

Monitoring Riparian Restoration: A Management Perspective

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Abstract—As the largest landholder of cottonwood-dominated riparian forest or “bosque” in the 150 miles of the middle Rio Grande from the Cochiti Dam to the Bosque del Apache National Wildlife Refuge, the Middle Rio Grande Conservancy District (MRGCD; a political subdivision of the State of New Mexico) and its cooperators are implementing “fuels reduction” projects throughout the bosque. Fuels reduction is defined as the removal of exotic phreatophytes such as Tamarisk (*Tamarix ramosissima*) and Russian olive (*Elaeagnus angustifolia*), treatment of the exotic stumps or stems with herbicide, and removing most dead and down wood to reduce fire hazard. Primary objectives for fuels reduction projects include: Fire management; habitat diversity; water salvage, and recreation access. While projects were initially small-scale, recently increased funding, and the availability of mechanical equipment such as mulcher-grinders and tree extractors, has enabled managers to implement projects more rapidly and on a larger scale. Concern for the effects of fuels reduction activities on wildlife, particularly the southwestern willow flycatcher (a Federally endangered species), and the growing influence of fire as the primary disturbance force in the bosque, has led to the establishment of two research projects by the MRGCD and the USDA Forest Service Rocky Mountain Research Station. These studies are examining the effects of different fuels reduction treatments and wildfire on vegetation, water resources, wildlife, and fuel loads in the middle Rio Grande bosque. They and other studies are part of an overall focus on bosque restoration that involves monitoring and research emphasizing ecosystem-level processes. The University of New Mexico’s Bosque Ecosystem Monitoring Program (BEMP), utilizing K-12 students between San Juan Pueblo and Lemitar, New Mexico, monitors monthly changes in litterfall biomass, precipitation and groundwater depth at 19 similarly organized sites. BEMP is now supported to begin monitoring large-scale restoration work in the Albuquerque reach of the Rio Grande. In addition, universities and government agencies are monitoring evapotranspiration from bosque vegetation as well as groundwater levels and movement in order to learn how restoration activities affect water supply. Scientifically sound monitoring and research programs have the potential to strongly influence how we look at the bosque and approach restoration, now and in the future. The question for bosque managers like the MRGCD is how monitoring fits into a management scheme—that is, whether, when and how information from different monitoring programs can be integrated efficiently into restoration plans and implementation strategies, including best management practices.

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Scientifically sound monitoring and research programs have the potential to strongly influence how we look at the middle Rio Grande’s riparian forest or “bosque” and approach restoration, now and in the future. The question for bosque landowners and managers like the Middle Rio Grande Conservancy District (MRGCD) is

how monitoring fits into a management scheme—that is, whether, when and how information from different monitoring programs can be integrated efficiently into restoration plans and implementation strategies, including best management practices.

There are numerous monitoring and research projects in the middle Rio Grande concerned with the river and riparian ecosystem. Many of these efforts are taking place on land owned by the MRGCD. At least three efforts have used public funding to identify and map restoration, research, and monitoring projects in the middle Rio Grande bosque ecosystem. Collecting and assimilating

this information from a variety of sources is a difficult task, however, and most of these efforts are focused on particular programs and don't claim to be comprehensive. Efforts to identify monitoring efforts thus far have not included evaluations of their scopes and methods. This information is needed to determine whether data from different programs is comparable and/or usable by managers but raises the question of whether those doing the monitoring should be the ones to evaluate methods and interpret monitoring data (Crawford 2004).

Other important questions for managers are how to do monitoring in the context of ecosystem-based management and who will do the monitoring? Coordination of groups conducting or funding monitoring and research is essential but can be thwarted by differences in management objectives and lack of planning and communication among agencies. This can result in different policies to address similar management issues (Crawford 2004). In the absence of good monitoring design, with replication of restoration methods, project design and implementation can be based on managers' personal observations and experience and/or the perspectives of other managers, without the benefit of comparative evaluation.

There are examples in the middle Rio Grande of managers developing monitoring programs and using results to develop or adapt management activities. The Bosque del Apache National Wildlife Refuge developed salt cedar removal (McDaniel and Taylor 2003) and controlled flooding studies (Sprenger and others 2002), the results of which have been published and used to design restoration projects on the Refuge. Adaptive management plans and monitoring programs are being developed for habitat restoration plans for the active floodplain on the Refuge (Dello Russo 2004) and from San Acacia to San Marcial, New Mexico as part of the Save our Bosque Task Force's Conceptual Restoration Plan (Tetra Tech, Inc. 2004). These plans will help coordinate and focus monitoring and management for a large reach of the middle Rio Grande.

The Middle Rio Grande Bosque Fuels Reduction and Wildfire Effects Studies are examples of cooperative research projects, involving multiple agencies interested in answering questions about the best way to accomplish hazardous fuels reduction and post-fire rehabilitation in the bosque ecosystem. The Fuels Reduction Study's research design contains replications of three fuels reduction treatments with control sites to determine effects on wildlife, groundwater tables and vegetation. This data can be used to guide objectives for restoration and rehabilitation projects and to develop specific prescriptions. However, time is needed to evaluate treatment effects and restoration activities are moving forward without the benefit of this information. Managers must weigh

the possible negative impacts of implementing large-scale fuels reduction projects with the risks and effects of catastrophic wildfire.

The Middle Rio Grande Endangered Species Act (Collaborative Program), while focusing monitoring activities on habitat restoration and protection for targeted endangered species, nevertheless provides one mechanism for stakeholders to collaboratively develop, implement and evaluate monitoring programs and target funding toward coordinated efforts. The Collaborative Program is also in the process of developing a database that would be a logical focal point for storing monitoring plans, data and other information that could be used by anyone developing restoration projects in the Program area. It is critical for Program signatories and others to provide input on the content and form of the database, the frequency of database updates and how monitoring programs will be evaluated relative to Program goals.

