San Bernardino and Leslie Canyon National Wildlife Refuges

Comprehensive Management Plan

1995 - 2015

DRAFT

U.S. Fish and Wildlife Service
Region 2
Albuquerque, New Mexico

COMPREHENSIVE MANAGEMENT PLAN APPROVAL
for the
San Bernardino and Leslie Canyon
National Wildlife Refuges

The attached Comprehensive Management Plan for the San Bernardino and Leslie Canyon National Wildlife Refuges has been reviewed and approved as submitted by the manager of the aforementioned National Wildlife Refuges.

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San Bernardino and Leslie Canyon National Wildlife Refuges Comprehensive Management Plan 1995-2015

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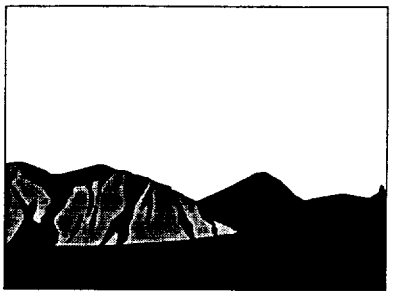
A. Introduction



This Comprehensive Management Plan is concerned with the San Bernardino and Leslie Canyon National Wildlife Refuges (NWR). San Bernardino NWR is located in Cochise County, 16 miles east of Douglas, Arizona, along the Mexican border. Leslie Canyon NWR, also in Cochise County, lies to the north of San Bernardino NWR and is situated in the Swisshelm Mountains.

Both refuges and their associated ecosystems have played, and continue to play, an important role in the conservation of wetland and aquatic systems in the desert southwest. Specifically, the two refuges are major components of a larger effort designed to lead to the long-term survival of four threatened and endangered fish: the Yaqui chub, the Yaqui topminnow, the Yaqui catfish, and the beautiful shiner. These refuge management units provide the last sanctuaries in the United States for these intermediate elevation fish.[1] The endangered fish are also found in Mexico within the Rio Yaqui watershed. The Rio San Bernardino, which flows through the San Bernardino NWR, is a tributary of the Rio Yaqui. Both refuges will be managed within the context of the larger set of ecotypes which fit within a defined "Area of Ecological Concern."[2]

While these refuges have a major focus in the recovery of the endangered fish, they are also important pieces of an overall ecological mosaic encompassing continually dwindling desert riparian landscapes in Arizona and the southwestern states in general. According to Minckley, et. al. (1991), fishes that withstood the stresses of "millennia of remarkable geologic and climatic changes" abounded in western streams just three or four decades ago.[3] The arrival of humans drastically affected this Area of Ecological Concern as it has others in the desert southwest. The diversity of the landscapes within the San Bernardino Valley quickly declined as a result of the introduction of farming, mineral extraction, and cattle production.[4] The streams from the springs and wells were channelled to the fields and cattle tanks. Black Draw, which apparently did not exist in the 1850s, was a creek lined with cottonwoods in the 1890s, and later became a ditch 3 to 5 meters deep, 5 to 25 meters wide, and was usually dry. The marshlands became fields, mesquite groves, and bare trampled earth. The Chihuahuan desert scrub and mesquite bosque thrived and expanded, desert grassland slowly deteriorated or disappeared, and riparian and aquatic habitats were destroyed

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[1]Fishes of intermediate elevations include some species that may have been forced upward with increasing aridity. In this case, the headwaters of the Rio Yaqui include the Rio San Bernardino and all its tributaries. Leslie Canyon NWR and San Bernardino NWR are parts of that larger watershed. The Rio Yaqui supports 20 species of the intermediate elevation fishes. Examples include various species of short-lived and long-lived minnows, pup fishes and topminnows. Specific examples include the four threatened and endangered species.

[2]An "Area of Ecological Concern" can be defined as: "An essentially complete ecosystem (or set of interrelated ecosystems) of which one part cannot be discussed without considering the remainder." [Malheur National Wildlife Refuge Master Plan and Environmental Assessment, 1985, pg. 7].

[3]Minckley, W.L., Rinne, John N., *Native Fishes in Arid Lands: A Dwindling Resource of the Desert Southwest*, U.S. Forest Service, U.S. Bureau of Reclamation, 1991. Minckley et al write: "They had adapted to survive the special conditions in canyon-bound rivers that varied from raging torrents in flood to isolated pools in drought. Some had specialized to withstand high summer temperatures and salts concentrated by evaporation in desert lakes and marshes."

[4]The San Bernardino Ranch was steadily ranched and farmed from 1900 until 1979 when The Nature Conservancy bought the property.

or reduced to disturbed remnants.[5] In 1951, Herbert Brandt concluded his chapter on bird-watching at San Bernardino Ranch by asking whether the ecological health of these disappearing wetlands can be restored.[6]

Important questions need to be addressed concerning how to restore the natural diversity in an area so severely affected by past human use (i.e., channelization, pumping, grazing, clearing, etc.). This is the reason this planning effort is conducted from the perspective that both San Bernardino and Leslie Canyon NWRs are elements of the larger Area of Ecological Concern.

B. Area of Ecological Concern General Make Up

Watersheds have been designated as the delineating basis for ecosystems within the Service's ecosystem focus for managing biological natural resources. On a large scale, both the San Bernardino and Leslie Canyon NWRs lie within the Yaqui watershed (See Map #1). However, for the practicality of managing Areas of Ecological Concern, watersheds are defined herein specifically to each refuge in order to focus on the unique characteristics of the smaller scale watersheds associated with that refuge. The Area of Ecological Concern for the United States portion of the Yaqui watershed is defined as the watersheds and groundwater basins that are directly associated with the management of the Yaqui fishes (See Map #2).

For San Bernardino NWR, the Area of Ecological Concern is defined by the San Bernardino Valley Watershed and artesian aquifer (See Map #3). The San Bernardino Valley is roughly a 900 mi^2 basin that contains 420 mi^2 within the U.S. and 580 mi^2 within Mexico. Within this valley are stream, lake, and lava deposits that compose the San Bernardino artesian aquifer. This aquifer is the source spring and well water on the refuge and is connected to the riparian aquifer that maintains the cottonwood-willow galleries on the refuge. The health of this aquifer is of primary importance to the sustainability of the San Bernardino Area of Ecological Concern. Both United States and Mexican legal protection is needed to ensure the long-range maintenance of flows in the Valley.

For Leslie Canyon NWR, the Area of Ecological Concern is defined as the Leslie Creek Watershed upstream and including the refuge (See Map #4). This watershed is roughly 80 mi^2 and spans from the west central portion of the Chiricahua Mountains to the eastern flank of the Swisshelm Mountains. The majority of this watershed runs through a pull apart basin separating the Chiricahuan and Swisshelm Mountain ranges. This basin is filled with river sediments that form the aquifer responsible for the base flow of Leslie Creek within the refuge. Any over-development of the aquifer would be a direct threat to the flows and fish habitat on the refuge.

Additionally, the Rucker and West Turkey micro basins within the United States portion of the Yaqui watershed are considered important areas for the long-range recovery of the fishes. Although these basins are not directly under Service jurisdiction, measures should be taken through the Service's Private Lands Program and ecological outreach programs to aid in the conservation of these important watersheds.

This comprehensive management planning effort sets management objectives only for the two refuges. However, the consideration of the associated natural resource components will hopefully lead to future development of natural resource objectives by other jurisdictions in the area as well. The Service invites other jurisdictions to view this planning effort as a vehicle for initiating cooperative natural resource ventures in the Area of Ecological Concern. Such ventures would contribute to effective wildlife and aquatic habitat management within the Area of Ecological Concern. Interjurisdictional efforts could and probably should lead to cooperative management agreements between the Service and other landowners, including those in Mexico when possible.

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[5]Lanning, Dirk V., *The Vertebrates of San Bernardino Ranch, Cochise County, Arizona*, Arizona Natural Heritage Program, Tucson, Arizona, 1981.

[6]Brandt, H., *Arizona and Its Bird Life*, The Bird Research Foundation, Cleveland, Ohio, 1951.

C. Refuges and Their Management Units

Refuges -- San Bernardino and Leslie Canyon NWRs are key components of the overall ecological mosaic in southeastern Arizona. The refuges' mix of habitats and natural resource characteristics are important elements in the broad context of the Area of Ecological Concern. Specifically, the refuges are considered "core habitats" with respect to the survival of the Yaqui fishes.[7] Both the San Bernardino and Leslie Canyon NWRs share the same basic purpose.[8] Although they are separated geographically, the combination of these two refuges has the potential to contribute cumulatively more toward the accomplishment of their similar objectives. In addition, both refuges share administrative resources.

Management Units and Special Project Activities -- Within the Leslie Canyon and San Bernardino NWRs are smaller geographically zoned areas named and characterized by the specific management activity that takes place there. These are called management units and they provide the framework for ongoing refuge management and special activities (See Maps #5 and #6). For instance, within the Leslie Canyon NWR there is the Leslie Creek Endangered Fish Management Unit. While the Leslie Canyon NWR as a whole has natural resource features and various habitat types, the management unit is characterized by the specific activity that takes place there, namely endangered fish management. These zoned areas on both refuges are the primary focus of annual work planning. Goals and objectives arising out of this planning process should be the basis upon which the refuges develop more specific work activity guidance for a particular year.

In addition, two types of areas were mapped within the two refuges:

(1) Special Project Areas -- Areas in need of site work or rehabilitation beyond that provided by regular refuge program management.

The rehabilitation areas form the basis for special activity planning, funding, and development over the 20-year planning period. For example, additional gabion or well development on the San Bernardino NWR are special activities or projects which are site-specific and require focused strategic planning. These projects are expected to be of relatively short duration even though the desired effects are long term. In contrast, activities such as routine maintenance of artesian wells are considered part of a refuge's normal year-to-year management program.

(2) Special Protection Areas -- Areas in need of special protection efforts.

The special protection sites are areas within the refuges with aquatic, vegetative, or wildlife characteristics in need of enhanced protection efforts. For example, there are highly sensitive areas in both refuges that are subject to a higher degree of threats from public use activities. Even though protection of certain areas is part of a refuge's year-to-year management program, these designated areas warrant additional protectionary strategies that may necessitate special management.

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[7]Baca, Thomas P., Nita M. Fuller, et. al., *Lower Colorado River National Wildlife Refuges Comprehensive Management Plan*, U.S. Fish and Wildlife Service, Region 2, 1992. A core habitat can be defined as habitat which: (1) Carries or potentially carries a naturally diverse wildlife mix by virtue of the structure and health of the vegetation and/or aquatic communities which thrive there, and the availability of resources to maintain and enhance these communities; (2) without which the remainder of the ecosystem(s) is consideribly diminished; and, (3) closely represent in character the quintessence of the Area of Ecological Concern as it existed prior to modern technological influences on natural processes (i.e. natural mixes of vegetation, aquaculture, and wildlife as would be provided by natural cycles of succession and predation).

[8]San Bernardino NWR was established in 1983 under authorization of the Fish and Wildlife Act of 1956 and the Endangered Species Act with its purpose "...to conserve fish or wildlife which are listed as endangered species or threatened species...or plants." Leslie Canyon NWR was established in 1988 under the authority of the Endangered Species Act. Its purpose is the same as that of San Bernardino NWR.

D. Planning Perspectives

The comprehensive management planning effort will integrate four perspectives so that the management direction over the next 20 years will produce holistic management approaches for these two National Wildlife Refuges and to the degree cooperative ventures permit, the Area of Ecological Concern.

The plan includes:

(1) An ecosystem sustainability perspective that relates the Service's commitment to fish and wildlife conservation through protecting and restoring ecosystem function, structure, and species composition while still providing for sustainable socioeconomic use;

(2) A broad perspective for Area of Ecological Concern issues; (i.e., contaminants, revegetation, endangered species and biological diversity, recreational use, water quality, inter-jurisdictional cooperation, socioeconomic considerations, etc.);

(3) A more narrow perspective for national wildlife refuge related policy issues which affect the San Bernardino and Leslie Canyon NWR programs; (water rights, compatibility, endangered species management, etc.) and,

(4) A focused perspective for refuge related activities and strategies affecting management units; (i.e., grasslands management, endangered fish management areas, public use activities).

An understanding of these four perspectives and the relationship between them lead to the formulation of an integral set of refuge goals and objectives for the next 20 years.

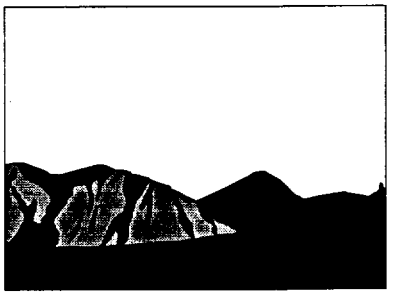
E. The Issues

The following is a list of the major issues that confront the San Bernardino and Leslie Canyon NWRs programs. Part II Analysis of this document considers these issues within the context of the perspectives described above. Part III Synthesis of this document outlines goals and objectives in an attempt to address these issues. The identified issues are:[9]

1. Ecosystem Sustainability
2. Biological Diversity and Habitat Management
3. Endangered Species Management
4. Water Rights, Water Management, and Wetlands Protection
5. Compatibility and Public Use
6. Environmental Education and Public Outreach
7. Cultural Resources Preservation and Management
8. Interagency Coordination
9. Land Protection
10. Staffing and Funding

[9]The list of issues and the corresponding goals in Part III of this Comprehensive Management Plan are not in any order of priority except to indicate that natural resource issues and goals take precedence by virtue of the ordering of the goals of the National Wildlife Refuge System [Refuge Manual 2 RM 1-4].

2. The Need For Action



The purpose of comprehensive management planning is to "provide long range guidance for the management of national wildlife refuges."[10] The San Bernardino and Leslie Canyon NWRs programs are important elements in the overall program of endangered species recovery and programs for wetland conservation and habitat management in the southwestern United States. Planning is necessary to strengthen these contributions to overall ecological health within the Area of Ecological Concern. Without a comprehensive management plan, decision-making on the refuges will potentially negatively impact the natural resources on the refuges and in the surrounding areas.

The Service's approach will be to plan consistently with ecologically desirable outcomes for the entire Area of Ecological Concern.

[10]Refuge Manual 4 RM 1.1

3. Expected Planning Outcomes

The following objectives were designed to be consistent with the Refuge Manual refuge comprehensive management planning objectives.

The planning effort should bring about the following outcomes:

(1) To ensure that national policy, the goals of the Service lands system, and the purpose for which the San Bernardino and Leslie Canyon NWRs programs were established are incorporated in the management of such;

(2) To provide a systematic process to collect, organize, and analyze information and aid decision-making;

(3) To provide a forum for determining the compatibility of uses on San Bernardino and Leslie Canyon NWRs;

(4) To ensure that other agencies and the public have opportunities to participate in planning for the management of San Bernardino and Leslie Canyon NWRs;

(5) To provide a basis for budget requests for operational, maintenance, and capital development programs for San Bernardino and Leslie Canyon NWRs;

(6) To provide a basis for monitoring progress and evaluating accomplishments at San Bernardino and Leslie Canyon NWRs;

(7) To identify broad management strategies and specific actions leading toward achievement of approved objectives for the San Bernardino and Leslie Canyon NWRs;

(8) To provide continuity in the management of the San Bernardino and Leslie Canyon NWRs; and

(9) To ensure that consideration is given to the ecological context in which San Bernardino and Leslie Canyon NWRs exist and help define their future role in maintaining ecosystem health.

4. Regional History and Setting

The Area of Ecological Concern encompasses primarily the San Bernardino River Valley and the mountains that surround it. These mountains include the Peloncillo Mountains to the east, the Perilla and Pedregosa Mountains to the west, and the Chiricahua and Swisshelm Mountains to the north. The San Bernardino River Valley extends beyond the United States and Mexico borders and forms the headwaters of the greater Rio Yaqui Basin. The Rio Yaqui eventually flows south and west into the Gulf of California and the Pacific Ocean.

