University of Arizona Water Sustainability Program

Conservation Easement Monitoring:
Development of a Monitoring Protocol for Riparian Area Management

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Water in Arizona and Problem of Land Fragmentation

Arizona is the fastest-growing U.S. state and this rapid population growth has led to the accelerated conversion of thousands of acres of rural land to urban uses. Fragmentation of private ranches and farms is becoming an issue of concern across much of the Western United States. The Texas Governor’s Task Force on Conservation has identified fragmentation of family-owned farms and ranches as the single greatest threat to wildlife habitat, water supply and the long-term viability of agriculture (Wilkins et al. 2003). Rapid population growth often leads to escalating non-agricultural value of nearby rural properties, creating incentives for farm and ranch owners to sell off or subdivide their land for development purposes (Kjelland et al. 2007). The resulting decline in rural property sizes means that there are more decision-makers, which can result in less integrated land management decisions.

Where landowners have rights of capture to groundwater, an increase in the number of landowners can lead to depletion of water supplies (Wagner and Kreuter 2004). Land fragmentation can also be associated with a decline in water quality; shifts in land cover from rangeland to cropland or other more intensive uses can increase the potential for pollution externalities, such as elevated nutrient run-off leading to increased water contamination (Kjelland et al. 2007). Land use strategies that do not account for the depletion of “natural capital” will almost certainly lead to significant loss of ecosystem function, including regulation of hydrological flows, storage and retention of water, and waste treatment and detoxification (Costanza et al. 1997).

Conservation Easements as a Possible Solution

Conservation easements represent a mechanism for combating these shifts in property size and as such conservation easements may facilitate integrated ecosystem management. Conservation easements are voluntary agreements with private landowners, in which land trusts or government agencies acquire and hold interests in property in order to restrict land use in perpetuity. Easement sales can compensate for loss of land value or buy out heirs and donations or sale of easements can reduce taxes (Gustanski and Squires 2000). Many larger easements allow for some commercial land use, such as ranching or timber extraction. These easements often have land management plans, which typically allow for agreement on operations and provide the flexibility for those prescriptions to change through regular consultation between the land manager and the easement holder (Rissman et al. 2007). This adaptive management plan is the greatest strength of ranching conservation easements and provides an essential tool for conservation of dynamic processes and communities within a permanent legal arrangement.

The land trust or government agency holding the easement has the perpetual legal responsibility to ensure that the owners of the property adhere to easement restrictions. Despite their growing use, there is very little quantitative data available on conservation easements and very little is known about the ecological outcomes of these arrangements at landscape or regional scales. Monitoring is extremely important for both compliance and for keeping track of on-going changes and there have been repeated calls for a detailed evaluation of the effectiveness of conservation easements for ensuring the continued provision of ecosystem services (Kjelland et al. 2007; Rissman et al. 2007). The rapid growth of conservation easements calls for the development and implementation of independent, cost-effective and scientifically defensible monitoring protocols.

Conservation easement management plans typically include provisions for the protection, and in some cases restoration, of riparian areas. Riparian areas serve to purify water, recharge groundwater, slow and alleviate floods and reduce erosion by water. Good
management of riparian areas may also mean increased forage productivity and stabilized incomes for livestock producers. Evans et al. (2007) have identified the establishment of conservation easements – in order to encourage the establishment of perennial riparian buffer vegetation - as an environmentally friendly alternative to traditional ditch channels for satisfying drainage requirements. As an alternative channel management strategy, riparian buffer vegetation enhances water quality functions while maintaining the necessary drainage function. Given the importance of riparian areas and their susceptibility to mismanagement, it is important that the landowner and easement holder be able to identify changes quickly and respond accordingly with modifications to the management plan.

**Purpose of the Study and Objectives**

The establishment of a monitoring protocol for riparian areas is a high priority and will serve as an important first step for broader conservation easement monitoring. This project will begin the development of a multi-level monitoring scheme for riparian response, which may include medium resolution satellite images, high-resolution satellite images or aerial photography, and field visits and ground measurements. Geospatial technologies are particularly appropriate for monitoring large easements and are currently being implemented to monitor working forest conservation easements in the Northeast (Williams et al. 2006), however a review of the literature found no published instances of their use in rangeland systems. These tools can greatly improve the efficiency of required monitoring and can enable the user to respond rapidly to change. This study will be a valuable step in determining what ecosystem services can be monitored at each spatial level and will help to track the effects of management actions on conservation targets. Importantly, efforts to monitor conservation easements will also allow land trusts and government agencies to start evaluating the effectiveness of conservation easements and what role they can play to protect the quality and quantity of water in Arizona.

Three specific objectives were identified for this study:

1. Meet with landowners, ranchers, and representatives of land trusts and other organizations working to protect riparian areas to discuss monitoring concerns and strategies. At the moment, it is not even clear what variables ought to be monitored to assure that even the most general conservation goals are being met (Merenlender et al. 2004). This collaborative process should yield a nascent protocol that is useable, enforceable and relevant.

2. The preponderance of the study will be the development of a multi-level monitoring protocol that will include satellite imagery, aerial photography, and ground measurements.

