Potential for Extending Major Land Resource Areas into Northern Mexico

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Abstract—*There is a significant history of cooperative efforts between Mexico and the United States on natural resource management issues. Mexico and the United States have jointly conducted research and developed range management technologies. Bringing these technologies together and improving technical communications are an ongoing process. This paper discusses a potential tool that can provide a common denominator for both countries to more easily frame, describe, and share data relative to rangeland resources. The objective is to present possibilities for utilizing current data and provide a vehicle that can facilitate technical communications. Existing maps including climate and elevation were used to define probable areas of Chihuahua and Sonora that would be similar enough to Major Land Resource Areas (MLRAs) of Arizona to consider them an extension of those MLRAs. Reconnaissance surveys were made to compare soils and vegetation to those described in Arizona. Comparisons were also made between Ecological Sites (ESDs) used in the United States with those developed in Mexico by COTECOCA. A preliminary map was developed that represents probable boundaries of MLRA 41 if extended from the U.S. border into the states of Chihuahua and Sonora. Some sites were mapped to test application of U.S. ecological site descriptions with on-ground conditions in Chihuahua. The potential for extending MLRA boundaries from the United States into Mexico are feasible and realistic. This would facilitate the direct use of Ecological Site Descriptions across borders and improve exchange of rangeland data between the two countries.*

Background and Objectives

Our presentation today is not the first discussion of this subject. There have been two previous accounts of the effort to explore the possibilities of extending Major Land Resource Area (MLRA) boundaries from the southern United States border into Mexico. These are Rebecca MacEwen and others paper (2005) *Defining Boundaries Across Borders: A Case Study Extending a Major Land Resource Area Into Mexico*, and Philip Heilman and others (2000) *A Framework for Cooperation Across the U.S./Mexico Border.*

The project demonstrates the cooperative nature of several agencies and individuals. All activities were under the leadership of the Southwest Watershed Research Center of the USDA-ARS. The principal partner in Mexico was the Instituto Nacional de Investigaciones de Forestales, Agricolas, y Pecuarias (INIFAP). Alicia Melgoza played a critical role in assisting with scheduling activities in Mexico, advising on conditions and characteristics of vegetation, and helping with plant identification. Antonio Chavez, former Director of Campo Experimental La Campana, made the facilities of La Campana available to serve as a headquarters site for those involved in the project. Rafael Fierros of Comisión Tecnico Consultiva para la Determinación Regional del los Coeficientes de Agostadero (COTECOCA), Chihuahua devoted his time and assistance to the effort, regarding COTECOCA site identification and plant identification.

The USDA Natural Resources Conservation Service (NRCS) provided excellent technical expertise with the participation of Dan Robinett, Range Conservationist, Tucson, Steve Barker, State Range Conservationist Phoenix, and Don Breckenfeld, Soil Scientist, Tucson. In addition, the producers of Ejido Nuevo Delicias, Chihuahua, cooperated by making their lands available for site correlation work. This paper will present an overview of the activities and findings in an attempt to identify limits of an MLRA boundary when extended from the U.S. border in Arizona to the states of Chihuahua and Sonora. Emphasis will be on an appreciation and understanding of the materials and data bases available that indicate the compatibility of the concept with other data bases and agencies rather than just the effort made to test extending MLRAs into Mexico.

Classification System

MLRAs are part of a hierarchical classification system that is important in classifying soils and ecological sites. The system was developed by the Soil Conservation Service, now NRCS, and published as USDA Handbook 296 in 1965. The handbook was revised in 1978, and published in 1981. This version was again revised and updated and published in 2006. The classification system has important and

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valuable application, particularly related to rangelands in terms of ecological site work, and soil/site correlation. The system components are shown below:

NRCS Hierarchical Classification System:
- LAND RESOURCE REGIONS
  - MAJOR LAND RESOURCE AREAS
    - LAND RESOURCE UNITS (or Common Resource Areas)
      - ECOLOGICAL SITES
        - SOIL SERIES

> Since the 1960's, NRCS has been using the soil and ecological site databases as the basic units of a hierarchical natural resource classification system called Major Land Resource Areas (MLRA's). This system provides a basis for making decisions about national and regional agricultural concerns, helps identify needs for research and resource inventories, provides a broad base for extrapolating the results of research within national boundaries, and serves as a framework for organizing and operating resource conservation programs"(Fox and others 1999).