A. Geology

San Bernardino Valley was formed during the middle to late Tertiary Period by steep, normal faulting that occurred near the present basin edges. The Chiricahua, Pedregosa, Perilla, and Peloncillo Mountains were formed when rock was displaced upward along the faults. Sedimentation of the basin was simultaneous with basin subsidence. This resulted from deposition of locally derived sediments and outpourings of basalt. Basin-fill sediments and stream alluvium overlie pre-basin and range deposits and bedrock on the valley floor.[11] The mountains surrounding the valley are composed of igneous, metamorphic, and sedimentary rocks of Paleozoic to middle Tertiary age. Some preexisting faulted and folded sedimentary and volcanic rock was displaced in mountain and basin blocks during basin formation. The consolidated rocks store and transmit small quantities of water through fractures, but generally act as barriers to ground water flow in the basin sediments. Limestone crops out in several places east of the refuge and north of the international boundary, but the subsurface extent is unknown.[12]

According to C. Sauer, the San Bernardino Valley fill sediments are of such massive depths that their extent remains unknown.[13] The valley consists of stream deposits, buried lake beds, and lava beds. O.E. Meinzer and F.C. Kelton stipulate that acidic lava flows rest directly upon stream deposits and all historical wells at the San Bernardino Ranch penetrated such a sheet at some depth above the lake deposits.[14] Volcanic accumulations different from buried acidic type occur on the surface of the western third of the San Bernardino Ranch. This provides evidence of another epoch of volcanic activity.

These are all considered relatively recent occurrences of volcanism in the San Bernardino Valley. According to Gayle Marrs-Smith, the San Bernardino Valley and the Area of Ecological Concern including northern Sonora, Mexico, have been subjected to recent seismic activity.[15] A profound earthquake struck northern Sonora in 1887. The earthquake was of devastating proportions (7.5 Richter Scale).[16] Shockwaves influenced a surface area extending between Yuma, Arizona, to Mexico City, covering approximately 720,000 square miles. The Slaughter Ranch house instantly collapsed from the shockwaves. More importantly, the earthquake permanently altered the structure of the groundwater basin. Old sources of water reportedly disappeared and new ones were created.

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[11]Menges, C.M., and McFadden, L.D., *Evidence for a Latest Miocene to Pliocene Transition from Basin Range Tectonic to Post Tectonic Landscape Evolution in Southeastern Arizona*, Arizona Geological Society Digest, Vol. 13, 1981.

[12]Cooper, J.R., *Reconnaissance Geologic Map of Southeastern Cochise County, Arizona*, U.S. Geological Survey Mineral Investigations Field Studies Map MF-213, 1959.

[13]Sauer, C., *Basin and Range Forms in the Chiricahua Area*, University of California Publications in Geography, 1930.

[14]Meinzer, O.E., and F.C. Kelton, "Geology and Water Resources of the Sulfur Springs Valley, Arizona," *U.S. Geologic Survey Water Supply Papers*, 1913.

[15]Gayle Marrs-Smith. *Vegetation and Flora of the San Bernardino Ranch, Cochise County, Arizona*, Arizona Nature Conservancy, 1983.

[16]Ardizone, Alan J., *Feasibility Study: San Bernardino Ranch*, Cochise County Parks Advisory Commission, Bisbee, Arizona, 1980. Ardizone writes that the quake caused a 35 mile long scarp and an offset of approximately 14 feet. Additionally, "...groundwater disturbances occurred causing many springs and wells to dry up as well as secondary rockfall in the Huachucas, Dos Cabezas, Pedregosas, Swisshelms and Whetstone Mountains."

B. Vegetation

The Area of Ecological Concern lands are predominantly desert grasslands that occur between the Chihuahuan and Sonoran Deserts. Limestone hills prevalent on the eastern side of the San Bernardino Valley favor the growth of Chihuahuan Desert flora at elevations normally suitable for grassland. Human activity in the area has altered vegetational community mixes and dominance in the past 100 years. According to Marrs-Smith, the greatest disturbances have occurred in marshland and grassland habitats. Marrs-Smith writes:

> "Marshland areas formed by seepage of surface artesian flows were drained and plowed for farmland or pasture. Only small, disturbed remnants of original marshland remain. Since 1980, when all cattle were removed, these once lush areas lay weed-covered or bare. Also, since the late 1800s, the ranges of the SB Ranch have been apparently overgrazed by livestock, contributing to depletion of ground cover, invasion of mesquite and snakeweed, and erosion of the topsoil typical of the region."[17]

In 1981, the vegetative communities of the area consisted of eight distinct habitat types outlined by Lanning as follows: (1) Desert Grassland; (2) Chihuahuan Desert Scrub; (3) Riparian Forest/Woodland; (4) Mesquite Bosque; (5) Riparian Scrub; (6) Marshland; (7) Aquatic; and (8) Old field/Disturbed.[18] The four dominant habitat types (See Table 1) are reflective of the vegetation mixes found from the Swisshelm Mountains into northern Sonora, Mexico. Since the acquisition of the San Bernardino Ranch, and subsequently the Leslie Canyon areas, the Service has taken actions to improve habitat conditions through various water conservation and other management strategies. These strategies have benefitted the survival of the endangered fishes, as well as a wide array of species which thrive in these dwindling desert wetlands.

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[17]Ibid., Gayle Marrs-Smith.

[18]Ibid., Lanning, Dirk V.

Table 1. Dominant Habitat Types with Associated Vegetation of the Area of Ecological Concern[19]

Desert Grassland	Desert Scrub	Mesquite Bosque	Marshland
Tobosa (*Hilaria mutica)*	Creosote bush (*Larrea tridentata)*	Honey mesquite (*Prosopis glandulosa)*	Spikerush (*Eleocharis parishii)*
Sixweeks grama (*Bouteloua barbata)*	Tarbush (*Flourensia cernua)*	Netleaf hackberry (*Celtis reticulata)*	Bulrush (*Scirpus americanus)*
Side-oats grama (*Bouteloua curtipendula)*	White thorn (*Acacia constricta)*	Creosote bush (*Larrea tridentata)*	Flatsedge (*Cyperus niger)*
Black grama (*Bouteloua eriopoda)*	Ocotillo (*Fouquieria splendens)*		Marsh alkali aster (*Aster pauciflorus)*
Alkali sacaton (*Sporobolus airoides)*	Snakeweed (*Gutierrezia microcephala)*		Sago pondweed (*Potamogeton pectinatus)*
Burrowgrass (*Scleropogon brevifolius)*	Honey mesquite (*Prosopis glandulosa)*		Bur marigold (*Bidens laevis)*
White-thorn acacia (*Acacia constricta)*	Soaptree yucca (*Yucca elata)*		Southern cattail (*Typha domingensis)*
Honey mesquite (*Prosopis glandulosa)*	Agave (*Agave sp.)*		Knotgrass (*Paspalum distichum)*
Prickly pear cactus (*Opuntia phaeacantha)*	Alkali sacaton (*Sporobolus airoides)*		Scratchgrass (*Muhlenbergia asperifolia)*
Christmas cactus (*Opuntia leptocaulis)*	Bush muhly (*Muhlenbergia porteri)*		Rabbitfoot grass (*Polypogon monspeliensis)*
	Fluffgrass (*Erioneuron pulchellum)*		
	Tobosa (*Hilaria mutica)*		
	Sideoats grama (*Bouteloua curtipendula)*		
	Sand dropseed (*Sporobolus cryptandrus)*		

[19] Ibid., Gayle Marrs-Smith.

C. Human Occupation[20]

Investigations into human occupance of the San Bernardino Valley area indicate habitation in excess of 10,000 years. From five distinct phases of the prehistoric and protohistoric culture to the early exploration and settlement by the Spaniards and Mexicans, and finally to the settlement of the "old west" by Anglo-Americans, the San Bernardino Ranch has been a distinctive cultural transition zone.[21] Each of these cultures found the waters of the San Bernardino to be crucial to survival in such an arid land, whether it was for hunting, agrarian practices, or simply, water supply.

The earliest Spanish presence in the Area of Ecological Concern occurred in 1694 with Father Eusebio Francisco Kino and Captain Juan Mateo Manje. In 1721, Captain Manje chronicled his experiences in Sonora and southern Arizona in his *Luz de Tierra Incognita*, 1693-1721.[22] Thus, documented history of the San Bernardino Valley began. Jesuit priests from Mission San Gabriel de Guevavi established a visiting site on the San Bernardino Ranch because there was an Opata Indian village there. There is no evidence of any permanent structures having been built at that time. However, about a mile across the Mexican border there are some adobe ruins thought to be the remains of an ancient chapel or a stamp mill. In 1763, an unknown Jesuit priest mentioned in his diary, entitled *Rudo Ensayo,* the existence of San Bernardino by name, and locates it as north of the Presidio de Fronteras. It is believed that during the Jesuit occupation of the ranch a detachment of soldiers from the Presidio de Fronteras occupied the high ground east of the main house, called "Mesa de la Avanzada," or Mesa of the Advanced Guard. When the Jesuits were expelled from New Spain in 1767, much of what occurred there was lost to history.

The San Bernardino owes its name to the Spanish presidio (Presidio de San Bernardino) established in 1775. The fort was located south of the present international boundary in order to defend against Apache raids into Sonora. Just 5 years later, the fort was abandoned due to the intense pressure the Apaches placed upon the small garrison located there.

For the next 40 years, the fort lay in a state of decay. Finally in 1822, the 73,000-acre San Bernardino Land Grant, created by decree of the Spanish crown, was acquired by Lieutenant Ignacio de Perez. Perez ranched the land and successfully built up approximately 100,000 head of cattle, mule, and horses. In the mid-1830s, however, Apache raiding caused him to abandon the land grant and the fort once again lay in ruins, later described as simply a collection of adobe walls. In December 1846, Lt. Col. Philip St. George Cooke and the Mormon Battalion, enroute to California, camped southwest of the current ranch house. Cooke and his battalion encountered many of the wild descendants of Perez' cattle near the old Charleston townsite.[23]

It was not until 1851 that the ranch again came to the attention of the Americans. John R. Bartlett, of the International Boundary Commission negotiating party for the Gadsden Purchase, described in some detail the layout and condition of Perez' complex. After the Gadsden Purchase of 1853, another boundary commissioner resurveyed the new international boundary, which left only 2,383 acres of the original San Bernardino Ranch within the Arizona-New Mexico Territory and over 70,000 acres in Mexico.

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[20]Much of this historical perspective was extracted from Ardizone, Alan J., *Feasibility Study: San Bernardino Ranch, Cochise County Parks Advisory Commission*, Bisbee, Arizona, 1980.

[21]Neily, Robert B., Beckwith, Ronald, *A Cultural Resource Inventory of the San Bernardino*, Cultural Resource Management Section, Arizona State Museum, University of Arizona, 1985. These distinct periods include: (1) Paleo-Indian (Clovis Culture); (2) Archaic; (3) Mogollon; and, (4) Animas Phase-Salado; Chiricahua.

[22]Translated as *Light of Lands Unknown*. This work was translated by Karns, Harry J., Arizona Silhouettes, Tucson, 1954.

[23]Ibid., Lanning. Lanning cites Bieber, R.P. (ed.) *Exploring Southwest Trails, 1846-1854*, Volume VII, Arthur H. Clark Co., Glendale, California, 1938. Lanning writes: "On December 2, 1846, Cooke, '...descended into the broad flat bottom to the east of it [ruins of San Bernardino Ranch], crossed, and camped near the old houses and a remarkably fine spring 15 paces in diameter... The soil of this great bottom is pronounced very good, but the grass is now very poor and the rising ground is a 'chaparral' of mesquite wood. The ox, in a perfectly wild state, abound here...'"

In 1884, some 65,000 acres of the San Bernardino Land Grant were purchased by "Texas" John Slaughter, one of the most colorful figures in Arizona history.[24] It is this episode for which the San Bernardino is most famous. Slaughter proceeded to build up one of the largest cattle spreads in Arizona, acquiring adjacent lands and leasing others. The earthquake of 1887 had disastrous effects on Slaughter's ranch. Sparks created by the rockfalls caused numerous fires on the landscape, drastically affecting grazing by livestock. All of the buildings constructed by Slaughter at the ranch were destroyed.[25]

A severe drought occurred in 1892 and lasted until 1893. This devastated Slaughter's 50,000 head of cattle and caused him to mortgage his property.[26] By 1900, Slaughter had recovered financially and had an active farming program growing hay, barley, wheat, and vegetables while still raising cattle.[27] The Slaughter Ranch, as it is known today, was steadily ranched and farmed from 1900 until 1979 when The Nature Conservancy purchased the property. Three years later, in 1982, The Nature Conservancy sold the 2,309-acre parcel of the original San Bernardino Ranch to the Service.

In recognition of the historic significance of the area, 180 acres of the old land grant was designated a National Historic Landmark in 1964.[28] [29] It was in 1982, when the Service acquired the 2,309 acres, that the Johnson Historical Museum of the Southwest assumed control of most (131 acres) of the Historic Landmark. Since then, the Slaughter Ranch Headquarter Site has been painstakingly restored to near original condition by the Johnson Museum.[30] In addition to the picturesque ranch buildings, the National Historic Landmark includes the remains of the 1910-1933 United States military encampment and outpost established on top of Mesa de la Avanzada (Mesa of the Advanced Guard) during the Mexican revolution. Also on the property is the Mormon House Ruin. This adobe house, now a vague ruin, once straddled the international border. Local legend has it that an employee of Slaughter built his house precisely on that spot in order to legally accommodate his two wives, one in the United States and one in Mexico.

D. Area of Ecological Concern Socioeconomic Features[31]

The Area of Ecological Concern lies within Cochise County, Arizona. The county is chiefly populated in such towns and municipalities as Benson on the extreme north, and Douglas to the extreme south. The economy of the area at one time was based almost solely on smeltering operations from large copper mines in Bisbee. These mines began to close in the early 1980s and efforts were made to attract light industries into the area. As a result, mining and mining-related employment fell to only 4.2 percent of the workforce of the county.

Agriculture and ranching continue to play a part in the economy of Cochise County as well as in northern Sonora, Mexico. Both activities contribute significantly to the local economies and rank first in the county in both employment and product value.

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[24]Allen, Erwin A., 1965. *The Southwest of John H. Slaughter*, A.H. Clark Co., Glendale, California.

[25]Ibid., Ardizone, Alan J.

[26]Ibid., Allen, Erwin A. Allen described the devastating results of the drought on the cattle herds: "A couple of years later, bone gatherers passed by the San Bernardino, piling bleached skulls and leg bones in pyramids. Soon train loads of jumbled skeletons were sent east to bone factories."

[27]Ibid., Lanning, Dirk V.

[28]National Park Service, 1967. *Prospector, Cowhand, and Sodbuster*, USGPO, Washington, D.C.

[29]Stewart, Janet Ann, 1974. *Arizona Ranch Houses*, Arizona Historical Society.

[30]Laetz, Catrien Ross, October, 1986. "San Bernardino Ranch", Arizona Highways Magazine.

[31]The major source for the following economic information was the Douglas Economic Development Corporation.

Maquiladoras -- In the mid 1960s, Mexico implemented the border Industrialization Program out of which arose the Maquiladora Program, or Twin Plant In-Bond Industry. The program started out in 1967 with 12 plants employing some 3,000 employees. As of today, the Maquiladora industry consists of 1,925 plants employing 452,399 workers and has become the second largest source of foreign exchange, second only to oil production in Mexico. Twin plants produce a diverse array of goods including dentures, musical equipment, computers, and automobiles.

Population Growth -- The economy's population base stems primarily from Douglas, which lies 16 miles west of the San Bernardino NWR near the United States/Mexico international border. Douglas' sister city in Mexico is Agua Prieta. Agua Prieta has a continually growing population of approximately 80,000, much larger than Douglas' 19,000. The total market area population, including populations in Mexico, is approximately 180,000. Projections for the year 2010 indicate that the population for the area will have increased to approximately 250,000.[32]

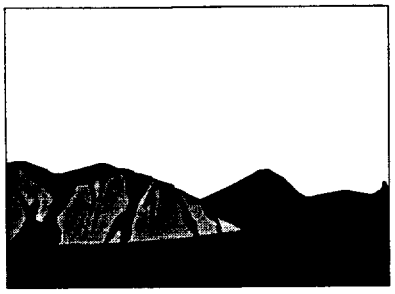
Mexican commerce, the growth of the Maquiladoras, and foreign interchange in general will potentially affect a number of aspects of the Cochise County environment. This dynamic interchange creates benefits to the economies of both Mexico and the United States. However, pollution is clearly problematic for the area, and could negatively affect both human and wildlife ecology well into the future. For instance, solid waste burning in Mexico, auto emissions, and ore processing at nearby smelters are only some of the products of a booming economy. Finally, the North American Free Trade Agreement (NAFTA) could prompt additional growth in the economies on both sides of this border. With this growth will come the need for an increased focus in environmental planning.