3. Apply and evaluate the protocol

**Key Accomplishments**

The planned outcome for this project is the development of a scientifically defensible, detailed and testable monitoring protocol/model for conservation easements. This protocol will address the questions of what should be monitored and at what scale it can/should be monitored. The first step is a thorough review of the monitoring and relevant remote sensing
literature, as well as the easement documents themselves; this will establish current system capabilities, as well as the relevant conservation targets.

**Objective 1: Connect with Stakeholders**

1. Formed Collaborations

   In order to create a model that is widely useable and relevant, it is important to understand the concerns of landowners and land trusts. In particular, it is crucial to get a sense of the financial limitations, time constraints and expertise limitations faced by these stakeholders. This feedback can then be used to design a framework that can be adapted for a variety of users. To this end, I have formed collaborations with representatives from The Malpai Borderlands Group, The Sonoran Institute, and The Nature Conservancy. I have also started to work with the Schwennesen family, who own the Double Check Ranch and currently have a conservation easement on their property.

   A multi-partner foundation for dialogue is not only a means of gaining understanding about the concerns of landowners, but these collaborations are also crucial sources of information. An important realization that has emerged from these conversations is that there is a large gap between what is being published in the peer-reviewed literature and what is happening on the ground. Many recent developments with regard to monitoring have not been reported or there is a significant lag time between implementation and reporting. Maintaining and strengthening these relationships is a high priority for the project and will ultimately facilitate the dissemination of knowledge and information into public space.

**Objective 2: Develop Monitoring Scheme**

1. Review of Legal Conservation Targets

   It has been widely noted in the literature that the conservation targets written into easement documents are often vague and thus present problems from monitoring. However, no review of legal conservation targets has been published and it is difficult to gauge the extent of this problem. Twenty-three conservation easements have been obtained or identified and are currently being compiled into a comprehensive record of legal conservation targets. Commonly used targets are being coded to facilitate linking with parameters of riparian health.

2. Identification of Riparian Health Indicators

   Federal and state standards and the peer-reviewed literature (standards determined by the scientific community) were examined to compile a list of widespread, commonly applicable and measurable parameters of riparian health. These indicators of riparian area health include water quality, water supply and biodiversity parameters and represent major components of both the riparian and aquatic ecosystems.

3. Remote Sensing Cost Comparison

   A survey/comparison of remote sensing data costs was conducted for medium-resolution satellite sensors, high-resolution satellite sensors and aerial photographs. Image
costs for remotely sensed monitoring will not only be an important consideration for the scope of this study, but will also affect future end-users and need to considered from the onset of protocol development.

4. Skills Acquired

Geospatial technologies have the potential to greatly improve the efficiency of monitoring and can enable the user to respond to changes quickly. In order to make use of these technologies, a number of relevant geospatial analysis skills were obtained, including:

- Land cover and land use change detection using both aerial photographs and satellite imagery.
- Integrated geospatial analysis and modeling techniques.
- Development of geospatial databases and cartographic display.

In order to understand the legal conservation easement documents and the legal organization on which they are based, it was necessary to develop legal analysis skills and to become familiar with relevant state and federal legislation. This step was not only vital for a full understanding of this topic, but is also important for understanding the construction of the legal document and the implications for monitoring.

Species identification skills are fundamental to the conduct of field research and ecological surveys. Efforts were made to develop vegetation field identification skills by participating in a field course and by attending relevant community and university lectures and presentations. These field identification skills are very important for ground truthing remotely sensed data and will help to determine the appropriate spatial scale for monitoring riparian vegetation parameters.

**Objective 3: Apply and evaluate the protocol**

Several parcels with riparian areas that are currently under a conservation easement were identified as potential test sites for the protocol. Conservation easements have only been used in the Southwest for approximately 15 years and some relevant ecological components exhibit relatively slow response in semi-arid ecosystems. In such cases, it might be necessary to look at areas beyond those protected by conservation easements in order to determine the applicability of using remote sensing to monitor a riparian health parameter. Where possible, it is preferable to use sites with easements; given the importance of landowner participation and feedback for this study, it is fitting to provide the landowner with a site-specific tool at the end of the study.

**Next Steps**

The next step for this study will be to reconcile the legal targets and objectives with the identified indicators. Some parameters may be more important than others and there may be some overlap or redundancy between parameters. A second consideration is that some parameters may be more suitable than others for an organization that relies on volunteers (e.g. bird counts rather than invertebrate monitoring). This step will likely include collaborating with the Sonoran Institute, as they have done substantial groundwork on the suitability of different
riparian health parameters for their soon-to-be-released Upper Santa Cruz Riparian Health Assessment. Once these final parameters are identified, it will be possible to determine the appropriate spatial scale for monitoring each parameter.

Land conservation is an essential part of a multi-barrier approach to protecting water supplies and the link between restricting land use in watersheds and water quality is strong (Wilkins et al. 2003). As the margin of error for unsustainable resource use decreases, integrated land and water use planning takes on a more critical role in connecting policies with decision-making.

References


