

The Forest Service, Rocky Mountain Research Station's Southwestern Borderlands Ecosystem Management Project: Building on 10 Years of Success

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Abstract—The USDA Forest Service's Southwestern Borderlands Ecosystem Management Project mission is to contribute to the scientific basis for developing and implementing a comprehensive ecosystem management plan to restore natural processes, improve the productivity and biological diversity of grasslands and woodlands, and sustain an open landscape with a viable rural economy and social structure in the borderlands of southeastern Arizona and southwestern New Mexico. The Project works closely with its numerous research and management partners from Federal and State agencies, universities, conservation organizations, non-governmental organizations, and private landowners. Approximately 180 research and resource publications, academic theses and dissertations, and other reports have resulted from this cooperation since 1994. Future research will determine the effects of rangeland restoration techniques and fire at landscape levels on Borderland ecosystem components, and develop and evaluate integrated cost-effective monitoring methodologies.

Introduction

The Forest Service's national headquarters developed a nationwide initiative in 1993 to encourage ecosystem research (Carlson and Weldon 2000). Proposals for projects were solicited from throughout the United States; a requirement for a proposal was that it should involve National Forest Management, the public, and the universities. The Rocky Mountain Research Station's Southwestern Borderlands Ecosystem Management Project, which was initiated in 1994, is the result of a successful proposal by Dr. Leonard F. DeBano (Rocky Mountain Research Station, retired) and Larry Allen (Coronado National Forest, retired). It is one of 19 ecosystem management units in the country and one of six in the Western United States. A main factor behind the success of their proposal was the broad support of the Coronado National Forest, the Malpai Borderlands Group, The Animas Foundation, The Nature Conservancy, the USDA Natural Resources Conservation Service (NRCS), the Bureau of Land Management, and the University of Arizona's School of Renewable Natural Resources (Edminster and Gottfried 1999). The ecosystem unit's mission is to: "Contribute to the scientific basis for developing and implementing a comprehensive ecosystem management plan to restore natural processes; improve the productivity and biological diversity of grasslands and woodlands; and sustain an open landscape with a viable rural economy and social structure in the region." Fragmentation of landscapes and land ownerships is a threat to the natural environment in the region and to rural societies. A viable local economy, where people can earn a decent living, is

indispensable to reducing fragmentation. This paper describes activities and accomplishments over the past ten years since the project was established and discusses its direction into the next decade.

The Southwestern Borderlands

The Southwestern Borderlands are located within the Madrean Archipelago, a region of the Basin and Range Physiogeographic Province between the Rocky Mountains to the north and the Sierra Madre Occidental to the south. The borderlands are located in southeastern Arizona, southwestern New Mexico, northeastern Sonora, and northwestern Chihuahua. This location between two major biological provinces accounts for the region's great biological diversity where individual mountain ranges can support more than 1,000 native plant species. The biogeography, ecology, biology, hydrology, and management of the Madrean Archipelago are described fully in numerous articles and presentations including those in the current conference and in the proceedings of the first Madrean Archipelago/Sky Islands Conference in 1994 (DeBano and others 1995).

The Southwestern Borderlands Ecosystem Management Project has concentrated most of its activities in southeastern Arizona and southwestern New Mexico, in a unique, relatively unfragmented landscape containing exceptional biological diversity and natural beauty. The geographic location includes the San Bernardino Valley, the San Simon Valley, southern Peloncillo Mountains, Animas Valley, and the

Animas Mountains. The area is under multiple ownerships and administrations: 53% is in private ownerships; 23% is in State ownership by Arizona or New Mexico; 16% is administered by the Coronado National Forest; 7% is administered by the Bureau of Land Management; and 1% is administered by the Fish and Wildlife Service. This complex ownership pattern requires that the research program be based on a partnership among private and public interests and that desired future conditions be developed through an evolving adaptive ecosystem management process. The dominant land uses on the program area are livestock grazing and recreation (primarily hunting and some eco-tourism).

Related research also is being conducted by collaborators in the Chiricahua and Huachuca Mountains, and in adjacent deserts and grasslands. Results from the research in the southwestern borderlands program region are applicable to other sites within the Southwestern United States and Northern Mexico. Most of the research is conducted under joint venture agreements with cooperators from universities or with scientists from other Federal and State agencies.

The Initial Problem Areas

The objectives of the project are to fulfill the mission goal of contributing to the scientific basis for developing and implementing a comprehensive ecosystem management plan for the Borderlands. To accomplish the mission, the Project identified two problem areas (Edminster and Gottfried 1999):

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

Three focus areas were identified within these problems. The first focus area was to determine what was known about the region and to summarize and synthesize the existing information. A key effort was the development of an annotated bibliography of literature pertaining to the northern Madrean Archipelago (Ffolliott and others 1999). Other studies documented: the role and importance of human and natural disturbances on plant communities; an archeological synthesis of pre-historic and early historic evidence; the status of wildlife information and a comparison of hydrological information for major watersheds in the general region. A related study examined the cultural and environmental history of the region.