Tourism -- Tourism plays an important role in the Cochise County economy and affects visitorship of the San Bernardino and Leslie Canyon NWRs. The county is the home of Tombstone, Boothill, and the OK Corral. Many tourists venture south to Douglas to catch the international flavor of the famous and historical Gadsden Hotel. Also, the Slaughter Ranch Headquarters Site, operated by the Johnson Historical Museum of the Southwest, adjoins the San Bernardino NWR. The ranch interprets the history of human occupancy in the San Bernardino Valley which is most famous for its colorful namesake, "Texas" John Slaughter. The Museum will play an important role in the future of the interpretation of many of San Bernardino NWR program resources.

[32]Arizona Statewide Comprehensive Outdoor Recreational Plan (SCORP)

UNIT 2. Legal, Policy, and Administrative Guidelines, and Other Special Considerations

1. Introduction



This Unit outlines current legal, administrative, and policy guidelines for the management of national wildlife refuges. It begins with the more general considerations such as laws and executive orders for the Service, and moves toward those guidelines that apply specifically to the San Bernardino and Leslie Canyon NWRs.

This unit also includes sections dealing with specially designated sites such as historical landmarks and archaeological sites, all of which carry with them specific direction by law and/or policy. In addition, consideration is given to guidance prompted by other formal and informal natural resource planning and research efforts.

All the legal, administrative, policy, and planning guidelines provide the framework within which management activities are proposed and developed. This guidance also provides the framework for the enhancement of cooperation between San Bernardino and Leslie Canyon NWRs and other surrounding jurisdictions in the Area of Ecological Concern, including the government of Mexico.

2. Legal Mandates

Administration of the refuges takes into account a myriad of bills passed by the United States Congress and signed into law by the President of the United States. These statutes are considered to be the law of the land as are executive orders promulgated by the President. The following is a list of most of the pertinent statutes establishing legal parameters and policy direction to the National Wildlife Refuge System. Included are those statutes and mandates pertaining to the management of the San Bernardino and Leslie Canyon NWRs.

For those laws that provide special guidance and have strong implications relevant to the Service or San Bernardino and Leslie Canyon NWRs, legal summaries are offered below. Many of the summaries have been taken from *The Evolution of National Wildlife Law* by Michael J. Bean.[33]

For the bulk of applicable laws and other mandates, legal summaries are available upon request.

Summary of Congressional Acts, Treaties, and other Legal Acts that Relate to Administration of the National Wildlife Refuge System:

1. Lacey Act of 1900, as amended (16 U.S.C. 701).

2. Antiquities Act of 1906 (16 U.S.C. 431).

3. Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-711) and 1978 (40 Stat. 755).

4. Migratory Bird Conservation Act, (1929) as amended. (16 U.S.C. 715-715s).

5. Migratory Bird Hunting Stamp Act of 1934, (U.S.C 718-718h).

6. Fish and Wildlife Coordination Act, (1934) as amended (16 U.S.C. 661-666).

The Act is "the first major federal wildlife statute to employ the strategy of compelling consideration of wildlife impacts. The act authorized 'investigations to determine the effects of domestic sewage, trade wastes, and other polluting substances on wildlife, encouraged the development of a program for the maintenance of an adequate supply of wildlife on the public domain' and other federally owned lands, and called for state and federal cooperation in developing a nationwide program of wildlife conservation and rehabilitation."[34]

7. Historic Sites Act of 1935 (16 U.S.C. 461).

The Act declared it a national policy to preserve historic sites and objects of national significance, including those located on refuges. It provided procedures for designation, acquisition, administration, and protection of such sites. National Historic and Natural Landmarks are designated under authority of this Act. As of January 1989, 31 national wildlife refuges contained such sites.

8. Convention Between the United States of America and the Mexican States for the Protection of Migratory Birds and Game Mammals, (1936) (50 Sta. 1311).

9. Convention of Nature Protection and Wildlife Preservation in the Western Hemisphere, 1940 (56 Stat. 1354).

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[33]Bean, Michael J., 1983. *The Evolution of National Wildlife Law*, Praeger Publishers, New York.

[34]Ibid., pp. 181.

10. Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742-742j).

11. Refuge Recreation Act, as amended, (Public Law 87-714.76 Sta. 653; 16 U.S.C. 460k-4) September 28, 1962.

This Act authorizes the Secretary of the Interior "to administer areas of the System 'for public recreation when in his/her judgement public recreation can be an appropriate incidental or secondary use; provided, that such public recreation use shall be permitted only to the extent that it is practicable and not inconsistent with the primary objectives for which each particular area is established.' Recreational uses 'not directly related to the primary purposes and functions of the individual areas' of the System may also be permitted, but only upon an determination by the Secretary that they 'will not interfere with the primary purposes' of the refuges and that funds are available for their development, operation, and maintenance."[35]

12. Refuge Revenue Sharing Act of 1964, (16 U.S.C. 715s) as amended (P.L. 95-469, approved 10-17-78).

The Act provides "that the net receipt from the 'sale or other disposition of animals, timber, hay, grass, or other products of the soil, minerals, shells, sand, or gravel, from other privileges, or from leases for public accommodations or facilities in connection with the operation and management'...of areas of the National Wildlife Refuge System shall be paid into a special fund. The monies from the fund are then to be used to make payments for public schools and roads to the counties in which refuges having such revenue producing activities are located."[36]

13. Land and Water Conservation Fund Act of 1965, as amended (16 U.S.C. 460L-4 to 460L-11), and as amended through 1987.

14. National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee).

This Act, derived from sections 4 and 5 of Public Law 89-669, "consolidated 'game ranges,' 'wildlife ranges,' 'wildlife management areas,' 'waterfowl production areas,' and 'wildlife refuges,' into a single 'National Wildlife Refuge System.' It (1) placed restrictions on the transfer, exchange, or other disposal of lands within the system; (2) clarified the Secretary's authority to accept donations of money to be used for land acquisition; and (3) most importantly, authorized the Secretary, under regulations, to 'permit the use of any area within the System for any purpose, including but not limited to hunting, fishing, public recreation and accommodations, and access whenever he determines that such uses are compatible with the major purposes for which such areas were established.'"[37]

15. National Historic Preservation Act of 1966 (16 U.S.C. 470).

Public Law 89-665 as repeatedly amended, provided for preservation of significant historical features (buildings, objects, and sites) through a grant in aid program to the States. It established a National Register of Historic Places and a program of matching grants under the existing National Trust for Historic Preservation. As of January 1989, 91 historic sites on national wildlife refuges have been placed on the National Register.

16. National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321-4347).

17. Protection and Enhancement of Environmental Quality Executive Order of 1970 (Executive Order 11514, dated March 5, 1970).

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[35]Ibid., pp. 125-126.

[36]Ibid., pp. 126.

[37]Ibid., pp. 125.

18. Environmental Education Act of 1975 (20 U.S.C. 1531-1536).

19. Use of Off-Road Vehicles on the Public Lands Executive Order of 1972, as amended (Executive Order 11644, dated February 8, 1972, as amended by Executive Order 11989, dated May 24, 1977).

20. Endangered Species Act of 1973 (16 U.S.C. 1531-1543 87 Stat. 884) P.L. 93-205). The Endangered Species Act as amended by Public Law 97-304, The Endangered Species Act Amendments of 1982, dated February 1983.

According to Bean, the 1973 Act "builds its program of protection on three fundamental units. These include two classifications of species--those that are 'endangered' and those that are 'threatened' --and a third classification of geographic areas denominated 'critical habitats.'"[38]

The Act: (1) Authorizes the determination and listing of species as endangered and threatened, and the ranges in which such conditions exist; (2) Prohibits unauthorized taking, possession, sale, and transport of endangered species; (3) Provides authority to acquire land for the conservation of listed species, using land and water conservation funds; (4) Authorizes establishment of cooperative agreements and grants-in-aid to States that establish and maintain active and adequate programs for endangered and threatened wildlife; and, (5) Authorizes the assessment of civil and criminal penalties for violating the Act or regulations.

Section 7 of the Endangered Species Act requires Federal agencies to insure that any action authorized, funded, or carried out by them does not jeopardize the continued existence of listed species or modify their critical habitat.

21. Floodplain Management Executive Order of 1977 (Executive Order 11988, dated May 24, 1977). Wetlands Preservation Executive Order of 1977 (Executive Order 11988, dated May 24, 1977).

These executive orders require both the protection and the enhancement of wetlands and floodplain. Both were signed in May, 1977. When Federally owned wetlands or floodplain are proposed for lease or conveyance to non Federal public or private parties, both executive orders require that the agency: "(a) reference in the conveyance those uses that are restricted under Federal, State or local... regulations; and (b) attach other appropriate restrictions to the uses of such properties by the ... purchaser and any successor, ... or (c) withhold such properties from..." lease or disposal (E.O. 11990, 4, E.O. 11988, 3(d). In addition, each agency is required to "avoid undertaking or providing assistance" for activities located in wetlands unless (1) ..."there is no practicable alternative...", and (2)... "the proposed action includes all practicable measures to minimize harm...which may result from such use" (E.O. 11990, 2). The term "agency" is defined in both of these executive orders as having the same meaning as the term "Executive agency" which means an Executive department, a Government corporation, and an independent establishment.

22. The Archaeological Resource Protection Act of 1979 (P.L. 96-95, 93 Sta. 721, dated October 1979). (16 U.S.C. 470aa - 47011).

This Act largely supplanted the resource protection provisions of the Antiquities Act for archaeological items. It established detailed requirements for issuance of permits for any excavation or removal of archaeological resources from Federal or Indian Lands. It also established civil and criminal penalties for the unauthorized excavation, removal, or damage of any such resources; for any trafficking in such resources removed from Federal or Indian land in violation of any provision of Federal law; and for interstate and foreign commerce in such resources acquired, transported, or received in violation of any State or local law. Public Law 100-588, approved November 3, 1988, (102 Stat. 2983) lowered the threshold value of artifacts triggering the felony provision of the Act from $5,000 to $500, made attempting to commit an action prohibited by the Act a violation, and required the land managing agencies to establish public awareness programs regarding the value of archaeological resources to the Nation.

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[38]Ibid., pp. 331.

23. Fish and Wildlife Conservation Act of 1980 (P.L. 96-366, dated September 29, 1980). ("Nongame Act") (16 U.S.C. 2901-2911; 94 Stat. 1322).

Approved September of 1980, this Act authorized grants for development and implementation of comprehensive State nongame fish and wildlife plans and for administration of the Act. It also required the Service to study potential mechanisms for funding these activities and report to Congress by March, 1984. According to Bean, the Act "strives to encourage comprehensive conservation planning, encompassing both nongame and other wildlife...The impetus for the enactment of this legislation was the perception that animals not ordinarily valued for sport hunting or commercial purposes receive insufficient attention and funds from state wildlife management programs."[39]

Public Law 100-653 (102 Stat. 3825), approved November 14, 1988, amended the Act to require the Service to monitor and assess nongame migratory birds, identify those likely to be candidates for endangered species listing, identify appropriate actions, and report to Congress one year from enactment. It also requires the Service to report at five year intervals on actions taken.

24. Administrative Procedures Act (5 U.S.C. 551-559, 701-706, 1305, 3105, 3344, 4301, 5362, 7521; 60 Stat. 237), as amended (P.L. 79-404, as amended).

25. Bald Eagle Protection Act of 1940 (16 U.S.C. 668-668d; 54 Stat.), as amended.

26. Canadian United States Migratory Bird Treaty (Convention Between the United States and Great Britain (for Canada for the Protection of Migratory Birds. (39 Stat. 1702; TS 628), as amended.

27. Clean Air Act (42 U.S.C. 1857-1857f; 69 Stat. 322), as amended.

28. Convention on Wetlands of International Importance Especially as Waterfowl Habitats (I.L.M. 11:963-976, September 1972).

This Convention, commonly referred to as the Ramsar Convention, was adopted in Ramsar, Iran, February 3, 1971, and opened for signature at UNESCO headquarters, July 12, 1972. On December 21, 1975, the Convention entered into force after the required signatures of seven countries were obtained. The United Senate consented to ratification of the Convention on October 9, 1986, and the President signed instruments of ratification on November 10, 1986. The Convention maintains a list of wetlands of international importance and works to encourage the wise use of all wetlands in order to preserve the ecological characteristics from which wetland values derive. The Convention is self implementing with the U.S. Fish and Wildlife Service providing U.S. secretariat responsibilities and lead for Convention implementation.

29. Cooperative Research and Training Units Act (16 U.S.C. 753a-753b, 74 Stat. 733), as amended. P.L. 86-686).

30. Federal Aid in Fish Restoration Act (16 U.S.C. 777-777k, 64 Stat. 430).

31. Federal Aid in Wildlife Restoration Act (16 U.S.C. 669-669i; 50 Stat. 917), as amended.

32. Federal Environmental Pesticide Control Act of 1972 (7 U.S.C. 136-136y; 86 Stat. 975), as amended.

33. Federal Land Policy Management Act of 1976 (43 U.S.C. 1701-1771, and other U.S.C. sections; 90 Stat. 2743). Public Law 94-579, October 1976.

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[39]Ibid., pp. 227.

34. Federal Property and Administrative Services Act of 1949 (40 U.S.C. 471-535, and other U.S.C. sections; 63 Stat. 378), as amended.

35. Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. 1251-1265, 1281-1292, 1311-1328, 1341-1345, 1361-1376, and other U.S.C. titles; 86 Stat. 816), as amended.

36. Fish and Wildlife Improvement Act of 1978 (16 U.S.C. 7421; 92 Stat. 3110) P.L. 95-616, November 1978.

37. Flood Control Act of 1944 (16 U.S.C. 460d, 825s and various sections of title 33 and 43 U.S.C.; 58 Stat. 887), as amended and supplemented.

38. Freedom of Information Act (5 U.S.C. 552; 88 Stat. 1561).

39. Refuge Trespass Act (18 U.S.C. 41; Stat 686).

40. Transfer of Certain Real Property for Wildlife Conservation Purposes Act of May 1948, (16 U.S.C. 667b-667d; 62 Stat. 240), as amended.

41. Water Resources Planning Act (42 U.S.C., 1962-1962a-3; 79 Stat. 244), as amended.

42. Waterfowl Depredations Prevention Act (7 U.S.C. 442-445; 70Stat. 492), as amended.

43. Clean Water Act of 1972, Section 404.

Under this Act, permits are required to be obtained for discharges of dredged and fill materials into all waters, including wetlands. Implementation of the 404 program involves three other federal agencies in addition to limited state involvement. The Environmental Protection Agency (EPA), the National Marine Fisheries Service, and the Service review permit applications and provide comments and recommendations on whether permits should be issued by the Corps. EPA has veto authority over permits involving disposal sites if impacts are considered unacceptable. EPA also develops criteria for discharges and state assumption of the 404 program. Section 404 regulations were changed in 1984 due to a national lawsuit, and 404 jurisdictions now apply to tributaries of navigable waters and isolated wetlands and waters if interstate commerce is involved. With the new regulations, all washes, drainages, and tributaries of navigable waters, including ephemeral and perennial streams, are included under the 404 program in Arizona.