Land Resource Regions

The broadest category in the hierarchy is **Land Resource Regions**. The region of most interest for this paper is Region D, Western Range and Irrigated Region shown in figure 1. It makes up 549,725 square miles (1,424,480 square kilometers). This is the largest of all the land resource regions in land area. It is a semi-desert or desert region of plateaus, plains, basins, and many isolated mountain ranges.

Major Land Resource Areas (MLRAs)

Regions are further subdivided into Major Land Resource Areas (fig. 2). This level of classification is the subject of this document.

MLRA lines end at the international border. The characteristics that the lines represent do not end at the border, but extend to some unknown extent into Mexico. This recognition was the fundamental rationale for exploring where the boundaries might lie within Mexico. Some important aspects of the MLRA system are:

- It is nationwide in scope.
- It is updated and refined periodically. Some states have refinements that reflect county level determinations.
- It is not an isolated concept useful only to NRCS. MLRAs have been correlated with other agency classification systems.

In addition to use by the Bureau of Land Management in its use of ecological sites, it has also been correlated with other agency classification systems. The information shown below illustrates the correlation that has been done to date. USDA Handbook 296 (2006) cross-references MLRAs with Environmental Protection Agency's (EPA) Level III Ecoregions, and with United States Forest Service (USFS) ecological units for the conterminous United States. A few cross references are shown in table 1. The fact that MLRAs have been

Figure 1—Region D: Western Range and Irrigated Region (source: USDA NRCS Agriculture Handbook 296).

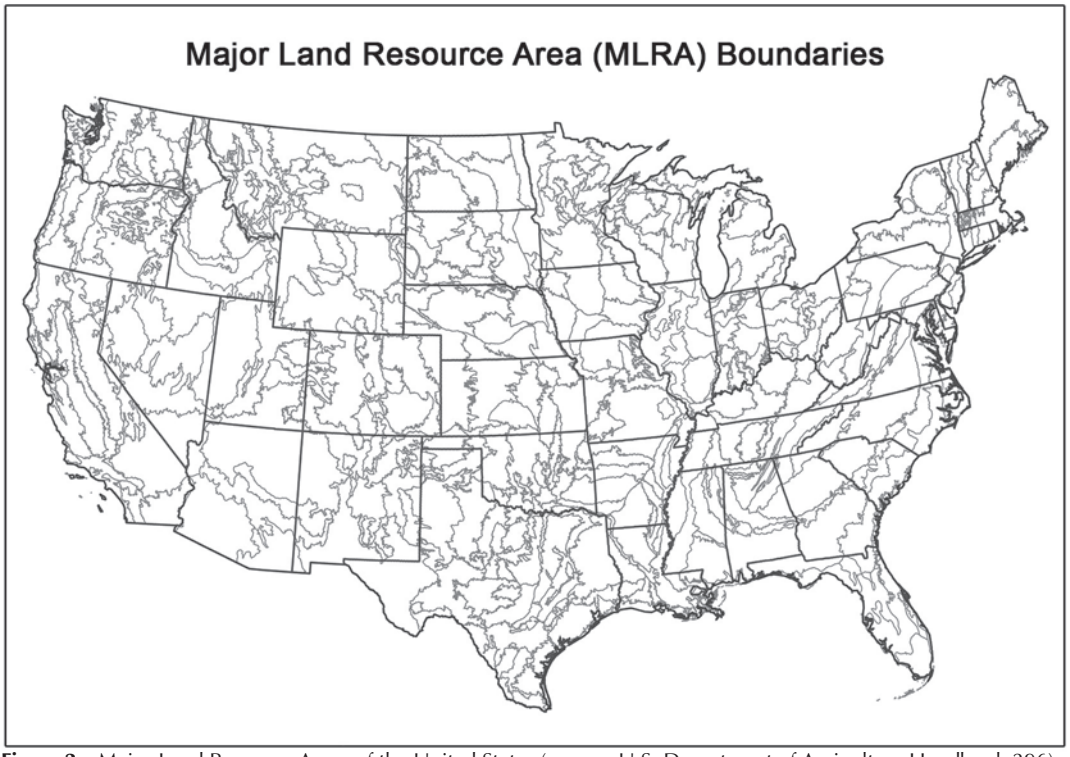

Figure 2—Major Land Resource Areas of the United States (source: U.S. Department of Agriculture Handbook 296), .

