MONITORING AND EVALUATION

The current understanding of the SLV and the Monte Vista NWR ecosystem has been 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 would benefit from continuing key monitoring studies and directed studies as needed (Paveglio and Taylor 2010). Monitoring will be determined primarily by refuge objectives, but some measures should be collected that facilitate evaluation of 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 Monte Vista NWR will depend on how well the physical integrity and hydrological processes that affect the refuge can be restored, maintained, and emulated by management actions. The availability of future water amounts, timing, and type (groundwater vs. surface water source) is a major factor that must be carefully considered because uncertainty exists about the future of some important water issues and the ability of the USFWS to influence appropriate hydrologic changes that 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 salt desert shrub habitats are not entirely known.

Whatever future management actions occur on Monte Vista NWR, activities should be done in an adaptive management framework where: 1) predictions about community response and water issues are made (e.g., increased diversity and vigor of wet meadow species) relative to specific management actions (e.g., restoration of seasonal sheetwater flow) in specific locations or communities (e.g., Torsido clay loam soils) followed by 2) monitoring to evaluate ecosystem responses to the action. Information and monitoring needs for Monte Vista NWR related to the hydrogeomorphic information evaluated in this report are identified below:

GROUND AND SURFACE WATER QUALITY AND QUANTITY

The recently completed Water Resources Inventory and Analysis (WRIA) for Monte Vista NWR 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.
- Evaluate potential alternatives to existing water sources and supplies to augment water supplies in the advent of decreased availability of some sources.
- Complete inventories of all water management infrastructure including water-control structure size, type, location, direction of flow, etc. to develop a refuge-wide water use management model.
- Conduct routine monitoring of water quality and contaminant issues in relation to water source and routing. Regular monitoring of surface, ground, and soil salinity if key reference locations related to HGM-determined communities should be established.

- Establish water flow metering at key points on the refuge.
- Monitor salinity levels in a variety of wetland types in relation to source of water, duration and depth of flooding, and seasonal flooding/drying regimes.
- Continue to participate in SLV water monitoring and management activities and determine potential effect 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 some more natural topography, water flow, and flooding/drying dynamics in managed wetlands. These changes include restoring at least some more natural sheetflow of water through natural drainages and across former wet meadow areas and managing units (that are retained) for more natural seasonal flooding regimes. Further, restoring interannual dynamics of flooding and at least partial drying of the impoundments managed for semi-permanent water regimes and persistent emergent vegetation is desired. The following monitoring will be important to understanding effects of these changes if implemented:

- Map locations of levees, ditches, and water-control structures that are removed or modified.
- Document how water moves across and infiltrates former wet meadow areas and soil types.
- Establish groundwater monitoring to document changes in subsurface flows as hydrology is restored to shrublands and wet meadows.
- Evaluate surface and groundwater interactions and flow throughout historic creeks and floodplains.
- Document changes in the water table in shrublands and extent, duration, and periodicity of sheetflow in these areas.
- Document surface and subsurface flow patterns across the alluvial fan.

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 Monte Vista NWR. Also, regular monitoring of at least some select animal species or groups helps define the capability of the Monte Vista 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:

- Detailed inventory and mapping of plant species composition, distribution, productivity, and coverage in all habitats. In areas where water-control structures are removed or modified, vegetation should be mapped prior to modification/removal to evaluate subsequent changes.
- Cover, density, and diversity, including expansion and contraction rates, of invasive species before and after control treatments.
- Abundance, chronology of use, survival, and reproduction of key waterbird and neotropical migrant songbirds including dabbling ducks, sandhill cranes, white-faced ibis, etc. For example, monitor use of foraging areas for white-faced ibis before and after changes are made to water management infrastructure.
- Rates and occurrence of fire, grazing, and mechanical disturbances in wetlands and grasslands in relation to vegetation response.
- Vegetation response to grazing strategies including the rate, timing, and intensity of grazing taking into account the seasonality and climatic conditions.
- Occurrence, distribution, and abundance of amphibians and reptiles such as the northern leopard frog in relation to all life cycle events. Document bull frog (*Lithobates catesbeianus*) presence in persistent emergent wetlands prior to and after changes in water management.
- Presence of invertebrate communities in existing wetlands with follow-up sampling in subsequent years to determine changes in abundance related to water regimes.