44. The Food Security Act of 1985 (Farm Bill).

3. Agency-Wide Policy Directions

A. Fish and Wildlife Service Agency Mission

Since the early 1900s, the Service mission and purpose has evolved, while holding on to a fundamental national commitment to threatened wildlife ranging from the endangered bison to migratory birds of all types. The earliest national wildlife refuges and preserves are examples of this. Pelican Island, the first refuge, was established in 1903 for the protection of colonial nesting birds such as the snowy egret and the endangered brown pelican. The National Bison Range was instituted for the endangered bison in 1906. Malheur National Wildlife Refuge was established in Oregon in 1908 to benefit all migratory birds with emphasis on colonial nesting species on Malheur Lake. It was not until the 1930s that the focus of refuge programs began to shift toward protection of migratory waterfowl (i.e., ducks and geese). As a result of drought conditions in the 1930s, waterfowl populations became severely depleted. The special emphasis of the Service (then called the Bureau of Wildlife and Sport Fisheries) during the next several decades was on the restoration of critically depleted migratory waterfowl populations.

The passage of the Endangered Species Act of 1973 refocused the activities of the Service as well as other governmental agencies. This Act mandated the conservation of threatened and endangered species of fish, wildlife, and plants both through Federal action and by encouraging the establishment of State programs. In the late 1970s, the Bureau of Wildlife and Sport Fisheries was renamed the U.S. Fish and Wildlife Service to broaden its scope of wildlife conservation responsibilities to include endangered species, as well as game and nongame species. A myriad of other conservation-oriented laws followed, including the Fish and Wildlife Conservation Act of 1980, which emphasized the conservation of nongame species.

The Service has no "organic" act to focus upon for the purposes of generating an agency mission. The agency mission has always been derived in consideration of the various laws (as listed in Section 2 of this Unit) and treaties that collectively outlined public policy concerning wildlife conservation. The Department of the Interior Departmental Manual states:

> "The U.S. Fish and Wildlife Service is responsible for conserving, enhancing, and protecting fish and wildlife and their habitats for the continuing benefit of people through Federal programs relating to wild birds, endangered species, certain marine mammals, inland sport fisheries, and specific fishery and wildlife research activities."[40]

B. Refuge System: Mission and Goals

The National Wildlife Refuge System (System) is the only existing system of Federally owned lands managed chiefly for the conservation of wildlife. The System mission is a derivative of the Service mission.

The System mission is:

> "To provide, preserve, restore, and manage a national network of lands and waters sufficient in size, diversity, and location to meet society's needs for areas where the widest possible spectrum of benefits associated with wildlife and wild lands is enhanced, and made available."[41]

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[40]Departmental Manual 142 DM 1.1.

[41]Refuge Manual 2 RM 1.3.

The broad goals of the System describe a level of responsibility and concern for the nation's wildlife resources for the ultimate benefit of the people. They include:

(1) To preserve, restore, and enhance in their natural ecosystems (when practical) all species of animals and plants that are endangered or threatened with becoming endangered.

(2) To perpetuate the migratory bird resource.

(3) To preserve the natural diversity and abundance of fauna and flora on refuge lands.

(4) To provide understanding and appreciation of fish and wildlife ecology and man's role in his environment, and to provide visitors with high quality, safe, wholesome, and enjoyable recreational experiences oriented towards wildlife, to the extent these activities are compatible with the purposes for which the refuge was established [Refuge Manual: 2RM 1.4]. [42]

The System is currently undergoing its own formalized assessment of the current issues in an effort to determine the best strategies for achieving its goals and objectives. This formal process has been called *Refuges 2003 - A Plan for the Future of the National Wildlife Refuge System*. The Refuges 2003 process has identified 20 issues and 9 management alternatives designed to deal with those issues. At the writing of this document, the Refuges 2003 document is still under review.[43]

4. Refuge Purpose Statements[44]

Formal establishment of a unit of the National Wildlife Refuge System is usually based upon a specific statute or executive order specifically enumerating the purpose of the particular unit. However, refuges can also be established by the Service under the authorization offered in such laws as the Endangered Species Act of 1973 or the Fish and Wildlife Act of 1956. In these cases, lands are identified by the Service that have the right elements to contribute to the recovery of a species or the maintenance of habitat types. Oftentimes, the Service works in cooperation with private nonprofit organizations in efforts to acquire suitable lands. This is the case for San Bernardino and Leslie Canyon NWRs. Both refuges were established under the authority of the Fish and Wildlife Act of 1956 and the Endangered Species Act of 1983 in order to "...conserve fish or wildlife which are listed as endangered species or threatened species...or plants."

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[42]A use may be determined to be compatible if it will not materially interfere with or detract from the purpose(s) for which the refuge was established. In practice, compatibility determinations are applied only to those uses for which the Service has existing legal authority to control.

[43]Refuges 2003 bulletin, No. 3, November 1991, fully details the issues and the alternatives. The bulletin is made part of the file for this planning effort and is available to the public.

[44]Refuge purpose statements are primary to the management of each refuge within the refuge system. The purpose statement is the basis upon which primary management activities are determined. Additionally, these statements are the foundation from which "allowed" uses of refuge are determined through a defined "compatibility process."

5. Land, Jurisdictional, and Special Designation Considerations

A. Land Jurisdiction[45]

The Service's jurisdictional rights on the San Bernardino and Leslie Canyon NWRs are proprietary. Some of the lands owned by the Service were purchased "fee simple."[46] The real property interest the Service owns or controls in these cases is characterized by all the rights conveyed by warranty deed unless excepted explicitly in the deed. The Service has full right, power, and authority except for the following:

Leslie Canyon NWR

1. All valid existing rights-of-way and easements of record.
2. Patent reservations.
3. A right of First Refusal for Grazing dated December 11, 1986, held by Jenalda Company.

San Bernardino NWR

1. Patent reservations.
2. All existing rights-of-way and easements of record.
3. Oil, gas, and minerals outstanding in third parties.
4. The Grantor (The Nature Conservancy) reserves for itself, its successors and assigns, all right, title, and interest to all water and water rights belonging or appertaining to the Historic Site, subject to the above mentioned reservations, together with the right of access over and across existing roads located on the Historic Site, and the right to manage the wildlife resources of the "House Pond," specifically for, but not limited to, endangered species located on the Historic Site.
5. The Grantee (Johnson Historical Museum of the Southwest) agrees that it shall not undertake or engage in any activities set forth in the deed if the Service determines that such activities may have an adverse effect on the fish and snail species occurring on the Historic Site or the Ranch.

B. Acquisition History

The 2,309-acre San Bernardino NWR was purchased in 1982 from The Nature Conservancy. Leslie Canyon was added to the National Wildlife Refuge System as a unit of San Bernardino NWR on May 31, 1988. The Nature Conservancy held the 1,240-acre Leslie Canyon parcel in trust for the Service until fee title purchase was accomplished under the authority of the Endangered Species Act of 1973, as amended. Funding for this acquisition was made available from the Land and Water Conservation Fund as authorized by the Land and Water Conservation Act of 1965, as amended. In 1994, The Conservation Fund purchased a 1,200-acre Resolution Trust Fund tract and

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[45]The four types of governmental land jurisdictions are: (1) exclusive; (2) concurrent; (3) partial; and, (4) proprietary. The majority of Service lands are controlled under proprietary jurisdiction. State civil and criminal laws apply fully, except where they might conflict with Federal law. Under proprietary jurisdiction, the Service owns and controls lands like a private citizen. Concurrent and partial jurisdiction are similar to proprietary jurisdiction in that state civil and criminal laws apply. [Refuge Manual, 1 RM 5.8]

[46]Fee simple title is that ownership which is without limitation to any class of heirs or restrictions on transfer of ownership. Fee simple ownership is conveyed by warranty deed which is merchantable, clear of any unknown or undisclosed encumbrances, and is usually insurable against any undisclosed "clouds" or encumbrances. All exceptions, limitations, and encumbrances are disclosed on the deed and are fully known at the time of acquisition or disposal.

subsequently donated the land to the Service as an addition to Leslie Canyon NWR. This acquisition virtually doubled the existing size of the refuge from 1,240 acres to 2,440 acres. The purpose of this refuge is to protect populations of two endangered fishes, the Yaqui topminnow and the Yaqui chub. Although not written into the formal purpose statement, it is also the intention of the refuge to preserve the ecologically important ash-willow-cottonwood riparian habitats that exist in the canyon. In the summer of 1993, Leslie Canyon was given the status of a full national wildlife refuge, however, it will continue to be managed by staff from San Bernardino NWR.

The Service owns the land within the defined boundaries of the refuges (2,309 acres for San Bernardino and 2,440 acres for Leslie Canyon) with the exception of the historic Slaughter Ranch Headquarters Site, consisting of 131 acres, which was sold to the Johnson Historical Museum. The Service does, however, maintain an easement with the Museum for the management of the fisheries in House Pond. Currently, there is a resident manager living at the Slaughter Ranch whose duty is to protect the property from vandalism, from artifact hunters, and to maintain structures, fencing, and equipment.

C. Adjacent Land Use

Properties immediately adjacent to the San Bernardino and Leslie Canyon NWRs consist primarily of privately owned ranch lands, BLM lands, and lands owned by the State of Arizona. The primary use for a large portion of these surrounding lands is cattle grazing.

D. Special Considerations: Designated Sites

Cultural Resources

San Bernardino NWR is most noteworthy for two important components: the prehistoric Animas Phase/Casas Grandes and Salado culture pueblos on the San Bernardino NWR, and the National Historic Landmark Slaughter Ranch complex on the adjoining Johnson Museum property.[47] Because the individual elements of these two components overlap onto both jurisdictions, and are obviously related by their proximity, they will be treated collectively as "San Bernardino" in this section.

Prior Research at San Bernardino -- Information on the prehistoric and historic human occupation of San Bernardino is drawn from two primary studies. In 1982, an intensive archaeological survey of the 131-acre San Bernardino Ranch National Historic Landmark was conducted.[48] Twenty-four historic and prehistoric sites were recorded in that survey. In 1984, the Service funded an intensive survey of 2,000 acres of San Bernardino NWR by the Arizona State Museum.[49] The survey recorded 33 prehistoric and historic sites and 99 isolated cultural features and artifacts.

Historic era research at San Bernardino has concentrated on the ranch headquarters area and its colorful namesake, John H. Slaughter. Numerous articles and books have dealt with the Slaughter Ranch and the Slaughter biography.

Prehistoric Archaeological Record -- The principal prehistoric periods represented at San Bernardino are the late Archaic, roughly 1500 to 500 B.C., and the late prehistoric pueblo occupation dating roughly between A.D. 1200 and 1400.

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[47]Authority for the National Historic Landmark program stems from the Historic Sites Act of 1935, and regulations governing landmarks appear under 36 Code of Federal Regulations (CFR) Part 65.

[48]Stone, Lyle and James Ayres. 1982. A Description and Evaluation of Archaeological Resources, San Bernardino Ranch National Historic Landmark, Cochise County, Arizona. Archaeological Research Services, Inc. Tempe, AZ.

[49]Neily, Robert and Ronald Beckwith. 1985. A Cultural Resource Inventory of the San Bernardino National Wildlife Refuge. Arizona State Museum. University of Arizona. 88pp.

The Archaic era sites and isolated artifacts are evidence of a widespread hunting-gathering lifestyle with ancient antecedents in the desert southwest. Ten sites have been identified as Archaic. All of the sites are open artifact scatters tentatively dated on the basis of 59 diagnostic projectile points (e.g., arrowheads) and the association of groundstone artifacts, plus the absence of any ceramics. The most extensive of the Archaic group is a high density artifact scatter with numerous hearth-like features and roasting pits possibly representing a semipermanent campsite above Hay Hollow Wash. The projectile points recovered from the study area include Pinto, Chiricahua, and San Pedro styles, plus unnamed triangular concave-base and unnamed corner-notched points, all presumed to be Archaic.

After an apparent hiatus in occupation lasting 1,000 years or more, the San Bernardino was occupied from roughly A.D. 1200 to 1400 by pueblo-dwelling agriculturalists living in permanently occupied settlements. Known alternately as the "Animas Phase" or "Casas Grandes" cultures, they possessed architectural and material culture traits pointing to strong ties with advanced societies in Chihuahua. Unfortunately, a significant amount of data regarding the Slaughter Ranch Site has been lost to vandalism and to digging that was carried out in the 1960s. Growing evidence in the international "four corners" region suggests however, that the settlements at San Bernardino may have been part of a vast regional exchange network emanating from the Casas Grandes complex in Chihuahua.

At some sites, a higher number of Gila and Tonto polychrome wares in comparison to the polychromes of Chihuahuan manufacture point to an affiliation with the later and more northern "Salado" archaeological complex. But regionally the distinctions between these three archaeological expressions remain quite murky. In the San Bernardino Valley, the terms Animas Phase, Casas Grandes, and Salado may all refer to the same occupational episode. However, archaeological studies are necessary throughout this district to define the sequence and the interrelationships of this late prehistoric occupation.

Of the nine pueblo period sites recorded at San Bernardino, the largest appears to be the Slaughter Ranch Site. Much of this pueblo has been destroyed by the construction of Astin Tank and the erection of an adobe house on the pueblo. The site has also been subject to some pothunting and extensive excavation by local residents in the 1960s.[50] The site is situated on a bench above Astin Spring Wash and Black Draw. Although the extent of the village is unknown, it may have consisted of perhaps 100 rooms, with detached roomblocks and one or more plaza areas. As many as 11 burials are reported from the pueblo. Artifacts number in the thousands, including complete effigy vessels and other decorated vessels exhibiting strong ties to 14th century populations in Chihuahua.

6. Relationship to Other Plans

The following is a listing of the most significant documents that influence the management direction of San Bernardino and Leslie Canyon NWRs, as well as the Area of Ecological Concern.

A. Endangered Species Recovery Plans

Fishes of the Rio Yaqui Recovery Plan[51] -- This plan outlines the objectives that must be achieved to recover the Yaqui chub, Yaqui topminnow, Yaqui catfish, and beautiful shiner as secure and stable members of the native fish fauna of the river system where they were once found. San Bernardino and Leslie Canyon NWRs serve as refugia and sources of stock for the recovery of these fishes. The limited amount of habitat found in the United States means that recovery cannot be accomplished solely by refuge pretection strategies. Mexico must have an important role in the recovery of these species, mainly with respect to habitat protection, in order for the fishes to ever be downlisted.

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[50]Mills, Jack and Vera. 1971. The Slaughter Ranch Site in The Artifact, Journal of the El Paso Archaeological Society. Vol. 9, No. 3.

[51]U.S. Fish and Wildlife Service. 1995. *Fishes of the Rio Yaqui Recovery Plan.* U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 48 pp.

There must be compliance with the following conditions for a period of 5 years before downlisting of the Yaqui chub and Yaqui topminnow to threatened status can be considered:

1. All non-native fish species must be eradicated from critical habitat.

2. Secure and protect the San Bernardino aquifer so that all artesian flows maintain themselves year round. Secure and protect Leslie Creek watershed to ensure adequate flows for Leslie Creek.

3. Protect critical habitat from detrimental human disturbance including mining, introduction of non-native fishes, water diversion, and removal.

Peregrine Falcon Recovery Plan -- There are recovery plans for different populations of the peregrine falcon. The general goal is to restore a self-sustaining population of peregrine falcons in the western United States. The San Bernardino and Leslie Canyon NWRs can contribute towards restoration goals through conserving wintering and migratory habitats, protecting falcons through law enforcement efforts, and promoting public support and understanding through education. The peregrine falcon is reported as being a rare migratory visitor to the refuges.

Bald Eagle Recovery Plan -- Recently, the bald eagle has been delisted from its endangered status to a threatened status throughout the country, *except* in Arizona, New Mexico, and portions of Texas and California. As such, any contribution the San Bernardino and Leslie Canyon NWRs can make towards eagle recovery should be considered significant. Again, by ensuring that bald eagle habitats are protected and enhanced, the refuges can contribute towards the maintenance and production of this endangered bird. In addition to conserving wintering and migratory habitats, the refuges also protect the eagles through refuge law enforcement efforts, and by promoting public support and understanding through education.

