

# International Arid Lands Consortium's Contributions to Madrean Archipelago Stewardship

**Peter F. Ffolliott**

School of Natural Resources, University of Arizona, Tucson, AZ

**Jeffrey O. Dawson**

Department of Natural Resources and Environmental Sciences, University of Illinois, Urbana, IL

**Itshack Moshe**

Southern Region, Land Development Authority, Israel

**Timothy E. Fulbright**

Caesar Kleberg Wildlife Research Institute, Texas A&M University, Kingsville, TX

**W. Carter Johnson**

Department of Horticulture, Forestry, Landscapes and Parks, South Dakota State University, Brookings, SD

**Paul Verburg**

Division of Earth and Ecosystem Sciences, Desert Research Institute, Reno, NV

**Muhammad Shatanawi**

Faculty of Agriculture, University of Jordan, Amman, Jordan

**Donald F. Caccamise**

Department of Fishery and Wildlife Sciences, New Mexico State University, Las Cruces, NM

**Jim P. M. Chamie**

International Arid Lands Consortium, University of Arizona, Tucson, AZ

***Abstract**—The International Arid Lands Consortium (IALC) was established in 1990 to promote research, education, and training activities related to the development, management, and reclamation of arid and semiarid lands worldwide. Building on a decade of experience, the IALC continues to increase the knowledge base for managers by funding research, development, and demonstration projects and special initiatives. Results from these scientific and technical efforts enhance management of arid and semiarid ecosystems for sustainable use within the framework of maintaining the integrity of the ecological processes. Contributions of the IALC to stewardship of the natural resources in the Madrean Archipelago are presented in this paper.*

## Introduction

The IALC promotes research, education, and training activities related to the development, management, and reclamation of arid and semiarid lands worldwide. Member institutions are indicated by affiliations of the authors of this paper. The IALC supports ecological sustainability and environmentally sound use of these lands by funding research, development, and demonstration projects. Results from these scientific and technical efforts enhance management of arid and semiarid ecosystems for sustainable use within the framework of maintaining the integrity of the ecological processes (Ffolliott and others 2001). This paper presents a synopsis of the contributions of the IALC's programs to stewardship of natural resources in the Madrean Archipelago region.

## Soil and Water Resources Development and Conservation

Carbon pools in dryland environments are comparatively large, but fluxes of carbon to and from the atmosphere have been poorly understood. Therefore, the extent that these environments sequester CO<sub>2</sub> from the atmosphere into the calcium-carbonate system and the magnitude of its formation was estimated in an IALC study. With this information, soils can be managed to sequester CO<sub>2</sub> and mitigate impacts of the greenhouse effect, leading to the possibility of "carbon credits" for these ecosystem managers.

Soil-organic matter plays a key role in stabilizing sandy soils in arid and semiarid environments. Studies in other ecosystems have shown that the contribution of soil-organic matter to soil structure depends largely on its composition and distribution. The results of an IALC study helped to identify the biotic and physical resources to manage when promoting soil aggregation, optimizing soil stability and productivity, and reducing land degradation from excessive soil losses through the actions of water and wind.

Increased awareness about wastewater disposal by using environmentally sound and economically beneficial methods evolved from this demonstration project. Specialists in water and soil management, small-business development, and community planning from the Southwestern United States and Northwestern Mexico collaborated in applying treated wastewater to landscapes not suited for agriculture to grow short rotation pulpwood trees for profit. This low-cost approach safely recycled sludge and wastewater from small communities along the border, while protecting the environment and providing enhanced economic development opportunities.

## Land Use and Reclamation

Coppice (sprouts) evolving from the rootstocks of harvested Emory oak trees use disproportionately high amounts of water (up to 80 percent of the annual precipitation) in transpiration in comparison to mature trees (about 45 percent of the annual precipitation). Less water is then available to recharge groundwater aquifers, produce streamflow, and help other plants grow. This research provides a basis for prescribing the management of post-harvest oak stands to optimize fuelwood production, achieve water conservation, and, through the results of companion studies, benefit other resource benefits in these woodlands.

