennial native grasses, reduce the dominance of woody shrubs, and improve soil properties and wildlife habitats. These studies are conducted in cooperation with the Natural Resources Conservation Service, the Arizona State Land Department, and several landowners. One of the experimental areas contains an important archeological site, and the implications of the range restoration treatments on cultural resources is an important part of the study.

Part of the third focus area includes the collection of information about the cultural and environmental history of the Borderlands with the objective of evaluating the implications of past land-use history for future management. Another important task is development of riparian ecosystem recovery priorities for the USDA Forest Service, Southwestern Region.

Landscape Scale Prescribed Fires

Several of the studies from the third focus group have been linked to the Peloncillo Programmatic Fire Plan. This plan advocates landscape-scale prescribed fires within the mountain range with the objective of establishing a balance of woody and herbaceous species and increasing fine fuels, as a precursor to the reintroduction of natural fire into the area's ecosystems. Landscape-scale prescribed fires were conducted in Baker Canyon in 1995 and in the Maverick Area in 1997. These fires, with highly variable burn intensities, created mosaics of burned and unburned areas. However, there were numerous questions about the effects of fire on important ecosystem components that needed to be answered before a final plan could be developed. Sponsored research included determining the effects of prescribed burning on bird populations, vegetation dynamics, Palmer agave (*Agave palmeri*) and foraging interactions with the endangered lesser long-nosed bats (*Leptonycteris curasoae yerbabuena*) and Mexican long-nosed bats (*L. nivalis*), and survival and behavior of montane rattlesnakes including the threatened New Mexico ridgenosed rattlesnake (*Crotalus willardi obscurus*). Another study is evaluating remote sensing and GIS techniques for mapping and analyzing fuels and fire behavior on the Maverick Burn.

Future Research

Plans for the future include expanding monitoring efforts and investigating the effects of prescribed burning at the landscape scale on vegetation, wildlife, soil properties, and hydrological parameters. Efforts also will relate vegetation responses and changes in soil and site conditions, and adapt predictive models of fire behavior to prescribed burning in the Borderland grasslands and savannas. Several of the new studies will use a watershed approach to evaluate the effects of prescribed fire prescriptions on a number of ecosystem components within small watersheds. The experimental range restoration treatments will continue to be evaluated and additional options may be tested.

International Conferences

A key element of science is communication. The United States and Mexico have common ecosystem research and

management questions. The Borderlands Management Research Program, in collaboration with the University of Arizona, conducted an international conference on the biodiversity and management of the Madrean Archipelago in September 1994 (DeBano et al. 1995). The purpose of the conference was to bring together scientists and managers from government agencies, universities, and private organizations to examine the biological, cultural, and physical diversity and management challenges of the region and to provide a basis for developing the research program. The University of Arizona and the Rocky Mountain Research Station also conducted two international conferences in 1996. One conference, with the University of Sonora, Mexico, concerned fire effects and management strategies (Ffolliott et al. 1996). The other conference focused on the future of arid grasslands (Tellman et al. 1998). The Rocky Mountain Research Station also was one of the sponsors of the Ninth U.S./Mexico Border States Conference on Recreation, Parks and Wildlife (Gottfried et al. 1998).

Partners Providing Research Support

A number of other partners in the Borderlands ecosystem management efforts are supporting scientific and monitoring in this region. The Malpai Borderlands Group has supported research into the habitat requirements of the New Mexico ridgenosed rattlesnake and monitoring activities for the Mexican spotted owl (*Strix occidentalis lucida*). The group's range consultant also is assisting the Rocky Mountain Research Station scientists, and some of its cooperators, with vegetation monitoring. The Nature Conservancy provided support for the vegetation map of the Borderlands Region that was developed from LANDSAT satellite imagery. The Animas Foundation is donating logistical support for several studies on the Gray Ranch. The Foundation is a partner, along with the Bureau of Land Management, University of New Mexico, and the Rocky Mountain Research Station, on a study about how a combination of cattle grazing and fire can be used to moderate or reverse woody plant increases, and how disturbance processes affect grassland structure. A companion study will measure the influence of reintroduced black-tailed prairie dogs (*Cynomys ludovicianus* ssp. *arizonica*) on grasslands. The Animas Foundation also is assisting with a study of the effects of burning, with and without grazing, on the mix of grasses and mesquite plants and animals in the shrub invaded grasslands. Other scientists are working independently with financial support from their universities or other agencies and foundations.

Partners

A healthy, productive, and unfragmented landscape in the Southwestern Borderlands Region is only achieved with the cooperative efforts of numerous organizations and agencies and, more importantly, by the dedicated efforts of people. The Rocky Mountain Research Station, Malpai Borderlands Group, Natural Resources Conservation Service, Coronado National Forest, The Nature Conservancy, University of Arizona, and the Animas Foundation have been mentioned, but there are many more partners. At least 14 additional federal, Arizona State, and New Mexico State agencies and five additional private conservation and ecology organizations are involved with the Borderlands effort. In addition to scientists and students from different schools and departments of the University of Arizona and the University of New Mexico, faculty and staff from at least five other universities are working in the region. Contacts also are maintained with Mexican managers and scientists from the Secretaria de Media Ambiente, Recursos Naturales y Pesca (SEMARNAP) and the University of Sonora. This project is a national example of how private citizens, organizations, and public agencies can collaborate to ensure the health and future of large, open landscape areas.

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