Aplomado Falcon Recovery Plan -- This falcon inhabits the desert grasslands and savannas of Latin America and formerly inhabited desert grasslands of southeastern Arizona, including those in the San Bernardino Valley. On March 27, 1986, the northern aplomado falcon was designated an endangered species in response to extirpation in the United States and pesticide contamination in Mexico. The recovery plan was approved in June 1990. The plan includes six objectives:

1. Evaluate, monitor, and minimize all threats, including pesticides, to extant populations.

2. Identify, maintain, and improve habitat.

3. Reestablish the northern aplomado falcon in the United States and Mexico.

4. Conduct studies of habitat requirements, physiological ecology, and behavior.

5. Enhance public support for this recovery effort through educational programs.

6. Encourage national and international cooperation and coordination in carrying out these objectives.

Currently, San Bernardino NWR is being considered as a possible reintroduction site for the falcon. Before any such release efforts, there should be further restoration of native grassland and riparian woodland areas to increase falcon habitat.

B. Biological Diversity Plans

Biological Diversity on Federal Lands: Report of a Keystone Policy Dialogue -- Representatives from the Service, as well as other Federal agencies, congressional committees, environmental organizations, commodity interests, professional associations, and academia, were active participants in a multi-agency dialogue attempting to address conservation of biological diversity on Federal lands. Efforts focused on formulating consensus recommendations for conserving biological diversity on lands managed by the major Federal land management agencies including the Service, BLM, U.S. Forest Service, National Park Service, and Department of Defense.

The document produced from the dialogues recommended that a national goal be developed to conserve, protect, and restore biological diversity on Federal lands. The participants determined that biological diversity, because of its intrinsic values, is important to sustain the health of ecological systems to provide for human well-being. Though the conclusions of the report are only recommendations, the Service is considering implementing these recommendations. (Final Consensus Report of the Keystone Policy Dialogue on Biological Diversity on Federal Lands, The Keystone Center, Keystone, Colorado: 1991)

Region 2 Biological Diversity Plan Draft -- In 1991, Region 2 initiated an effort to formally establish a region-wide plan and program for biological diversity. The effort is ongoing for the region.

The plan sets out a purpose to identify "goals, objectives, and strategies for the conservation of the natural biological diversity of Region 2, with emphasis on those species and habitats for which the Service has primary statutory jurisdiction. This group includes federally listed endangered/threatened species, migratory birds, and anadromous or inter-jurisdictional fishes. Service management authority extends to all fish and wildlife species and their habitats to all national wildlife refuges and fish hatcheries, in coordination with state governments."[52]

The goal for Region 2 is:

> To reverse the loss of natural biological diversity.

The plan proposes the following objectives:

1. Monitoring: Identify and monitor the status of nongame fish and wildlife species of concern, biological communities, and other elements of biological diversity.

2. Research: Identify and evaluate the factors contributing to the decline of biological diversity and the management strategies necessary to reverse that decline.

3. Management: Identify and implement conservation actions promoting conservation of biological diversity.

4. Education: Enhance public awareness and appreciation of the values of the threats to natural biological diversity.

5. Training: Enhance technical capability of Service employees related to the conservation of biological diversity.

6. Partnerships: Enhance coordination and partnerships between Federal, State, academic, and private landowners or organizations with shared responsibility for the conservation of biological diversity.

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[52]Region 2 Biological Diversity Draft Plan, July 23, 1991.

7. International Cooperation: Enhance conservation of biodiversity in the Caribbean and Latin America through research, education, and technical assistance.

C. Other Plans

Partners in Flight: Neotropical Migratory Bird Conservation Program -- This document was prepared by participants at the Neotropical Migratory Bird Workshop in Atlanta, Georgia, in December of 1990. The document outlines strategies to reserve the documented population decline of passerine birds that breed in North America and winter in the Caribbean and Latin America. The goal of the program is to focus the combined resources of agencies, academia, and private organizations on the improvement of monitoring, research, management, and education programs relating to neotropical migratory birds. Implicit in the strategy document is the need to identify, protect, manage, and restore essential habitats.

North American Waterfowl Management Plan -- The North American Waterfowl Management Plan guidelines were published in May 1986. The plan is a broad framework describing the overall scope of the requirements for management of migratory waterfowl in the United States, Canada, and more recently, Mexico. Specifically, the plan recognizes that the recovery and perpetuation of waterfowl populations depends on restoring wetlands and associated ecosystems throughout the North American continent. As stated in the 1994 update, the purpose of the plan is "to achieve waterfowl conservation while maintaining or enhancing associated ecological values in harmony with other human needs."[53] The plan is a partnership effort based on the joint venture concept, including private, State/Provincial, and Federal interests. The plan also focuses on the many ongoing and planned waterfowl management efforts continent-wide and stimulates new efforts.

Implementation of this plan requires these nations to convert international objectives into operational plans. The 1994 updated plan includes a review of all population goals and habitat objectives and provides a list of recommendations to help achieve them. More successive updates are planned.

National Wetlands Priority Conservation Plan (NWPCP) and National Wetlands Inventory (NWI) -- The NWPCP was completed in compliance with the provisions of the Emergency Wetlands Resources Act of 1986. The purpose of the Act was to promote, in concert with other Federal and State statutes and programs, the conservation of the wetlands of the nation in order to maintain the public benefits they provide. The Act provides for wetlands acquisition and gives equal consideration to acquisition involving the purchase of wetlands with monies from the Land and Water Conservation Fund (LWCF). While acquisition of wetlands for public outdoor recreation has always been eligible for LWCF assistance, they are now specifically highlighted under the Emergency Wetlands Resources Act.

The NWI has been conducted by the Service across the nation. The NWI conducted in Arizona undertook the task of inventorying and classifying the State's wetlands. The plan describes the majority of Arizona's wetlands as being directly related or indirectly associated with streams and their drainages. It has been the concern of some natural resource experts that the NWI did not include a majority of floodplain vegetation communities, and instead, only considered the vegetated islands within a stream channel. These riparian communities of old growth cottonwood-willow galleries and mature mesquite bosques, growing on the terraces above the actual channel, are just as dependent upon the existing aquifer for their survival as the more traditionally accepted wetlands vegetation. In efforts to re-address this, the Phoenix Ecological Services Field Office, in close coordination with the Arizona Riparian Council, developed an additional classification system strictly for these wooded riparian habitats. To date, approximately 26 percent of the state of Arizona has been classified under the new system. San Bernardino and Leslie Canyon NWRs still remain to be surveyed.

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[53]1994 Update to the North American Waterfowl Management Plan -- Expanding the Commitment. Joint venture between the U.S. Fish and Wildlife Service, Canadian Wildlife Service, and SEDESOL. 30 pp.

Arizona State Comprehensive Outdoor Recreation Plans (SCORP) -- The major purpose of the SCORPs are to provide a comprehensive framework for the orderly planning, acquisition, development, and administration of Arizona and California's outdoor recreation resources. The 1983 SCORPs identified recreation needs and implementation strategies. The need for natural resources conservation was one of the major issues identified and many activities in the plans are aimed at this issue. Included in the Arizona statewide priorities for the 1983 plan were priorities relative to wetlands acquisition and protection.

Arizona Wetlands Priority Plan -- This plan was prepared to comply with the Emergency Wetlands Resources Act of 1986. The purpose is to promote, in concert with other State and Federal statutes and programs, the conservation of wetlands of Arizona in order to maintain the public benefits they provide. The Arizona plan was prepared as an Addendum to the Arizona SCORP.

UNIT 3. Natural Resource Inventory

This unit describes in detail the diverse natural resources presently found on San Bernardino and Leslie Canyon NWRs. Included in this unit is an inventory of geological resources, soil resources, wildlife and habitat resources, and water resource values.

1. Geologic Resources

The Area of Ecological Concern has been subjected to recent seismic activity. In 1887, an intense earthquake measuring 7.5 on the Richter scale rocked northern Sonora, Mexico. The epicenter was in Batepito Valley at the northern end of the Teras Mountains.[54] The quake influenced a surface area of 720,000 square miles. It caused a 35-mile-long scarp and an offset of about 14 feet. The shockwaves caused the buildings at the San Bernardino Ranch to collapse, springs and wells to dry up, new water sources to appear, and secondary rockfalls in the surrounding mountain ranges. The sparks produced by the rockfalls started numerous brush fires. Interestingly enough, the springs found on the San Bernardino Ranch were not severely altered or displaced.

Leslie Canyon is situated in the Swisshelm Mountains and dissects layers of deformed Paleozoic sedimentary rocks and intrusions of Tertiary age volcanic rhyolite. Between the Swisshelm and the Chiricahua range is a basin that is filled with thick, permeable, alluvial sediments and is an excellent catch basin for Leslie Creek. The seismic activity within the San Bernardino Valley accounts for the occurrence of ore deposits, which includes gold.[55] Prospecting and mining for gold has been conducted in the Area of Ecological Concern since the late 1800s.

2. Topography and Soil Resources

The elevations within the Area of Ecological Concern and between the two refuges vary greatly. Leslie Canyon NWR's highest elevation is at 5,529 feet, while the lowest point of San Bernardino NWR sits at 3,720 feet where Black Draw leaves the United States. The soils of the valley floor support mesquite bosque and riparian habitats, and belong to the Karro Association. The upland soils to the east and west of the bosques belong to the Bonita Sontag Association.

The soils within the Area of Ecological Concern are classified into eight soil series, six of which are found on San Bernardino NWR[56] (See Map #7). A soil series is a group of soils formed in a particular kind of parent material that has genetic horizons which, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the soil profile. The characteristics upon which soils are based include color, structure, reaction, consistence, and mineralogical and chemical composition. The eight soil types include:

Karro Loam -- This series consists of well-drained soils that formed in old alluvium from mixed igneous and sedimentary rocks on alluvial fans on uplands. Slopes are 0 to 3 percent. Associated soils are in the Jal, Mohave, Stellar, Berino, and Pintura series. In a representative profile, the surface layer is light brownish-gray and pale-brown heavy loam and silt loam about 11 inches thick. The subsoil is light brownish-gray silty clay loam about 12 inches thick. Areas of Karro soils range from 4,000 to 5,000 feet. The average annual precipitation is 9 to 11 inches. The frost-free season is 190 to 210 days. The vegetation consists mainly of short and mid grasses, mesquite, and thornbush. These soils support mesquite bosque and riparian habitat, thus offering good to fair habitat for deer,

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[54]Goodfellow, G.E., "The Sonoran Earthquake, 1887," *Science*, 9: 162-167, 1888.

[55]Cooper, J.R., *Reconnaissance Geologic Map of Southeastern Cochise County*, Arizona Mineral Investigations Field Studies Map, 1959, MF 213, USGS, Washington, D.C.

[56]The soils of Leslie Canyon NWR have yet to be surveyed.

javelina, fox, dove, quail, and a host of other birdlife. Limitations are moderate for shallow water impoundments for ducks and for deepwater impoundments for fish.

Bonita Clay -- These soils are deep, well-drained, level to hilly clay soils. They are found on alluvial fans, terraces, floodplains, and basin floors. Slopes are 0 to 3 percent. Associated soils are in the Forrest, White House, and Courtland series. In a representative profile, the surface layer is brown to dark reddish brown, cobbly clay loam about 9 inches thick. The subsurface layer is brown clay to dark reddish brown silty clay from 9 to 25 inches thick. Elevations for these soils range from 4,100 to 4,500 feet. The average annual precipitation is 12 to 16 inches and the frost-free period is 240 to 260 days.

Bonita Cobbly Clay -- These soils are deep, well-drained cobbly clay loam soils and are found on terraces and basin floors. Their slopes range from 0 to 3 percent with elevations ranging from 4,400 to 4,600 feet. The average annual precipitation is 12 to 16 inches. The frost-free period is 180 to 220 days. Bonita cobbly clay soils are well suited for herbaceous plants, shrubs, and trees.

Riggs -- The Riggs series consists of very deep, moderately well-drained soils formed in stream or fan alluvium from volcanic, granitic, and sedimentary rock. Riggs soils are on flood plains and alluvial fans and have slopes of 0 to 2 percent. The average annual precipitation is about 13 inches and the mean annual temperature is about 61 degrees F. The soils are on level to nearly level alluvial fans and flood plains at elevations of 2,400 to 5,000 feet. Native vegetation consists of tobosa, vine-mesquite, sacaton, and side-oats grama.

Stronghold -- These soils consist of deep, well-drained soils that formed in fan alluvium from mixed sources and wind transmitted (eolian) sediment. Stronghold soils are on fan terraces and have slopes ranging from 1 to 12 percent. They formed in fan alluvium from limestone, schist, granite, andisite, rhyolite, and eolian sediments. Elevations range from 4,000 to 5,200 feet, the average annual precipitation is 12 to 16 inches, and the mean annual temperature is 59 to 69 degrees F. The frost-free period is 180 to 260 days. Stronghold soils support vegetation including bush muhly, fluffgrass, creosote, and white-thorn.

Mabray -- The Mabray series consists of shallow to very shallow, well-drained soils formed in slope alluvium from limestone and are found on hills and mountains. Elevations range from 3,000 to 5,500 feet with slopes ranging from 5 to 70 percent. Mean annual precipitation fluxuates from 12 to 16 inches, and falls as summer thundershowers and gentle winter rain with occasional snow. The frost-free period is about 160 to 240 days with the mean annual air temperature ranging from 57 to 66 degrees F. Mabray soils support a variety of vegetation such as ocotillo, white-thorn, sotol, snakeweed, some mesquite, side-oats grama, hairy grama, and fluffgrass, making them suitable for wildlife habitat.

Lampshire-Ridgelite -- This series consists of very shallow to shallow, well-drained soils. They formed in mixed slope alluvium from sedimentary and igneous rocks, primarily granite and rhyolite. They are found on hillslopes and mountain slopes that range from 20 to 50 percent. The elevation varies from 5,000 to 5,700 feet, and the average annual precipitation and mean annual temperature is 16 to 20 inches and 57 to 63 degrees F, respectively. The frost-free period is 180 to 200 days. These soils make up a small portion of the soils in southeastern Arizona.

Gadwell (T) Caralampi Complex -- These soils are found on fan terraces having slopes ranging from 1 to 5 percent and elevations from 4,400 to 6,000 feet. The mean annual air temperature is 59 to 65 degrees F, while the mean annual precipitation ranges from 12 to 16 inches. The frost-free period is 160 to 180 days. Herbaceous annuals, shrubs, and trees are well suited for this series.

Soil Ratings -- The Soil Conservation Service has grouped the San Bernardino Valley into 10 soil groups according to their potential to produce specific types of wildlife habitat. Table 2 relates the suitability of each soil type for the various vegetative elements of the Area of Ecological Concern's habitat resources. This table should give the refuge manager an idea of the potential of the soils for various types of wildlife habitat. The ratings also serve as a guide for land use planning for improving conditions for fish and wildlife in certain locations.

Table 2: Vegetative Elements of Wildlife Habitat[57]

Soil Type	Desertic Herbaceous Plants	Desertic Shrubs and Trees	Wetland Plants
Karro			very poorly suited
Riggs			well suited
Stronghold	well suited	well suited	poorly suited
Bonita*			well suited
Mabray	well suited	well suited	very poorly suited
Lampshire	moderately well suited	moderately well suited	very poorly suited
Ridgeline	moderately well suited	moderately well suited	very poorly suited
Cajalco	well suited	well suited	very poorly suited
Carsitas	well suited	well suited	very poorly suited
Bonita**	well suited	well suited	well suited

*Bonita soils here are specific to Soil Conservation Map #420.
**Bonita soils here are specific to Soil Conservation Map #1050.

Well Suited: Soil properties allow vegetation to be easily improved, managed, or created. Limitations are moderate. Some management will be necessary to maintain the soil and vegetation. **Moderately Well Suited:** Soil properties allow vegetation to be improved, managed, or created. Limitations are moderate. Management will be necessary to maintain the soil and vegetation. **Poorly Suited:** Soil properties severely limit the ability to produce vegetation. Managing for vegetation is possible, but creating vegetation through planting may be very difficult and the potential for success is questionable. **Very Poorly Suited:** Soil properties make it impractical to attempt to create or improve vegetation. Failure is probable. In some instances, very intense management may be successful.