Table 1-Cross reference of MLRAs, USFS, and EPA.

MLRA	USFS	EPA
39 Arizona and New Mexico Mountains	M313A White Mountains-San Francisco	23 Arizona/New Mexico Peaks-Mogollon Rim
40 Sonoran Basin and Range	322B Sonoran Desert	81 Sonoran Basin and Range
41 Southeastern Arizona Basin and Range	**321A Basin and Range**	**79 Madrean Archipelago**
41 Southeastern Arizona Basin and Range	**321A Basin and Range**	**24 Chihuahuan Deserts**
42 Southern Desertic Basins, Plains, and Mountains	321A Basin and Range	24 Chihuahuan Deserts

correlated to other agency classification systems broadens their utility and expands their range of application. Similar applications and interest are shown in The Nature Conservancy's work in the Apache Highlands Ecoregion, Gori and Enquist (January 2003).

In our primary area of interest, the following figure illustrates the MLRAs as they occur in Arizona. One can see that in the Southeastern corner of Arizona lays MLRA-41, Southeastern Arizona Basin and Range, which is the primary focus of this paper. MLRA 41 is further subdivided into three Common Resource Areas (Climatic Zones), or Land Resource Units (fig. 3):

- Common Resource Area 41-1 Mexican Oak-Pine Woodland and Oak Savannah
- Common Resource Area 41-2 Chihuahuan-Sonoran Desert Shrub Mix
- Common Resource Area 41-3 Southern Arizona Semidesert Grassland

The extension of MLRAs into Mexico would allow the direct use of Ecological Site Descriptions (ESDs) for "on-the-ground" ecological interpretations. In addition to being a valuable grazing management tool, ecological site descriptions provide a documented biodiversity benchmark in the list of plant species that are known to occupy a particular ecological site. In addition to providing a list of documented plants, the ESD also indicates the potential primary production range of each species, or groups of species. This provides a new level of information subject to interpretation for biodiversity studies.

Acitivies and Methods

Initial work consisted of reconnaissance surveys, focusing on observations of vegetation and soil characteristics as compared with that of ecological sites described in Arizona. A primary tool used in the evaluation of MLRA boundaries was the application of Geographical Information System (GIS) technology. Virtually all the activities of the project were correlated with and incorporated into a GIS database that proved invaluable in evaluating and displaying findings.