Status and management opportunities for sensitive bird species have been evaluated as a contribution to the Southwestern Borderlands Ecosystem Management Research Project, headed by the USDA Forest Service (Gottfried and others 1999) to provide a basis for better ecosystem management. Greater seasonal shifts in species richness occurred on sites supporting the greatest woody cover, while total bird numbers varied little between seasons except on sites with little woody cover. Prescribed burning treatments and lower livestock grazing intensities are likely to create a mosaic of diverse woody plant communities that would support the greatest bird-species diversity.

Historical and current information on public grazing lands has been assembled to develop electronic formats that facilitate the planning process used by Federal agencies in preparing livestock-allotment plans. The database template provides a model to maximize benefits of past financial inputs, offer new planning opportunities, and operate in compliance with Federal laws and regulations pertaining to public grazing lands. A variety of delivery mechanisms are available to ensure that the broadest constituency possible is served.

## Processes Enhancing the Management of Ecological Systems

Human disturbances often lead to habitat fragmentation, which influences the sustainability of wildlife populations and other natural resources on the affected sites. Understanding how habitat fragmentation impacts ecosystem processes at species, community, and population levels was determined in this investigation. Availability of this information (in turn) facilitates proper management of wildlife resources when fragile ecosystems are impacted by livestock grazing, urbanization, and interventions to restore degraded landscapes.

The IALC supported preparation of a video called *Survivors in the Sand* that increased the awareness and interest in natural resources and their management issues. Conservation, sustainable use, and management of arid and semiarid lands were documented in the 1-hour video through on-site interviews and film archives from the Madrean Archipelago and other dryland regions. Topics presented included the conservation of water resources, land reclamation treatments, and sustaining endangered and threatened species. There has been widespread airing of the video by public and private television.

## Inventorying and Measurement Techniques and Monitoring

Landscape-scale management often requires information that is not easily obtained from sample plots or extrapolations from time-dependent data sets. Long-term photographic databases of broom snakeweed (*Gutierrezia sarothrae*) have been incorporated into information visualization system to overcome this problem for this noxious plant species. The ability to couple historical information with the results of small-scale experiments conducted at specific points in time represents a powerful tool to help people to better understand the landscape changes that result from alternative management activities and land-use practices.

Sampling of large rainfall and runoff events, flooding, and other outlier events is difficult in the Madrean Archipelago because of the extreme variability of the occurrence of these events. Research on the Walnut Gulch Experimental Watershed showed that peak stormflows can be estimated from knowledge of surface water profiles indicated by high water marks and post-flow stream channel geometries. The uncertainty associated with these indirect peak streamflow-discharge estimates was also estimated. These methodologies can be expanded to improve estimates of hydrologic processes on lands with little ground-based monitoring.

## Summary

Efforts of the IALC to learn more about the ecological sustainability and development of arid and semiarid landscapes such as those represented by the Madrean Archipelago region continue. Results from these scientific and technical efforts enhance management of arid and semiarid ecosystems for sustainable use of the inhabiting resources within the framework of maintaining the integrity of the ecological processes.

## Acknowledgment

Preparation of this paper was supported largely by funds provided to the International Arid Lands Consortium by the USDA Forest Service and Cooperative States Research, Education, and Extension Service.

## References

- Ffolliott, P. F.; Dawson, J. O.; Fisher, J. T.; Moshe, I.; DeBoer, D. W.; Fulbright, T. E.; Tracy, J.; Al Musa, A.; Johnson, C.; Chamie, J. P. M. 2001. Arid and semi-arid land stewardship: A 10-year review of accomplishments and contributions of the International Arid Lands Consortium. Gen. Tech. Rep. RMRS-GTR-89. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 74 p.
- Gottfried, G. J.; Eskew, L. G.; Curtin, C. G.; Edminster, C. B., comps. 1999. Toward integrated research, land management, and ecosystem protection in the Malpai Borderlands: Conference summary. Proc. RMRS-P-10. Fort Collins, CO: U. S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 138 p.