Desertic Herbaceous Plants: Native and naturally established grasses and forbs, including weed. Examples: Bush muhly, vine-mesquite, Arizona cottontop, bristlegrass, false mesquite, curly mesquite, threeawn, globemallow, grama grasses, and sacaton. **Desertic Shrubs and Trees:** Bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Examples: Fourwing saltbush, mesquite, whitethorn, catclaw, skunkbush sumac, and yucca. **Wetland Plants:** Annual and perennial wild herbaceous plants that grow on moist or wet sites, not including submerged or floating aquatic plants. Examples: Smartweed, saltgrass, cordgrass, rushes, sedges, and reeds.

[57]This table relates to map units in the Douglas-Tombstone area (671) produced by the Soil Conservation Service. Each map unit was rated for its suitability to produce certain categories of vegetation. The rating is based on limiting factors which include: (1) Available water capacity; (2) Stoniness; (3) Depth to bedrock; (4) Depth to hardpan; and, (5) Salinity/Sodicity. Vegetative elements of wildlife habitat vary throughout the survey area. Each map unit was rated for its suitability to produce some or all the following: (1) Desertic herbaceous plants; (2) Desertic shrubs and trees; and (3) Wetland plants. Levels of suitability for producing vegetation are assigned a range of levels from Well Suited to Very Poorly Suited.

3. Habitat and Wildlife Resources

The following section describes the existing habitat and wildlife resources found on the refuges. An analysis of biological use and resource capabilities, along with recommended actions, is offered in Part II, Unit 2 of this document. A complete inventory of plant and animal species are found in Appendices A-E in this document .

HABITAT RESOURCES

The various habitats found on San Bernardino and Leslie Canyon NWRs are typical of the Chihuahuan desert. Eight habitat types comprise the refuges, ranging from arid desert scrub, desert grassland, mesquite bosque, and fallow fields to contrasting riparian forest/woodland, riparian scrub, marshland, and aquatic habitats[58] (See Map #8):[59] Appendix E of the plan is an inventory of the plants found on the refuges listed by common and scientific name.

Chihuahuan Desert Scrub-- This is the dominant habitat of the eastern, central, and western portion of the Area of Ecological Concern and forms the largest and most contiguous type of all the habitats represented on the refuges. The major plant species are creosote bush, tar-bush, white-thorn, ocotillo, and snakeweed. Other plants include honey mesquite, soaptree yucca, agave,and thornbush. The most common perennial grasses are bush muhly, tobosa, side-oats grama, sand dropseed, and alkali sacaton.

Desert Grassland-- Grasslands occur mainly on the mesa and on the northern boundaries of the refuges. They also occur as mosaics in other areas, as narrow bands separating other types, or as isolated patches where deep, fine alluvium soils are found. The dominant perennial grasses are tobosa, bush muhly, side-oats grama, black grama, and alkali sacaton. Desert shrubs are mixed in with the grasslands and include white-thorn, and honey mesquite. Cacti include prickly pear and Christmas cactus.

Mesquite Bosque-- This habitat type contains primarily mesquite where the canopy cover exceeds 50 percent and the canopy is more than 6-feet high. There is virtually no understory, or if present, the little that is found is comprised of annuals such as plains bristlegrass and vine mesquite. Other plants found in association with mesquite bosques are creosote bush, net-leaf hackberry, graythorn, and desert sumac. Secondary woody plants include mexican elder, wait-a-minute bush, gum bumelia, and mulberry. The most common perennial grass is alkali sacaton.

Fallow Fields-- Fallow fields are areas that were previously disturbed as a result of cultivation practices and today are characterized mostly by monotypic stands of weedy annuals. The dominant plants found in this type are tumbleweed, Palmer's amaranth, slimleaf bursage, common sunflower, yellow tansy-mustard, flixweed, and goathead.

Riparian Forest/Woodland-- The dominant trees represented in this habitat include cottonwood, willow, alder, ash, and walnut, and are primarily found scattered along the banks of Black Draw, Hay Hollow Wash, and near artesian wells. The understory is made up of shrub species mixed within patches of grasses and sedges, especially near the water's edge.

Riparian Scrub-- Cottonwood and willow are the dominant overstory species for riparian scrub habitat. Also integrated within the trees includes seepwillow, burrobush, and occasionally, isolated salt cedar trees. The grasses common to this vegetative community include Johnson's grass, lovegrass, and Bigelow's bluegrass, while weedy, herbaceous plants consist of straggling gilia, desert tobacco, common sunflower, crownbeard, and sneezeweed. Riparian scrub areas thrive in moist stream channels, which is in contrast to riparian forests and woodlands that fare better along the stream banks.

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[58]The majority of the following habitat summaries with their associated vegetative species is taken from Gayle Marrs-Smith.

[59]The habitats of Leslie Canyon NWR have yet to be mapped.

Marshland-- Marshlands or cienegas are those areas of land that are permanently flooded by non-impounded artesion water. These "wet meadows" are an oasis in the dry desert environment, supporting lush stands of vegetation.

Two distinct vegetation zones occur within this vegetative type: (1) the zone directly in and around the water source; and (2) the areas away from the water source but within its area of inundation.[60] Prevelant emergents in the first zone include bulrush, bur marigold, and southern cattail. Submergents such as common pool mat and sago pondweed are also present. The second zone is characterized by spikerush, flat sedge, marsh alkali aster, awlleaf aster, western cudweed, and water parsnip. Grasses found growing in these wet areas include knotgrass, scratchgrass, rabbitfoot grass, and giant reed.

Aquatic-- Water, of course, is the primary determinant of this habitat type and differs from marshlands in that the water is contained. This is undoubtedly the habitat type of greatest concern for the refuges from the standpoint of protection of the Yaqui topminnow, Yaqui chub, Yaqui catfish, and beautiful shiner, as well as other special status species of fish and fauna of the Rio Yaqui basin. Plant species found in association with aquatic habitats include white water-lily and holly-leaved water nymph.

FISH AND WILDLIFE RESOURCES

San Bernardino and Leslie Canyon NWRs both offer an extremely diverse assortment of wildlife species. The various habitats described above, especially the unique desert riparian areas, support over 90 species of neotropical birds. In addition to these, the refuges also provide habitat for waterfowl, marsh and waterbirds, shorebirds, gulls, terns, raptors, and other migratory birds bringing the total number of bird species to approximately 250. Mammals, reptiles, fishes, and amphibians are also well represented on both refuges, with the total number of species in each class equaling 42, 27, 9, and 10, respectively. [61]

Species information is based primarily on a survey done by Dirk V. Lanning. Other sources of information include discussions with wildlife biologists and review of qualitative information found in Federal and State agency reports. It should be noted, however, that wildlife inventory data is limited for most species found on the refuges. A complete inventory is given for mammals, birds, reptiles and amphibians, and fishes in Appendixes A-D, respectively, in this plan.

The following is a list of some of the more common wildlife species found on the refuges:

Threatened (T) and Endangered (E) Species-- This list contains the following: Yaqui catfish (T), Yaqui topminnow (E), Yaqui chub (E), beautiful shiner (T), peregrine falcon (E), and aplomado falcon (E). Lesser long-nose bat (E) and desert tortoise are (T) thought to occur on the refuges as well.

Candidate Species-- Candidate species are those species in which the data are insufficient to determine their existing status. This list includes longfin dace, San Bernardino spring snail, Mexican garter snake, and Chiricahuah leopard frog.

Waterfowl-- There is no large body of water on or near the refuges, consequently, waterfowl numbers are not very high. However, the diversity of species is quite notable. Those seen on the refuge include snow geese, greater white-fronted geese, tundra swan, sandhill crane, northern shoveler, cinnamon teal, green-winged teal, blue-winged teal, mallard, Mexican duck, canvasback, redhead, ring-neck, American widgeon, gadwall, bufflehead, ruddy duck, and American coot.

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[60]Ibid., Gayle Marrs-Smith.

[61]These numbers represent only those species actually observed on refuge lands. The numbers are higher if those species expected to be on the refuge are included. See Appendices A-D for complete inventories, including species expected to inhabit the refuges.

Marsh and Waterbirds-- Of this category, great blue heron, green-backed heron, black crowned night heron, great egret, sora, Virginia rail, pied-billed grebe, western grebe, double-crested cormorant, belted kingfisher, green kingfisher, and American bittern are all found on the refuges.

Shorebirds, Gulls, Terns, and Allied Species-- This grouping includes American avocet, black tern, killdeer, black-necked stilt, ring-billed gull, Wilson's phalarope, red knot, and solitary sandpiper.

Raptors-- The refuge supports a wide array of raptors including gray hawk, red-tailed hawk, Swainson's hawk, sharp-shinned hawk, Cooper's hawk, northern harrier, golden eagle, American kestrel, prairie falcon, black-shouldered kite, black vulture, turkey vulture, Chihuahuan raven, great-horned owl, western screech owl, and barn owl.

Neotropical Birds-- Commonly observed species on the refuge include yellow warbler, blue grosbeak, Vermillion flycatcher, ash-throated flycatcher, summer tanager, loggerhead shrike, phainopepla, mockingbird, white-crowned sparrow, ruby-crowned kinglet, Audubon's warbler, Lucy's warbler, green-tail towhee, western kingbird, Cassin's kingbird, Say's phoebe, Lincoln sparrow, song sparrow, and lesser goldfinch.

Game Birds-- The refuges provide habitat for several species of quail, including Gambel's, Harlequin (rare), and scaled quail. Also common to the area are mourning dove, as well as white-winged doves and common ground doves. Utilizing the riparian areas during the summer and fall is a rare visitor, the Gould's turkey.

Mammals-- Mammals found on the San Bernardino and Leslie Canyon NWRs include mule deer, white-tail deer, javelina, mountain lion, bobcat, coyote, raccoon, badger, striped skunk, hognose skunk, porcupine, jack rabbit, cottontail, Yuma antelope squirrel, rock squirrel, pygmy pocket gopher, and a wide variety of mice and rats.

Fish-- There are eight species of native fishes that historically inhabited the Rio Yaqui basin. These include Yaqui chub, Yaqui topminnow, Yaqui catfish, beautiful shiner, Yaqui sucker, Mexican stoneroller, roundtail chub, and longfin dace. Today, only four of these occur on the refuge (Yaqui chub, Yaqui topminnow, beautiful shiner, and longfin dace). The remaining four species maintain populations in Mexico; however, their statuses need further study. Additionally, Yaqui catfish are being propagated at Dexter National Fish Hatchery and Technology Center. Unfortunately, from time to time a number of non-native fishes (i.e., mosquitofish, bullhead, sunfish) have also been introduced into refuge waters.

Reptiles-- An extensive number of reptile species are known to inhabit the refuges. This list includes lesser earless lizard, Clark's spiny lizard, eastern fence lizard, tree lizard, Texan horned lizard, desert grassland whiptail, coachwhip, western patchnose snake, gopher snake, common kingsnake, longnose snake, Mexican garter snake, checkered garter snake, western diamondback rattlesnake, Mojave rattlesnake and others.

Amphibians-- Some of the more common species include Couch's spadefoot, western spadefoot, red-spotted toad, Great Plains toad, and bullfrog (introduced). Leslie Canyon NWR supports populations of the Chiricahua leopard frog.

4. Water Resources

Limited information is available regarding the subsurface hydrologic configuration of the San Bernardino Valley. Research efforts are underway to collect data on the depth of alluvium, volume, and direction of subsurface flows. The San Bernardino Valley is a rift basin composed of stream deposited sands and gravels, lake clays, and interfingering lava flows from a volcanic field in its northern portion. The modern fluvial system runs along the valley axis from north to south. Near the international border, this stream valley has been sunk to the groundwater level and consequently, springs emanate from the valley sides. The water is warmer than normal for this region, its temperature

ranging between approximately 83° F and 90° F. It is used for irrigation even in the winter season[62]. A water quality analysis conducted in 1983 showed that all the artesian wells have similar water chemistry to the surface water. This may indicate that the artesian aquifer and the unconfined alluvial aquifer are connected. Further studies will confirm or disprove this.

U.S. Geological Survey photos taken from the same point in 1958 and again in 1979, document downcutting in cienega habitats since 1958. Furthermore, old photographs taken by the historic ranch owner, John Slaughter, show artesian wells, on what is now the San Bernardino refuge, with sufficient hydraulic pressures to lift water 12 feet above ground level. Current well pressures are limited to a maximum of 4 feet of lift.

5. Water Rights

Leslie Canyon NWR -- Leslie Creek supplies both the vital baseflow and flushing flow waters that are essential for the survival of the Yaqui fishes and their habitat. Although the base flow of the creek is very low, the native fishes and related riparian areas depend on these flows for their existence. Ensuring instream flow rights was therefore needed to guard against water depletion that could ultimately harm these resources.

A notice of application to appropriate public water from Leslie Creek within Leslie Canyon NWR was submitted to the Arizona Department of Water Resources in March 1992. The Service was granted the instream flow rights in April 1992 to be used for the purposes of wildlife, including fish and recreation, and for the maintenance of a continuous minimum instream flow. Discharge (Cubic-feet/Second) records are provided by a U.S. Geological Survey gage located on Leslie Creek within the refuge boundary. The flow rates and the cumulative totals are as specified below:

Month	Discharge (cfs)	Acre feet/month
January	.62	38.3
February	.54	33.0
March	.53	32.6
April	.52	32.2
May	.45	27.5
June	.35	21.8
July	.34	21.0
August	.59	36.4
September	.63	38.7
October	.74	45.3
November	.81	49.9
December	.70	43.3

Total: Acre Feet/Year = 419.90

San Bernardino NWR -- Arizona water rights on the San Bernardino NWR date back to the late 1800s at the time of original settlement of the area by the cattle industry. These rights have not been perfected since the acquisition of the property by the Service. The water rights are summarized in Table 3 which details the right, right location, quantity, beneficial use, and priority date. The rights are divided into two types; groundwater permits (those whose registration number begins with a 55) and unlitigated surface water rights (those whose registration number begins with a 36).

[62]Geology and Water Resource of the Sulphur Springs Valley Basin, Arizona, 1913 USGS publication.

The San Bernardino NWR has Arizona groundwater well registration permits for 10 wells on the refuge and also the Johnson Museum property (See Map #9). These wells exist outside of an Arizona Active Management Area, thus they have not been adjudicated. These wells have a quantity of 250-acre feet per annum (AF/Annum) for each claimed registration, which equates to 155 gallons per minute (gpm). The beneficial use for these wells is specified as stock water and water production (miscellaneous use). These wells have the very senior priority dates of January 1, 1903. It should be noted, however, that the rights for the wells do not protect the artesian flow. Consequently, if the artesian head drops in the basin, the Service would be required to outfit the wells with pumps. If the head were to drop to a point where the wells went dry, then the Service would be required to drill deeper wells. Finally, if the groundwater was depleted in the basin, at this point the State would have the legal responsibility to shut down Junior pumpers in order to restore water for the Service's wells.

The Service's groundwater rights for the refuge offer no protection from pumping occurring within the Mexican portion of the San Bernardino Basin. Roughly 400 square miles of the basin lie within the United States and roughly another 400 lie within Mexico. The issue of international water protection is very pertinent to the refuge since depletion in artesian flow has already been correlated with pumping just across the border in Mexico. It is highly recommended that strategies for international water protection be explored.

The Service has Arizona surface water claims for six springs on the refuge as well as the Johnson Museum property. As with the wells, these claims have yet to be adjudicated, thus they do not have the legal standings of a permit nor a certificate. The priority date for these waters is January 1, 1884. The beneficial uses for these claims is specified depending on the spring, as a combination of stock, domestic, irrigation, and recreational (See Table 3). The quantity of the water claimed ranges from 3.8 to 62 gpm.