The MRGCD and others have proposed efforts to collaboratively develop and evaluate restoration goals, methods and outcomes by developing a strategy for bosque "landscape alteration," and by revising and expanding the Draft Prescription Guide for the Rio Grande Bosque (Najmi and Wicklund 2000), which contains objectives and prescriptions for fuels reduction and fire rehabilitation projects.

In 2004, Dr. Cliff Crawford, Professor Emeritus of Biology at the University of New Mexico and Sterling Grogan, Biologist/Planner for the MRGCD, developed a proposal for reducing catastrophic bosque fires and water use by riparian vegetation through landscape alteration (Crawford and Grogan 2004). The suggested approaches for reorganizing the bosque's landscape were the subject of a workshop hosted at the University of New Mexico's Utton Transboundary Resources Center on May 25, 2004. Participants commented on the basic principles outlined in the proposal, raised additional questions and began to discuss implementation strategies and considerations in break-out groups. A workshop report was produced and distributed that articulated the following objectives for bosque landscape alteration:

1. Reorganize the bosque landscape to retain, within current constraints, its historical processes and wildlife communities
2. Recreate, by doing this, its former patchy mosaic of native trees and open spaces along the present day river's narrow floodplain, while containing the distribution of invasive species
3. Reduce, by having created this mosaic, the intensity of bosque wildfires both at the wildland-urban interface and within the rest of the bosque, and the landscape water depletion by bosque evapotranspiration (ET) (Utton TRC, 2004).

Assuming these goals and associated implementation strategies are adopted by bosque managers and integrated into planning efforts and projects, a monitoring program must be developed to determine whether these goals are met. If monitoring criteria are components of the goals, the following could serve as initial guidance:

- Monitor changes in habitat diversity and corresponding biological diversity, changes in water availability and ET, fuels loads and fire behavior.

We then must examine the question of the minimum level of monitoring required to indicate whether we are meeting goals. The following is a preliminary list for consideration:

- Vegetation structure, composition and cover
- Bird and mammal populations
- Endangered or sensitive species habitat
- Invertebrates
- Fuel load estimates (dead and live)
- Surface and groundwater hydrology, and ET (in select areas)
- Fire extent, behavior and intensity
- Soils and geomorphology
- Other conditions such as weather, soil and fuel moistures

Out of the suite of current restoration and/or monitoring programs in the middle Rio Grande bosque, four are collecting, or have the potential to collect, a range of data for multiple sites throughout the middle Rio Grande bosque with reference sites for comparison. These programs are The University of New Mexico's Bosque Ecosystem Monitoring Program (BEMP), the Middle Rio Grande Bosque Fuels Reduction and Wildfire Effects Studies, and the Middle Rio Grande Endangered Species Collaborative Program. Table 1 provides a broad overview of the scope and locations of these programs to begin to assess whether their methods are adequate to monitor the outcomes of bosque landscape alteration and whether the results from different programs might be comparable or complementary. Monitoring components for BEMP (Eichhorst and others 2002) and the Middle Rio Grande Bosque Fuels Reduction (Finch and others 2003a) and Wildfire Effects Studies (Finch and others 2003b) were taken from annual reports submitted to the MRGCD, and updates for BEMP were obtained from program volunteers. Monitoring components for the Endangered Species Collaborative Program are taken from the Program's Draft Monitoring Plan (MRGESACP 2004). The Draft Monitoring Plan has not been approved by the Collaborative Program but is useful for comparison purposes.

Table 1. Comparison of four monitoring programs in the middle Rio Grande bosque.

Monitoring Components	Program name and location by New Mexico County			
	BEMP ^a	BFRS ^b	BWES ^c	MRGESACP ^d
Vegetation structure		X	X	X
Vegetation composition	X	X	X	X
Vegetation cover	X	X	X	X
Post-fire veg. growth and survival			X	
Fuels inventories	X	X	X	
Fire intensity & behavior				
Leaf fall	X			
Hydrology (groundwater)	X	X	X	X
Hydrology (surface water)	X			X
Water quality				X
Riparian evapotranspiration				X
Geomorphology				X
Bird surveys (breeding)		X	X	X
Nest monitoring		X	X	X
Bird surveys (fall & winter)		X	X	X
Arthropods	X		X	
Herpetofauna		X		
Bats/Small mammals		X		
Ichthyofauna				X
Endangered species		X		X
Soils		X	X	X
Precipitation	X			

^aBosque Ecosystem Monitoring Program (Rio Arriba, Sandoval, Bernalillo, Valencia, Socorro counties)

^bMiddle Rio Grande Bosque Fuels Reduction Study (Bernalillo, Valencia, Socorro counties)

^cMiddle Rio Grande Bosque Wildfire Effects Study (Valencia and Socorro counties)

^dMiddle Rio Grande Endangered Species Collaborative Program (Taos, Rio Arriba, Santa Fe, Sandoval, Bernalillo, Valencia, Socorro counties)

Monitoring is an essential component of any restoration program but often gets inadequate attention and planning in the rush to implement projects, and can be the first budget reduced or eliminated when funding shortfalls occur. Monitoring programs developed as part of ecosystem-based or large-scale restoration plans may result in better designs that answer the critical questions, with coordination and support among stakeholders. Monitoring programs developed as part of larger restoration efforts are also more likely to be peer-reviewed. Some of the current large-scale restoration efforts in the middle Rio Grande provide the best opportunities to develop coordinated monitoring and adaptive management plans and secure the funding to implement them.

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