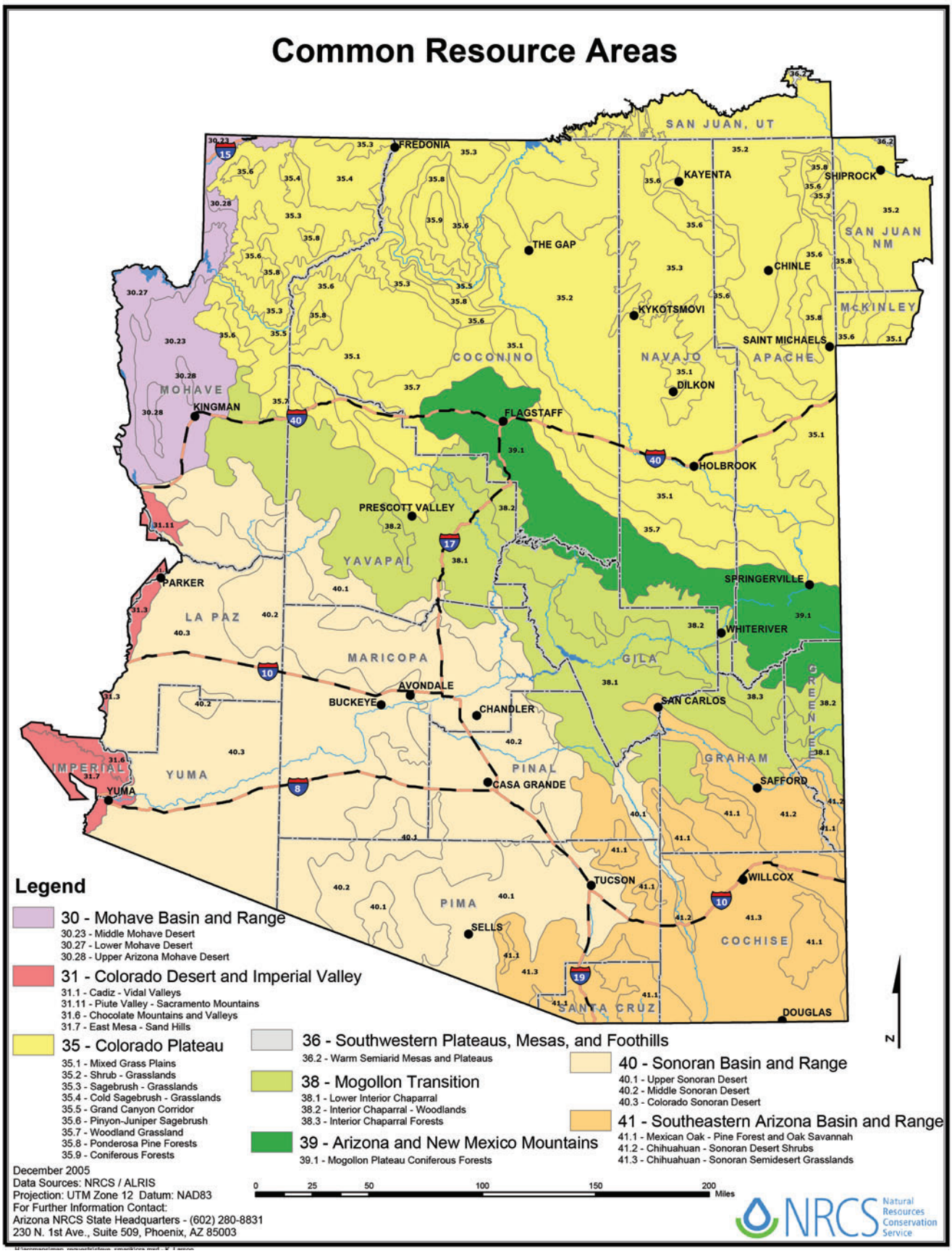

Figure 3—MLRAs and CRAs of Arizona.

Based on information developed from the initial reconnaissance trips and other sources, a map was developed by Heilman (2000) and MacEwen (2005) showing a suggested extension of MLRA boundaries (fig. 4). This preliminary map was largely developed by digitizing vegetation maps of Sonora and Chihuahua from Brown and Lowe's (1994) *Biotic Communities of the Southwest*. Ultimately, the Brown and Lowe based map turned out to be an excellent first approximation that provided valuable guidance for field determinations.

Further field work included investigations by Don Breckenfeld, NRCS Soil Scientist. Soil profiles were described and compared to known soil series in Arizona. All of the soil profiles described were determined to be very similar to soil series associated with MLRA-41 (fig. 5).

Existing maps relative to climate and elevation were used to define probable areas of Chihuahua and Sonora that would be similar enough to Major Land Resource Areas (MLRAs) of Arizona to consider them an extension of those MLRAs. Comparisons were also made between Ecological Site Descriptions used in the United States with site descriptions developed in Mexico by COTECOCA.

Hydrologic studies were also included in the field activities. A rainfall simulator was used to evaluate hydrologic conditions as related to ecological conditions and soils on several sites within the projected MLRA area. The technology and procedures are described by Stone and Paige (2003) (fig. 6).