Table 3: San Bernardino NWR Summary of Water Rights

Well/Spring Name	Registration Number	Legal Description T24S, R30E	Quantity of Claim	Beneficial Use	Priority Date
Headquarters Spring	36-68793	SESW Sec. 15	100 AF/Annum	Irrig., Stock, Dom., Recr.	January 1, 1882
Headquarters Domestic	36-68794	SESW Sec. 15	19 gpm	Dom., Stock	January 1, 1884
Barn Spring	36-68795	SESW Sec. 15	15 gpm	Irrig., Stock	January 1, 1884
Bathtub Spring	36-68796	SESW Sec. 15	9.5 gpm	Dom., Stock, Irrig.	January 1, 1884
Cattail/Fig Spring	36-68797	NWSE Sec. 15	49 gpm	Dom., Stock, Irrig.	January 1, 1884
Mesa Seep Spring	36-68798	SESE Sec. 10	3.8 gpm	Stock	January 1, 1884
Well #1 (East Border)	55-627158	NWSW Sec. 11	250 AF/Annum	Stock, Water Production	January 1, 1903
Well #2 (West Border)	55-627159	NWSW Sec. 11	250 AF/Annum	Stock, Water Production	January 1, 1903
Well #3 (Bath House)	55-627160	NWNW Sec. 14	250 AF/Annum	Stock, Water Production	January 1, 1903
Well #4 (Upland)	55-627161	NWNW Sec. 23	250 AF/Annum	Stock, Water Production	January 1, 1903
Well #5 (Bunting)	55-627162	NWNW Sec. 14	250 AF/Annum	Stock, Water Production	January 1, 1903
Well #6 (North Pond)	55-627163	SWNW Sec. 14	250 AF/Annum	Stock, Water Production	January 1, 1903
Well #7 (Cottonwood)	55-627164	NESE Sec. 15	250 AF/Annum	Stock, Water Production	January 1, 1903
Well #8 (Middle)	55-627165	SESE Sec. 15	250 AF/Annum	Stock, Water Production	January 1, 1903
Well #9 (Cienega)	55-627166	NENW Sec. 23	250 AF/Annum	Stock, Water Production	January 1, 1903
Well #10 (Twin Pond)	55-627167	NWNE Sec. 23	250 AF/Annum	Stock, Water Production	January 1, 1903

UNIT 4. Public Use Inventory

1. General

The San Bernardino and Leslie Canyon NWRs are open to the public under a special use permit system. Certain public use activities are allowed. Hunting is permitted, and includes the taking of cottontail rabbit, dove, and quail only. Additionally, birdwatching, wildlife viewing, and hiking are also permitted. Fishing is prohibited on the refuges due to conflicts with the threatened and endangered fishes. The main concern associated with public use is the potential for visitors to introduce and transport non-native fish species, especially mosquitofish, onto the refuges. This has occurred in the past as evidenced by the presence of mosquitofish in Black Draw.

Visitation data for the refuges are limited, and are based on current and expected use of similar areas in the immediate vicinity of the refuges. The two key areas used for comparison are the Guadalupe Canyon and the Johnson Historical Museum of the Southwest.

Guadalupe Canyon is visited by birdwatchers from throughout the United States. The road leading to the canyon is also the access route to the San Bernardino NWR. Because the refuge offers good birdwatching opportunities as well, an estimated 90 percent of the canyon visitors may stop at the refuge. The canyon, however, is privately owned and use of the area has not been recorded, which makes it difficult to assess the actual number of people that visit San Bernardino and Leslie Canyon NWRs.

The staff at the Johnson Museum estimates annual visitation at 3,000, the majority of which probably visit the refuge as well. It is possible that changes in the urban environment, such as closing of the Phelps Dodge Smelter and a resultant influx of retirees, could increase visitation to the refuges to a point where more intense visitor management would be required. This change cannot be predicted at this time.

2. Interpretation

1. Wildlife Trails: There are no developed, designated trails on the refuges.

2. Wildlife Tour Routes: The refuges have no interpretive tour routes.

3. Visitor Center: The headquarters office is in Douglas and has no visitor center.

4. Visitor Contact Station: The headquarters serves as the contact station for issuance of permits and for distribution of information and brochures.

5. Staff Conducted Activities: Judging events, tours, presentations, and displays are provided to groups such as the Audubon Society and Kiwanis Club on request.

3. Educational Services

Refuge personnel devote time to elementary and high school students for the purpose of disseminating fish and wildlife information. This service is provided upon request.

4. Fish and Wildlife Oriented Recreation

1. Hunting: Quail, dove, and cottontail hunting are the only types of hunting allowed on San Bernardino NWR.[63] The number of hunters using the refuge is insignificant, with estimates ranging from zero to five hunters per year. This is attributed to the dense mesquite thickets which make hunting on the refuge less desirable than other areas that are more accessible.

2. Fishing: Fishing is prohibited on both refuges.

3. Trapping: Trapping is not permitted on either refuge.

4. Wildlife Observation: Special use permits for certain areas are issued upon request to those wanting to visit the refuges to birdwatch.

5. Non-Wildlife Oriented Recreation

1. Camping: Camping is permitted only to researchers conducting research on the refuge.

2. Off-Road Vehicling: Off-road vehicle use is not permitted.

6. Law Enforcement

The refuges' primary efforts are directed toward the protection of the native fishes and their habitat and patrolling during hunting seasons. Although there is no evidence to suggest that the cultural sites on the refuge have been subject to any recent vandalism or threat, protection of the archaeological and historic resources of the refuge remains a primary law enforcement concern as well. Currently, two refuge staff employees have law enforcement authority.

The San Bernardino Valley is an active drug smuggling area, particularly after marijuana is harvested in Mexico in the fall. Refuge personnel coordinate enforcement operations closely with U.S. Customs agents throughout the year. Any suspected drug trafficking is reported to Customs.

UNIT 5. Administration, Personnel, and Funding

This narrative summarizes the current administrative, staffing, and funding resources available to the San Bernardino and Leslie Canyon NWRs. It is not the purpose of the comprehensive management plan to include a comparative analysis or a trend analysis of funding and staffing.

1. Administration and Personnel

Refuge staff consists of three permanent, full-time (PFT) employees:

Refuge Manager
Office Assistant
Maintenance Worker

[63]Currently, hunters are not required to obtain a special use permit to hunt on the refuge. Their state-issued hunting permit serves to allow them access onto the refuge. However, in order to provide consistency to the overall public use program, this issue will be addressed in a public use plan that is currently being developed.

The small size of the units and the rather specific purpose for which the refuges were established, places restrictions on the range of management objectives for the plan. The San Bernardino and Leslie Creek NWRs require a small staff, annual operations and maintenance funding base, and development/construction budget to accomplish plan objectives as compared to larger or more complex refuges.

2. Funding

Based on the ongoing needs assessment relative to refuge programs, the refuge manager submits an annual budget request to the Regional Office annually. Each of the seven regions compete for the dollars allocated to the Service that are not already earmarked for special purposes. Ultimately, it is the final annual allocation of dollars that influences staffing, operations, maintenance, and special projects.

Table 4 shows the funding levels (in thousands) for the past 5 fiscal years. As with many refuges, insufficient funding allocations make it difficult to manage the refuge as desired in order to accomplish refuge goals and objectives. It is anticipated that as the refuges continue to expand their programs and their on-the-ground management activities, budget needs will need to increase accordingly. The goals and objectives formulated in Part III of this Comprehensive Management Plan provide a practical basis for realistic and justifiable budgetary requests.

Table 4: San Bernardino and Leslie Canyon NWRs Funding Levels, FY 1990-1994

FISCAL YEAR	O&M	MMS	FIRE	COST SHARE	OTHER	TOTAL
1990	110.0	34.3	9.0	0.0	31.0	184.3
1991	120.0	32.4	7.5	5.0	26.5	191.4
1992	128.1	39.5	2.3	16.0	1.0	186.9
1993	140.0	53.0	3.2	4.0	10.85	211.05
1994	*207.5	47.0	5.7	6.0	0.0	266.2

* Included in this amount is $67.5 of yearend money to cover the cost of a new truck and moving expenses for the new biological technician. The actual O&M funding for FY 1994 was 140.0. If the additional $67.5 is subtracted from the total, the actual budget for FY 1994 was $198.7 which is a decrease from FY 1993 of $12.35.

KEY

O&M = Operation and Maintenance; includes day-to-day operations such as routine maintenance, utility bills, and personnel salaries.

MMS = Maintenance and Management System; this money is used for the purchase of new equipment and to carry out major projects such as drilling new wells, building impoundments, etc.

COST SHARE = The Challenge Cost Share is a partnership program in which the Service provides matching funds for projects that support the management, restoration, and protection of natural resources on public and private lands.

OTHER = Includes funding for various programs such as the Youth Conservation Core (YCC), law enforcement, and volunteer activities.

PART II: ANALYSIS

Both the San Bernardino and Leslie Canyon NWRs make significant contributions to the Area of Ecological Concern by manipulating the aquatic resources to support Rio Yaqui fishes and utilizing land management practices for the restoration of aquatic, desert, and grassland ecosystems.

The potential success of these efforts is strengthened through a systematic and coordinated analysis of baseline data presented in Part I that leads to management objectives. In order to manage the natural resources consistently and effectively, both the biological and administrative elements must be included as part of the planning process. Consideration of both results in coordinated management for both units of the refuges and assures a mix of natural resource benefits for the plants, fish, and wildlife found in the Area of Ecological Concern.

This planning process analyzes existing information including biological, administrative (Service policy issues, management direction), public/recreational use, and cultural resource information. Unit I of the Analysis addresses 10 of the major issues confronting the refuges, while Unit II details analyses of the various biological resources along with policy and legal implications. The outcome of the analyses is a set of recommendations that serve as the foundation for setting refuge objectives.

Species-specific biological data for fish and wildlife and their habitats is limited. Generally, the data was derived from review of, and extrapolation from, inventories or monitoring surveys and discussions with the refuge manager and other field personnel.

UNIT 1. Management Direction and Policy Issues

Several major policy issues and concerns have surfaced as a result of this comprehensive management planning process. Although the following are not policy analyses in the strictest sense, they attempt to summarize the policy concerns and associated problems, and to suggest possible avenues for resolution. The goals and objectives delineated in Part III of this document are an attempt to address the problems and opportunities addressed in this informal analysis. Resolution of these problems will determine the long-term impact of this comprehensive management planning approach, as well as its effectiveness in actual implementation of this comprehensive management plan.

The policy concerns addressed in this section include:

1. Ecosystem Sustainability
2. Biological Diversity and Habitat Management
3. Endangered Species Management
4. Water Rights, Water Management, and Wetlands Protection
5. Compatibility and Public Use
6. Environmental Education and Public Outreach
7. Cultural Resources Preservation and Management
8. Interagency Coordination
9. Land Protection
10. Staffing and Funding

1. Ecosystem Sustainability

The guiding principle behind the Service's Ecosystem Approach to Management hinges on preserving our nation's fish and wildlife resources by bringing the ecological, social, and economic needs of any given area into a closer balance. Clearly, this approach recognizes that humans cannot be separated from the "ecosystem equation." Humans are recognized as an integral part of ecosystems, depending on them for their survival and well-being just as plant and animal species do. As the human population continues to expand and place increasing demands on our natural resources, it is essential that various human dimensions including beliefs, attitudes, values, and socioeconomic factors are integrated within the context of maintaining sustainable and functioning ecosystems. As a natural resource management and protection agency, the Service is committed to our part in maintaining the integrity of ecosystems; that is, to assure the continuation of all of their structural and functional ecological components, while at the same time assuring healthy, sustainable local economies and societal needs.

Relative to the San Bernardino and Leslie Canyon NWRs, the Service's primary concern lies in the overall protection of the watershed and all of its ecological functions from uses that could ultimately harm valuable refuge resources. Of major importance is the protection of the water resource. Water is the lifeline that sustains the unique cottonwood-willow-ash riparian corridors and other aquatic habitats that in turn support the threatened and endangered Yaqui fishes, Chiricahua leopard frogs, Mexican garter snakes, Huachuca water umbels, San Bernardino spring snails, and a host of other desert plants and animals associated with the refuges. If the quality and quantity of the water is negatively impacted, the ecosystem could be seriously impacted. Another concern is the encroachment of woody, invader species such as mesquite into native grassland habitat, thereby decreasing habitat value and overall biodiversity.

Equally as important, the Service recognizes that the livelihoods of much of the local community, namely private landowners, depend on the very same resources that the San Bernardino and Leslie Canyon NWRs are trying to protect. Inherent to the success of ecological and economic sustainability then, is the involvement of the public and private sectors in striving for the conservation of fish and wildlife and their habitats. The Service should facilitate cooperation among all parties, including other governmental agencies, to foster awareness regarding ecosystem sustainability.

To achieve this, the Service is working in conjunction with the Malpai Borderlands Group, a grassroots, landowner-driven organization attempting to implement ecosystem management on nearly one million acres of virtually unfragmented open-space landscape in southeastern Arizona and southwestern New Mexico. Their goal is "to restore and maintain the natural processes that create and protect a healthy, unfragmented landscape to support a diverse, flourishing community of human, plant, and animal life in the Borderlands Region. Together, we will accomplish this by working to encourage profitable ranching and other traditional livelihoods which will sustain the open space nature of the land for generations to come."

This nonprofit organization has been working with a coalition of ranchers in Hidalgo and Cochise counties, as well as various agencies in southeastern Arizona and southwestern New Mexico including Coronado National Forest, Las Cruces and Safford districts of the Bureau of Land Management, Soil Conservation Service, Arizona State Land Department, New Mexico State Land Office, Desert Laboratory at the University of Arizona, Hidalgo Soil and Water Conservation District, Whitewater Draw Natural Resource Conservation District, Animas Foundation, and The Nature Conservancy. The Forest Service has taken the lead in the planning process and has designated this project a priority "Ecosystem Management" model. Furthermore, both the Forest Service and the Soil Conservation Service have assigned people to full-time positions to coordinate the project. The Service is formally represented by the refuge manager in this effort.

Common objectives of all participants involved in this project are to protect and improve the watershed's stability and hydrologic function as well as to preserve native biodiversity and the "open space nature" of the land. In order to achieve this, the Malpai Borderlands Group is proposing to reintroduce fire as a means to reduce undesirable woody species and by working cooperatively with the private landowners to establish non-development easements and

conservation easements on land and water use in the Valley. Because this is a landowner led initiative with the agencies cooperating as partners, participation levels are high. This is in part due to the genuine concern held by the ranching community of increasing land fragmentation caused by human development and because of the loss of native grasslands to encroaching woody vegetation. Not only are these in direct conflict with ranching operations, but they also interfere with the aesthetic beauty and openess of the landscape, something the landowners do not want to lose. To date, several non-development conservation easements in the Valley have already been obtained, and several more are currently being negotiated. They have also initiated a "Ranchers Endangered Species Program" which involves protection measures for the Chiricahua leopard frog, a candidate species. The project will provide permanent water to the rancher's stock ponds for the frogs which in turn will also help ranchers in their overall management. The Service commends all of these efforts as they are true examples of ecosystem management in action.

In addition to the above cooperative efforts, the Service is working independently to encourage private landowners and organizations to participate in watershed protection and wildlife conservation efforts while still remaining sensitive to private property rights. Various land protection strategies are being explored including conservation easements, Partners for Wildlife projects, cooperative agreements, offering technical assistance, and other measures. Recently, The Conservation Fund purchased a large tract of land adjacent to the southern boundary of Leslie Canyon NWR and subsequently donated it to the Service. The Service is also currently in the process of negotiating a three-way land exchange involving Leslie Canyon NWR and two private landowners, one in the United States and one in Mexico, offering the Service a valuable opportunity to work cooperatively at both the local and international levels. Additional land protection projects involving both the public and private sectors are also being considered.[64]

As the Service strives to fulfill its role in the ecosystem approach to managing natural resources, it will become more and more necessary to conduct inventories and assessments, and to monitor the effects of human uses on the refuges' resources. This information should be assimilated and applied to management strategies that will ensure both the sustainability of the ecosystem and the socioecomomic needs for future generations to come.

2. Biological Diversity

Biodiversity is defined by the Service as the variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur. Since the passage of the Endangered Species Act, State and Federal wildlife and natural resource agencies have attempted to focus on turning around downward slides of specific fish, wildlife, and plant species determined to be on the brink of extinction. The National Wildlife Refuge System contributes significantly to this effort. Clark writes:

> "The refuge system harbors just about every kind of wild animal and plant native to the North American continent: over 220 species of mammals, 600 species of birds, 250 reptiles and amphibians, 200 fish species, and uncounted numbers of invertebrates and plants. Over 135 threatened and endangered species occur on refuge lands with over 400 refuges reporting the occurrence of one or more of these species. Most refuges also report the occurrence of at least one candidate or state-listed species as well." [65]

Causes for the loss of biodiversity are numerous. Most prevalent is the rapid expansion of human populations, which place increased pressures on our natural resources, mainly in the form of habitat conversion and degradation that leads

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[64]Please refer to Part II, Unit 1, Section 10 entitled "Land Protection," for additional information regarding watershed protection strategies.