The second focus was to develop a comprehensive landscape inventory and monitoring system to serve research and management needs. Several studies have been completed in this category; they include the mapping of current vegetation using TM imagery and ground validation; delineation and interpretation of geomorphic surfaces, integrating geology with the NRCS soil maps; photographic monitoring of landscape

changes; and a digital archive of the long-term records at the Santa Rita Experimental Range.

The third focus area was the specific research studies identified as having a high priority to filling gaps in the existing knowledge base. One of the key land management objectives is to reintroduce fire into the region's ecosystems. The Coronado National Forest and its cooperators are developing the Peloncillo Programmatic Fire Plan to facilitate landscape scale prescribed fires in the mountain range. Fire was the most common natural disturbance prior to the 1880s, when cattle ranching rapidly grew following suppression of the Apache Indians and the construction of the transcontinental railroad through the region. The loss of the herbaceous cover prevented wildfires from spreading and contributed to the increase of woody vegetation and soil erosion. Many of the studies in this focus group are designed to support this programmatic plan by determining information to aid in its development and sound implementation. Some of the research is designed to determine past fire regimes or the consequences of reintroducing programmatic prescribed fire onto the landscape. A cross-section of the fire-related studies include: a reconstruction of fire regimes in the Southwestern United States and Northern Mexico; effects of different fire frequencies; fuel accumulations in forests, woodlands, and savannas, and effects on nutrient budgets within grasslands; understanding the spatial patterns of fire regimes and fire behavior at landscape scales; effects of prescribed fire on vegetation, bird populations, and selected endangered species; techniques for fuels visualization, mapping, and fire spread modeling; and developing riparian ecosystem recovery priorities for the region. Another study is examining the archeological implications of using intensive cattle grazing as a site preparation tool to increase native perennial grasses prior to initiating a prescribed fire program.

The Coronado National Forest in cooperation with the Malpai Borderlands Group, the Animas Foundation, Bureau of Land Management, the Natural Resources Conservation Service, and other Federal and State agencies has conducted three landscape level prescribed fires within the Southern Peloncillo Mountains. The objectives of these burns are to reduce tree cover and to create a mosaic of cover types across the landscape. The Baker Canyon Fire occurred in 1995 and the Maverick Fire occurred in 1997. The Rocky Mountain Research Station assisted in the planning and monitoring of the fires. Two important efforts concerned the impacts of fire on threatened or endangered species; one examined the impacts of fire on *Agave palmeri*, an important source of food for lesser long-nosed bats (*Leptonycteris curasoae*), and the other studied populations and impacts of fire on the New Mexico ridge-nosed rattlesnake (*Crotalus willardi obscurus*). This information was used as part of the planning and approval process for the 46,000 acre Baker Canyon II Fire in 2003. This burn is on record as the largest successful prescribed fire in the United States and involved both Federal and private lands.

Major Landscape Studies

The Southwestern Borderlands Ecosystem Management Project and its cooperators have initiated three major long-term

landscape scale research studies. The studies will continue into the future. The studies are experimental treatments to restore degraded Apacherian grasslands, the Peloncillo Watershed study, and the McKinney Flat fire and grazing interactions study.

Rangeland Restoration

The objective of the rangeland restoration study is to improve the cover of native perennial grasses on mesquite (*Prosopis glandulosa* var. *glandulosa*) dominated semi-desert grasslands and to create sufficient grass cover so that sites can be maintained by periodic prescribed fires (Gottfried and others 1999). This is a joint study with the NRCS, and is being conducted on three ranches and on State lands in Arizona or New Mexico. Three treatments were selected to be tested: a control; mechanical crushing of mesquite with no grass seeding; and crushing of mesquite with seeding of locally adapted native perennial grass seed. Each site was divided into 12 blocks, and each treatment was randomly assigned to four blocks. A weather station is located at each site. Initial results showed that the seeded blocks had the best results; unfortunately, the continued drought in the region has compromised the treatments because of subsequent mortality and the lack of natural regeneration. The lack of winter rains has also prevented the establishment of an annual grass cover to help carry the fires. However, vegetation cover and production changes are being monitored in anticipation of better climatic conditions. An associated study is examining the feasibility of using cattle as a site preparation tool on a site with significant archeological value.