As another evaluation of site similarities, a small ranch just south of La Campana was mapped using NRCS ESDs. Most of the sites were very similar to ecological sites in Arizona, and should be considered to be adequate for management interpretations (fig. 7). The Arizona site descriptions used in developing the above map, and a corresponding translation name used are as indicated in the table 2:

Comments Regarding Range Sites, Forage Production Sites, and Ecological Sites

Both the United States and Mexico have invested major resources in their respective efforts to define and classify rangeland units for the purposes of conducting inventories, analysis of rangeland resources, and as range management tools. The most significant units developed for these purposes have been the Ecological Site concept in the United States, and the Sitios de Productividad Forrajera (Forage Production Sites) in Mexico. The Range Site (now Ecological Site) concept was adopted by the USDA Soil Conservation Service (now Natural Resources Conservation Service [NRCS]) in 1949, based on the work of E.J. Dyksterhuis (1949).

The principal application of Range Sites was in conducting inventories and rangeland analyses during the process of range management planning with ranchers on privately owned lands. The purpose was to help individual ranchers manage rangeland resources to improve rangeland conditions and increase economic returns for the rancher.

The primary purpose of the COTECOCA sites (fig. 8), at the time they were developed and mapped, was to establish grazing capacities for the different major plant community types for the entire nation. Heilman and others (2000) made several important observations regarding the resolution differences between ecological sites and forage production sites:

Figure 5—Describing soil, Chihuahua.

Figure 6—Rainfall simulator studies, Chihuahua.

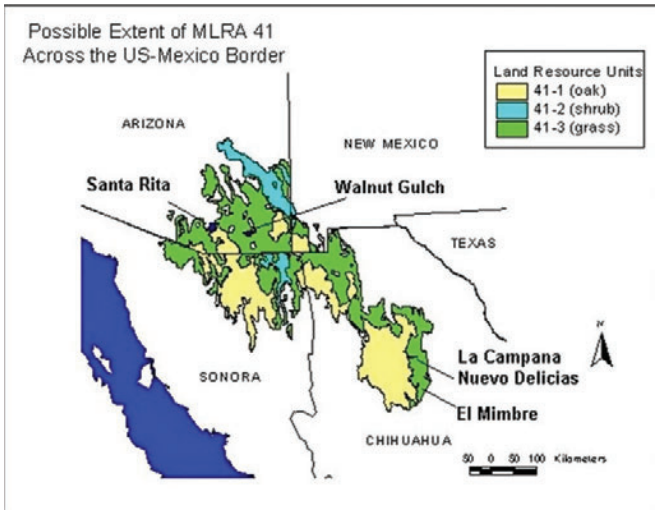

Figure 4—Possible extent of MLRA 41 boundaries (from Heilman and others 2000).

Figure 7—Ecological sites mapped in Chihuahua.

Table 2-Site names and map symbols

Arizona Site Name	Translation	Map Symbol
Shallow Hills 41-1	Lomas – Suelos Poco Profundo	LPP
Loamy Hills 41-1	Lomas Francosa	LF
Loamy Upland 41-3	Llano Francoso	LlF
Granitic Hills 41-3	Lomas Graníticas	LG
Sandy Loam Upland 41-3	Franco Arenosa	FA
Shallow Upland 41-3	Llano – Suelos Delgados	LlD

