

MONITORING AND EVALUATION

The current understanding of the SLV and the Alamosa NWR ecosystem has been greatly enhanced by documentation of system attributes and management actions (such as in former annual narratives of the refuge) and past monitoring and evaluation studies of vegetation and animal communities, water quality and quantity, and specific management actions. Future management of the system should incorporate key monitoring studies and direct research as needed (Paveglio and Taylor 2010). Monitoring will be determined primarily by refuge objectives, but some measures should be collected that indicate how factors related to ecosystem structure and function are changing, regardless of whether the restoration and management options identified in this report are undertaken. Ultimately, the success in restoring and sustaining communities and ecosystem functions and values at Alamosa NWR will depend on how well the physical integrity and hydrological processes and events within the refuge can be restored, maintained, and emulated by management actions as well as the relative resiliency of different habitat types. Therefore, monitoring and evaluation of the management strategies employed at Alamosa NWR must be long enough to account for the spatial and temporal rate of change for different abiotic and biotic characteristics that are altered (Michener and Haeuber 1998). The availability of future water amounts, timing, and type (groundwater vs. surface water source) is a major item that must be carefully monitored and considered as future management for the refuge is considered. Uncertainty exists about the future of some important water issues and the ability of the USFWS to make some system changes because they are not completely under the control of the USFWS. Also, specific

techniques for certain management actions, such as controlling and reducing introduced plant species and the efficacy of restoring native composition and integrity of wetland and desert shrub habitats are not entirely known.

Whatever future management actions occur on Alamosa NWR, activities should be done in an adaptive management framework where: 1) predictions about community response and water issues are made (e.g., decreased invasive weed dominated habitats) relative to specific management actions (e.g., restoration of seasonal sheetwater flow) in specific locations or communities (e.g., Vastine soils) and 2) follow-up monitoring is conducted to evaluate ecosystem responses to the action. Information and monitoring needs for Alamosa NWR related to the hydrogeomorphic information evaluated in this report are identified below:

GROUNDWATER AND SURFACE WATER QUALITY AND QUANTITY

The recent WRIA for Alamosa NWR (Striffler 2013) identified several important future monitoring and information needs related to water. These and other needs include:

- Protect water rights for the refuge through careful monitoring and reporting of water use and ecosystem benefits. This will include updating well-meter calibrations, restoring and maintaining points of water diversion, and use of appropriated water rights.
- Evaluate potential alternatives to existing water sources and supplies to augment water supplies in the advent of decreased availability of some sources.

- Initiate a baseline water monitoring program to document long-term changes in surface and groundwater quality and quantity.
- Conduct routine monitoring of water quality and contaminant issues in relation to water source and routing. Regular monitoring of surface, ground, and soil salinity in key reference locations related to HGM-determined communities should be established.
- Install water flow metering stations at key points on the refuge if/when historic drainage pathways are utilized to allow water to more naturally flow through the system.
- Continue to participate in SLV water monitoring and management activities and determine potential effects of various climate change scenarios.

RESTORING NATURAL WATER FLOW PATTERNS AND WATER REGIMES

This report identifies several potential physical and management changes that could help restore natural topography, water flow, and flooding/drying dynamics in managed wetlands. These changes include restoring sheetflow through natural drainages across the floodplain and managing impoundments (that are retained) for more natural spring-flooded seasonal flooding regimes. Further, restoring inter-annual dynamics of flooding and partial drying of the impoundments managed for seasonal and semi-permanent water regimes and persistent emergent vegetation is desired. The following monitoring will be important to understanding effects of these changes if implemented:

- Evaluate current water-control infrastructure to determine if current and future water management needs (e.g. capacity and placement) are being met or if changes to the system are warranted.
- Evaluate current hydrologic flow patterns in relation to HGM recommendations to restore some historical flow through natural channels.
- Evaluate surface and groundwater interactions and flow. Development of an annual water budget which incorporates both surface and groundwater based on predictions and actual conditions could help in creating future Augmentation Plans and maintaining water rights.
- Document and monitor timing, duration, and extent of surface water across habitat types. Observations of how water flows through current water-control structures in, for example, wet meadow habitats will help guide the modification of existing structures and the placement of new ones in appropriate locations, both vertically and horizontally, to distribute water in a sheetflow pattern without causing head-cuts or other water delivery-induced impacts to the system (Zeedyk 1996).
- Monitor groundwater changes within features such as natural levees where revegetation activities occur, such as pole plantings of cottonwood.

LONG-TERM CHANGES IN VEGETATION AND ANIMAL COMMUNITIES

The availability of historic vegetation information coupled with regularly documenting changes in general and specific vegetation communities is extremely important to understand the long-term changes and management effects on Alamosa NWR. Also, regular monitoring of at least some select animal species or groups helps define the capability of the Alamosa NWR ecosystem to supply key resources to, and meet annual cycle requirement of, animals that use the refuge and regional area. Important survey/monitoring needs include:

- Mapping the cover, density, and diversity of invasive species over time in relation to management strategies.
- Success of cottonwood and willow regeneration on Sandy Alluvial Land soil series areas and in other areas such as natural levees where this habitat type is being promoted.
- Changes in extent of different wetland and upland habitats as hydrologic changes occur in relation to timing, duration, periodicity, and source of water resources utilized
- Occurrence, timing, and habitat use of key migratory and breeding birds, including Neotropical songbirds, secretive marsh birds, waterfowl, and colonial waterbirds.

- Rates and occurrence of fire in riparian areas, wetlands, and shrublands in relation to invasive weeds and native vegetation cover and diversity.
- Vegetation response to grazing strategies, including the rate, timing, and intensity of grazing (e.g., warm vs. cool season plant response to various strategies).
- Vegetation response to mowing and/or haying in relation to season
- Vegetation response to mechanical manipulations mimicking natural processes such as scouring events.
- Occurrence, distribution, and abundance of amphibians and reptiles in relation to different hydrologic regimes, wetland types, and management strategies.
- Occurrence, distribution, and abundance of invertebrates in relation to different hydrologic regimes, wetland types, and management strategies.



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