The Peloncillo Watersheds

One of the major questions that has been posed by the programmatic fire plan has been the effects of cool season compared to warm season prescribed burning. The region generally has burned naturally during the warm season prior to the onset of monsoon rains. These fires tend to be hot. Some people maintain that cool season burning would be less harmful to the ecosystem and some of the component species. There also is a lack of knowledge about the hydrology of oak savannas and woodlands. A landscape-scale study was established on 12 small watersheds that support typical oak savannas on the east side of the Peloncillo Mountains of the Coronado National Forest and adjacent private lands (Gottfried and others 2000). The objective is to examine the effects of seasonal burning on as many ecosystem attributes as possible. Each watershed has been instrumented with a pair of Parshall flumes, and weather stations and supplemental rain gages have been established throughout the area. In addition, studies are being conducted to determine the impacts of burning on erosion and sedimentation, overstory and understory vegetation, small and large mammals, bird populations, and soil nutrient dynamics. Scientific partners include the NRCS; Rocky Mountain Research Station's riparian and watershed project at Flagstaff; the University of Arizona's School of Natural Resources; and the Arid Lands Project. Pretreatment measurements are currently being conducted prior to burning

by the Coronado National Forest. The study is planned for a minimum of 10 years.

McKinney Flats

The McKinney Flats Fire and Grazing Interactions Study will be described in more detail by Charles Curtin (Curtin, this proceeding). The Southwestern Borderlands Ecosystem Management Project is one of the main sponsors of this research. The objective is to better understand how fire and livestock grazing can be used as management tools to sustain ecological processes, biological diversity, economically viable ranching, and to restore degraded habitats in Southwestern grasslands. One component of this study examines the interactions between prairie dogs (*Cynomys ludovicianus*), livestock, and vegetation.

Dissemination of Results

Scientific information only is useful if it can be disseminated to other scientists and to managers. The Rocky Mountain Research Station through the Southwestern Borderlands Ecosystem Management Project was the main organizer and sponsor of the 1994 Madrean Archipelago Conference that brought together representatives of a large and diverse group of agencies, universities, and conservation organizations to exchange information and to examine future activities and goals (DeBano and others 1994). Similarly, the Station and Project are a main sponsor and organizer of this 2004 conference. The project also has organized and supported a number of regional and international conferences in the interim, which have been discussed by DeBano and Ffolliott (this proceedings).

The Project's scientific dissemination accomplishments between 1994 and November 2003 number 175 publications, including 23 in peer reviewed or refereed journals, 16 in peer reviewed management journals, 9 conference proceedings, 6 Station peer reviewed publications, 17 M.S. theses or Ph.D. dissertations, and 4 GIS maps of soils, vegetation, and geology. Research and management results have been presented at local, regional, and international conferences and workshops and reported in the resulting proceedings. There also have been formal and informal tours of research sites for scientists and public and private land managers. The current conference includes about 14 presentations based on research that was fully or partially funded by the Project. Many of our regular cooperators also are presenting their independent research and views.

The Future

The Project is embarking on its second decade and will build on the established 10-year research foundation. The basic mission statement will remain the same; however, there will be a shift in specific assigned problems. Research will continue to develop an understanding of the effects of rangeland health restoration techniques, including mechanical treatments and prescribed fire, and interactions with grazing management strategies on the components of Borderlands grassland,

savanna, and woodland ecosystems. This research is critical because of the need for both management and restoration guidelines to evaluate the ecological consequences of competing human demands. The second problem will attempt to increase our understanding of the effects of fire at a landscape level on ecosystem components, including soils, water, vegetation, wildlife, and cultural resources. This problem not only includes the determination of prescribed fire effects but also the ability to assess fuel conditions and predict fire behavior and effects before ignition. Monitoring the effects of land management activities is a required activity for public land managers and is desirable for private land owners; this is the third problem. Monitoring is a key component of the adaptive management process. Managers often lack appropriate and comprehensive methods for evaluating the status of Borderlands ecosystems and the impacts of their activities. Monitoring methodologies need to be integrated to encompass a wide range of biological and physical conditions and trends as well as past and future management goals. The value of monitoring data for discerning long-term changes on the land requires that they be stored in well-documented and accessible archives for scientists and managers alike.

Cooperators

The Project could not have been successful without the cooperation of a large number of land managers and scientists, and their help is greatly appreciated. We hope for continued cooperation and success in our next ten years.

The list of private and agency partners includes: the Malpai Borderlands Group; The Animas Foundation; Coronado National Forest; Douglas Ranger District; Natural Resources Conservation Service; U.S. Fish and Wildlife Service-Ecological Service Division and San Bernardino National Wildlife Refuge; Bureau of Land Management; Arizona and New Mexico Land Departments; Arizona and New Mexico Game and Fish Departments; Whitewater Draw and Hidalgo Conservation Districts, Fort Huachuca; and the Secretaria de Media Ambiente, Recursos Naturales y Pesca of Mexico.

The research partners include: the Rocky Mountain Research Station; Agricultural Research Service; USGS Desert Laboratory; The Nature Conservancy; New Mexico Heritage Program; Audubon Society; Desert Botanical Garden; University of Arizona; Arizona State Museum; Office of Arid Land Studies (U of A); Arizona Geological Survey; the Forest Service's Southwestern Region's Terrestrial Ecosystem Survey; Arizona State University; New Mexico State University; University of New Mexico; California State University; Indiana State University; University of Notre Dame; Oklahoma University; University of Sonora; Arid Lands Project; and Society for Ecological Restoration.

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