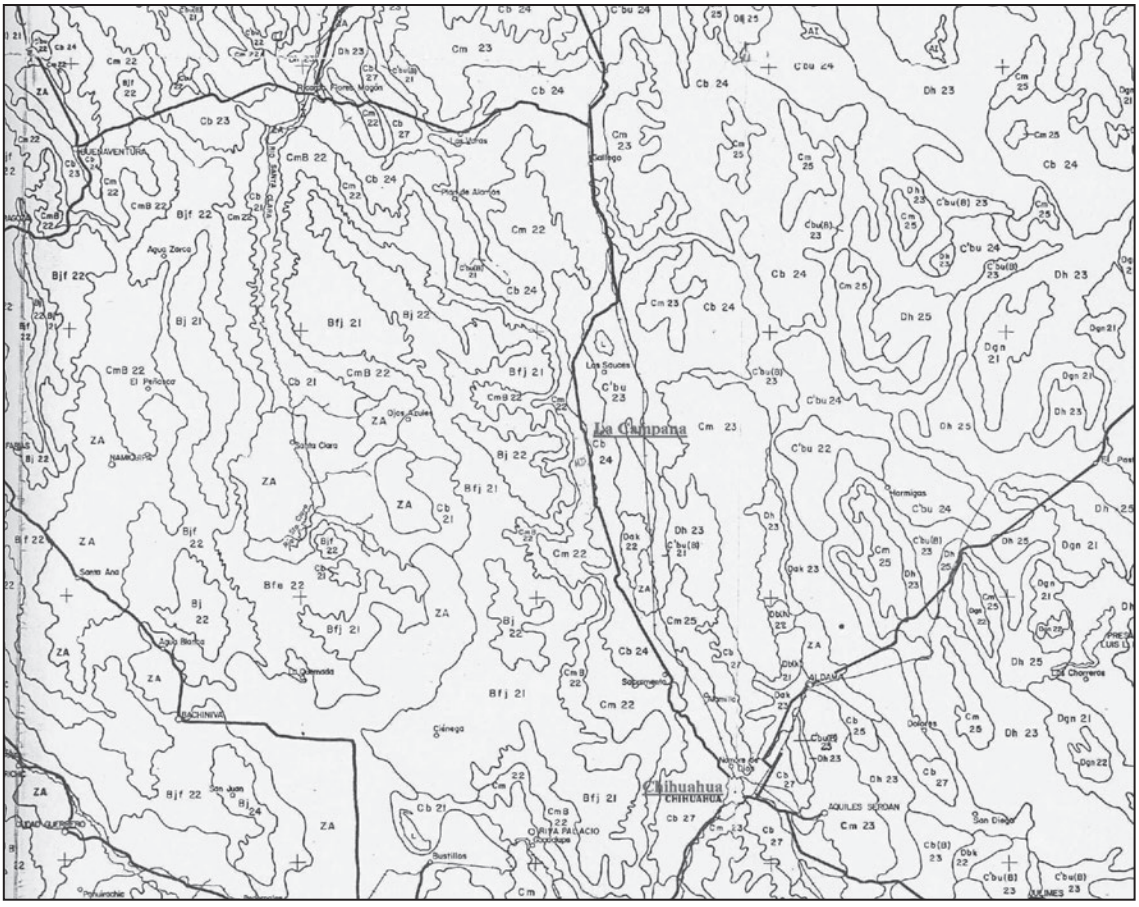

Figure 8—A portion of Chihuahua showing COTECOCA site mapping

Defining sites on an ecological, rather than forage, basis leads to a finer resolution of sites in the U.S. In Arizona, 503ecological sites are defined over a total area of 29m hectares. In Chihuahua, 64 forage production sites are defined for 24m hectares. Per unit area then, there are almost 7 times as many ecological sites defined in Arizona as there are forage production sites defined in Chihuahua. Both approaches distinguish areas with the potential for homogeneous stands, such as sacaton bottoms, as separate sites. However, the Natural Resources Conservation Service defines more sites in areas with heterogeneous plant communities, even though those sites could all have the same forage production capability.

Results

A refined map of probable MLRA boundaries was developed that represents estimated boundaries of MLRA—41 if extended south from the U.S. border into the states of Chihuahua and Sonora. Figure 9 shows the adjustments made to the original map that reflect, hopefully, a more accurate definition of MLRA boundary lines.

Conclusions

In keeping with the subject of this conference "Biodiversity and Management," we hope that the materials that have been presented in this paper will provide some insight in recognizing the opportunities that exist for further, and broader in scope, collaboration between the United States and Mexico.

Although the effort described in this paper demonstrates the potential for extending MLRAs into Mexico it should not be considered definitive. Boundary lines that were developed need further refinement and additional field evaluations. However the lines can be considered to be a reasonably accurate first approximation, and can be utilized with a fair degree of confidence. The potential for extending MLRA boundaries from the United States into Mexico is feasible and realistic. This would facilitate the direct use of ESDs across borders and improve exchange of rangeland data between the two countries. Mexico would have a direct benefit from the use of MLRAs as a valuable and useable management tool through the direct use of ecological site descriptions in range management planning. COTECOCA site descriptions should not be overlooked. They represent descriptions of all grazing sites within the country, and have been mapped on a state basis. It is probable that Brown and Lowe maps can be effectively applied in future efforts to extend MLRA boundaries in other parts of Mexico.

This is an opportune time to work with Mexico in the refinement of site descriptions. The NRCS is in a continuing process of revising Ecological Site Descriptions and comparisons could be made between COTECOCA descriptions resulting in correlating the two systems. This would be valuable in strengthening the ecological interpretations of COTECOCA sites, and would allow for Mexican researchers, rangeland managers, planners, and others to tap into an existing, rich

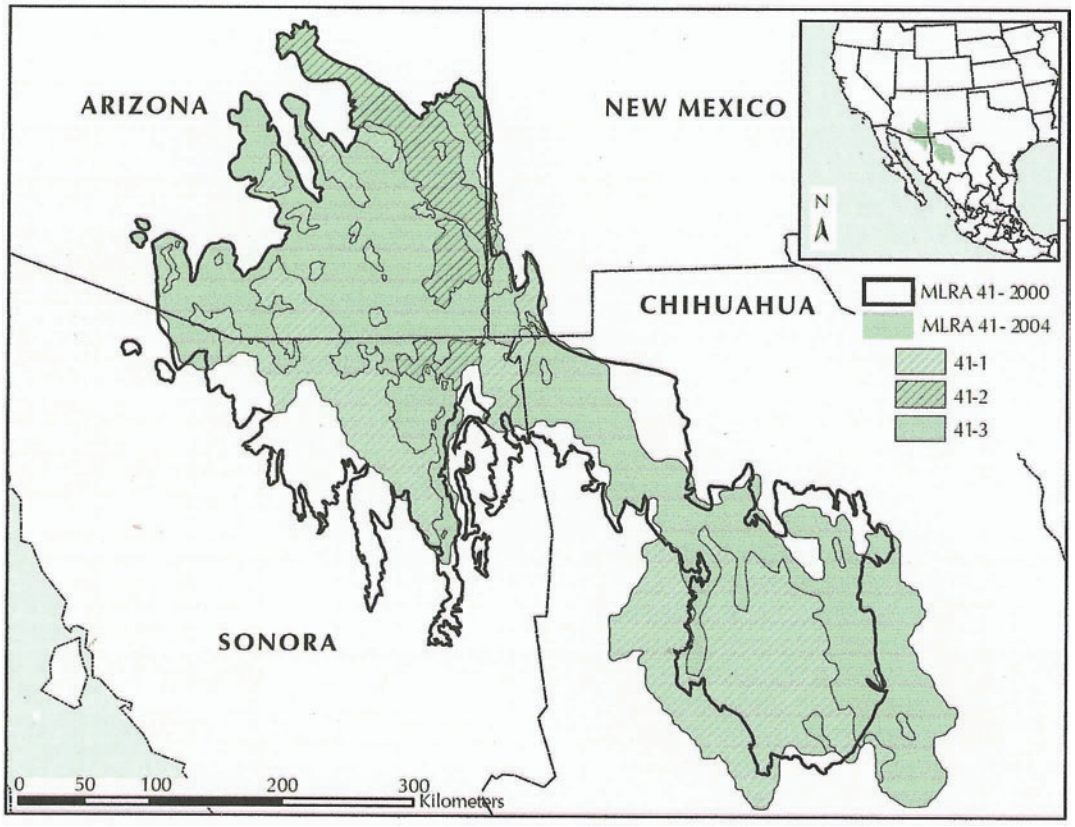

Figure 9—Adjustments made in projected MLRA boundaries in Sonora and Chihuahua.

database that will increase the value and utility of a neglected, but valuable resource. Utilizing MLRAs in Mexico would be a valuable addition to international communications, research, and exchange of data. MLRAs can serve as a common denominator for classifying and framing technical data that currently is not being utilized. The wheel does not have to be reinvented.

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