[65]Clark, Jim. 1992. Refuge Management and Biological Diversity: A Refuge Manager's Perspective. U.S. Fish and Wildlife Service. Transactions of the 57th North American Wildlife and Natural Resource Conference. Pp. 571-576.

to overall habitat loss. Pollution, introduction of exotic species, toxic chemicals, exploitation, certain land use practices, and habitat fragmentation have also taken their toll on plant and animal populations.

The values for preserving biological diversity go beyond utilitarian uses such as commodity production, food reliance, or recreational uses such as hunting and fishing. Foremost are the ecological services that healthy systems provide humankind.[66] Biodiversity is vital to the maintenance of healthy environments in order to sustain the integrity and resiliency of the very ecosystems upon which humans depend. Healthy, species-rich systems are needed to provide a natural defence against a host of today's environmental problems such as global warming, acid rain, air pollution, and loss of soil productivity. Biodiversity is also responsible for providing many of the goods and services that today's economies rely upon. For example, many plant species contain chemical substances that are extracted to make critically needed medicines, yet the vast majority of plant species remain unexplored for their medicinal properties. Wild plant relatives have been genetically crossed with domestic species such as corn and tomatoes to yield food and fiber crops that are not only more productive, but also more resistant to pests, disease, drought, and other threats. Finally, preserving biological diversity is important simply for its intrinsic and aesthetic values, that is, the spiritual and ethical appreciation of nature for its own sake.

Biological Diversity and Habitat Management in the Area of Ecological Concern

Prior to the introduction of cattle in the 1800s, the Area of Ecological Concern supported unique ash-willow-cottonwood stands, lush native grasslands, and many springs. A perennial stream flowed through the valley creating cienegas, or wet, marshy meadows. The combination of these unique habitats harbored a variety of plant and wildlife species, including the now threatened and endangered fishes of the Rio Yaqui.

As heavy grazing practices persisted, the fragile ecosystem began to falter and native grasslands gave way to invading woody species and undesirable forbs. In addition to being of less value to the native wildlife species, these invaders caused an increase in evapotranspiration and surface runoff rates that ultimately decreased the infiltration into the water table. Cattle trampled streams, ponds, and other riparian areas and as a result, severe erosion occurred. Poor grazing practices, intense farming, and occasional droughts also played their part in the deterioration of the watershed.

Fortunately, with the acquisition of San Bernardino and Leslie Canyon NWRs, many of these processes have been halted and are slowly being reversed in order to maintain the diversity of fish, wildlife, and plant species on the refuges.[67] Cattle grazing has been completely eliminated, allowing for natural regeneration of willows and cottonwoods. With the establishment of these desirable woody species, along with the construction of gabion structures, stream banks are being stabilized, and erosion has been greatly curtailed. Grassland and cienega habitats are being recreated through active management practices. Along with thinning out of undesirable woody species, abandoned farm fields are mowed periodically to reduce weeds and allow for native grass growth. Although with limited success, reseeding efforts have also been implemented. Finally, cienega habitats are being restored by piping water and allowing it to flow into suitable areas (such as abandoned farm fields), which are then stocked with native Yaqui fishes.

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[66]Erlich and Erlich (1981) describe these services as: (1) maintaining atmospheric quality by regulating gas ratios and filtering dust and pollutants; (2) controlling and ameliorating climate through the carbon cycle and effects of vegetation in stimulating local and regional rainfall; (3) regulating freshwater supplies and controlling flooding (wetlands, for example, can act as giant sponges to soak up moisture during rainy periods and release water slowly during dry periods); (4) generating and maintaining soils through the decomposition of organic matter and the relationships between plant roots and mycorrhizal fungi; (5) disposing of wastes, including domestic sewage and wastes produced by industry and agriculture, and cycling of nutrients; (6) controlling pests and diseases, for example through predation and parasitism on herbivorous insects, and (7) pollinating crops and useful wild plant species by insects, bats, hummingbirds, and other pollinators.

[67]Please refer to Part II, Unit 2: Analysis of Plant and Animal Diversity for specific habitat types and their associated wildlife species. Specific management actions are also offered.

3. Endangered Species Management

While developing a program of managing for biological diversity, the first responsibility of the National Wildlife Refuge System is to "preserve, restore, and enhance in their natural ecosystems (when practical) all species of animals and plants that are endangered or threatened with becoming endangered." [Refuge Manual, 2 RM 1.4] Both San Bernardino and Leslie Canyon NWRs have threatened, endangered, or candidate species to contend with.

(1) Threatened and Endangered Rio Yaqui Native Fishes -- Four species of fishes that formerly inhabited the Rio Yaqui Basin in the United States and Mexico are Federally classified as either threatened or endangered. These include the Yaqui chub (endangered), the Yaqui topminnow (endangered), the Yaqui catfish (threatened), and the beautiful shiner (threatened). Currently, wild populations are limited to San Bernardino and Leslie Canyon NWRs in Cochise County, Arizona, with the exception of Yaqui catfish which are being raised at Dexter National Fish Hatchery and Technology Center for future stockings onto the refuges.

The Yaqui Fishes Recovery Plan outlines specific management strategies for the survival, recovery, and maintenance of the threatened and endangered Yaqui fishes. Specific objectives are to stabilize existing populations, downlist the Yaqui chub and the Yaqui topminnow, reintroduce Yaqui catfish and beautiful shiners into historic habitats in the United States, and establish self-sustaining populations. Because they provide critical habitat, San Bernardino and Leslie Canyon NWRs will play a significant role in meeting these objectives.[68]

(2) Chiricahua Leopard Frog -- Leopard frog populations throughout the southwest have been steadily declining in recent decades. The refuges populations are no exception. Once abundant throughout the refuges, leopard frogs currently are found only at Leslie Creek on Leslie Canyon NWR. Reasons for their decline are speculative; however, the introduction of bullfrogs in the 1970s is known to have had detrimental effects on leopard frog populations, as they make up an important part of the bullfrog's diet. It is probable that the removal of exotic fish species to better manage for the native fish species removed the predation pressures on bullfrogs, allowing their populations to explode.[69] The fact that leopard frogs are present in bullfrog-free areas exemplifies the predatory role of the bullfrogs and merits control efforts of this introduced species. Leslie Canyon NWR currently exerts control measures to reduce bullfrog numbers by using a combination of gigging along with continuous trapping during the warm season. This process has succeeded in decreasing bullfrog populations and will continue to be employed. Because the decline of leopard frogs is occurring on a widespread basis, alternative explanations for their reduced numbers also need to be considered.

To date, conservation efforts concerning San Bernardino's frogs have consisted of collecting tadpoles from Leslie Creek and raising them at the Arizona Sonora Desert Museum. This has succeeded in establishing a separate population while at the same time safeguarding the wild populations. Cooperators in this translocation venture include the Arizona Game and Fish Department, the National Biological Service, University of Arizona, and the Service Phoenix Ecological Services Field Office.

More recently, four small impoundments were created for use as reintroduction sites for the leopard frogs. The ponds have been fenced to prevent bullfrog invasions in hopes that a viable population can once again be established on Leslie Canyon NWR. To date, leopard frogs have been transplanted to the ponds and are doing well. It is still too early, however, to determine the success of the project.

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[68]A full analysis of Yaqui fishes management is given in Part II, Unit 2; Recovery and Maintenance of Native Populations of Yaqui Fishes and the Role of San Bernardino and Leslie Canyon NWRs.

[69]Rosen, Philip C. and Cecil R. Schwalbe. 1993. Interim report on bullfrog impacts on sensitive wetland herpetofauna and herpetology of San Bernardino National Wildlife Refuge. University of Arizona, Tucson. 11pp.

(3) Mexican Garter Snake -- Mexican garter snakes are also suffering due to the expanding bullfrog populations on San Bernardino NWR. Due to their predatory nature, bullfrogs have large impacts on young garter snake survival. As evidenced by capture efforts that consistently catch primarily older snakes, garter snakes probably endure only due to the high survivorship of adults.[70] As such, bullfrog removal and control is necessary to ensure future recruitment of garter snakes.

(4) San Bernardino Spring Snail -- Populations of the San Bernardino spring snail, listed as a Candidate Category 2 species,[71] probably declined in the past due to gambusia predation and control efforts to eliminate non-native fish species. Today, limited habitat poses their largest problem. Only the San Bernardino Snail Spring outflow provides the shaded, hillside seeps necessary for their survival. Attempts to provide more of their habitat needs could prove beneficial; however, because so little is known about the natural history of this snail, management efforts will, for the most part, be experimental.

(5) Aplomado Falcon -- Although never sighted on the refuges, aplomado falcons historically occupied the San Bernardino Valley. Consequently, the San Bernardino NWR is being considered as a possible reintroduction site for this endangered bird. The refuge offers typical habitat types previously utilized by aplomados, namely mesquite bosques or riparian areas for nesting and native grasslands for hunting. Grassland and riparian woodland habitat restoration to increase the quality of the habitat, as well as increase the prey base for the falcons, will need to be implemented to meet recovery goals and objectives of any proposed reintroductions. The endangered peregrine falcon, a rare migratory visitor to the refuge, would also benefit from the aforementioned efforts.

(6) Huachuca Water Umbel -- The Huachuca water umbel is a Candidate Category 2 plant species found growing in Black Draw, Oasis Pond, and the north end of Evil Twin Pond on San Bernardino NWR. It fairs well in disturbed areas with shallow water depths; however, other habitat types/requirements warrant further studies. The Arizona Nature Conservancy has experimented with plug transplants with only limited success. Alternative methods for the restoration and protection of this plant need to be explored.

4. Water Rights, Water Management, and Wetlands Protection

Water Rights -- Ground and surface water rights are key components for biological conservation within riparian systems. Without adequate moisture, natural regeneration of woody, riparian vegetation such as cottonwoods and willows cannot occur. By ensuring continued surface and near surface flows, the water required during critical seed dispersal and germination periods will be assured, thereby aiding in the restoration and stabilization of San Bernardino NWR's damaged riparian areas. Downcutting and erosion processes would be slowed, and an eventual increase in biodiversity would result due to the increased vegetation. Also, the more established, healthier systems will continue to prosper and provide valuable feeding, nesting, resting, and cover habitat for many wildlife species. Equally as important, critical Yaqui fishes habitat would be safeguarded if the water resources were further protected on the refuge.

Surface water rights exist for Leslie Canyon NWR and consist of instream flow rights for Leslie Creek within the refuge. Although groundwater rights do currently exist on the San Bernardino NWR, the nature and quantity of these rights needs to be investigated.

The necessity to protect surface and near surface flows within Black Draw is essential for the conservation of both its riparian corridor and fish habitat. However, the method for protecting these flows is not clear and needs to be investigated. A State instream flow right would protect the flows in the near border section of Black Draw where springs emerge and create pools of water and slowly moving flow. Several difficulties exist with this possibility.

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[70]Ibid., Rosen, Philip C., et. al.

[71]Candidate Category 2 includes species for which the existing data are considered inadequate to make a listing decision.

First, the near border stretch of Black Draw may not be perennial, making it difficult to secure instream flow rights with the State. Additionally, private landowners within the Valley have expressed a concern over instream flow rights on San Bernardino NWR encroaching upon their water rights. Though an instream flow right in Black Draw would have a priority date post dating any existing water rights in the Valley, these fears need to be addressed and discussed with the local community. The refuge has begun to investigate the possibility of working with private landowners in establishing conservation easements on water use within the Valley. This strategy may be preferable to a State water right as it would establish legal limits on water use while still addressing the concerns and ideas of the local community. Because of these difficulties, it is critical that a strategy be developed for the protection of surface and near surface flows (riparian) on the San Bernardino NWR. As part of this strategy, a monitoring network and computer model is being established for the refuge in order to determine the natural hydrologic connections and limits of the local aquifers. Please refer to the Water Management section below for further discussion related to the model.

With the passing of NAFTA and the possibility of industrial development within the Mexican portion of the San Bernardino Valley, the water rights of the San Bernardino NWR have become even more complex. Along with the strategy for protecting refuge water resources within the United States, a separate strategy needs to be developed that addresses both the complexity of international law and the avenues for enforcement. Again, the computer model discussed below that is being developed by the University of Arizona is a critical first step toward confronting this problem.

Water Management -- Declines in flow of artesian wells obviously pose a serious threat to the Yaqui fish community, as well as other wildlife that depend on these unique wetland habitats. The assumption cannot be made that the aquifer can sustain enough water to support any proposed increases in development. Water management strategies must therefore be designed to safeguard water levels during periods of low or inadequate flows.

As recently as 1992, two new wells were drilled to depths of 600 feet. These replaced the older, degenerative wells at the Bunting and Twin well sites, and have succeeded in providing considerably more reliable flows to Yaqui fishes habitat. Other ongoing water management projects include repairing damaged or broken wells such as leaky casings and collecting flow data.

More important though, is the current effort with the University of Arizona Department of Hydrology to create a computer model of the San Bernardino Valley aquifer. This cooperative study is a crucial first step towards developing water management guidelines for the refuge. Critical to this endeavor is the necessity of setting up monitoring devices (pressure gauges, peizometers) in Mexico and on the refuge (to augment the current refuge monitoring system) in order to gauge the extent of water use and determine the effects of such usage on the San Bernardino aquifer. Finally, baseline water quality data including dissolved oxygen, pH, and total dissolved oxygen needs to be evaluated and monitored to ensure good quality water is provided to the wetlands. Once the appropriate data is collected, it will be incorporated into the model, which will analyze the information and in turn, determine the aquifer limits. The main advantage the model offers is the ability to predict the effects that development will have on the aquifer so that a plan of action can be strategically developed to protect the water supply.

Wetlands Protection -- Wetlands on San Bernardino and Leslie Canyon NWRs provide essential habitat for many fish and wildlife species for breeding, rearing, and feeding activities. In addition to the various habitat provisions, wetlands also contribute to flood control and help maintain water quality by assimilating contaminants and nutrients, reducing sediment loads, and processing chemical and organic wastes. As such, protection of these areas is vital, especially with respect to the recovery of the threatened and endangered Yaqui fishes.

Nationwide, there is a new level of awareness by the public of the inherent ecological values in wetland areas. This strengthened awareness creates a need for a more comprehensive approach to evaluating water-related resources before allowing activities, projects, and developments in wetland areas.

Cooperation among agencies, organizations, user groups, and landowners has resulted in the implementation of strategies for protecting fish, migratory bird, and waterfowl habitat. For example, the State of Arizona, along with

commercial industries and organizations, is initiating programs and activities designed to protect the remaining wetlands and riparian systems. They produced an addendum to their State Comprehensive Outdoor Recreation Plans entitled Arizona Rivers, Streams and Wetlands Study in 1989. Video programs and educational booklets on desert riparian systems have been published by the University of Aizona Cooperative Extension Service. Furthermore, the Arizona Nature Conservancy has begun an ambitious fund raising campaign, Streams of Life, to protect and acquire sensitive riparian habitats throughout the State.

The recently enacted North American Wetlands Conservation Act establishes a clear wetland policy direction. This policy directs natural resource agencies to focus on migratory bird and waterfowl habitat conservation with the provision of broad benefits for fish, wildlife, soil, and water conservation. This is the present policy direction being supported and fostered by the Service. This comprehensive management planning effort, along with current management activities occurring on the refuges, are all part of the Service's larger commitment to preserve and enhance our nation's wetlands. For example, the removal of cattle, the development of artesian wells, and the restoration of deteriorated habitats through grassland and cienega rehabilitation, have all contributed to maintaining the aquatic habitats on San Bernardino NWR. Inherent to aquatic ecosystem restoration is, of course, the restoration of all habitat types on the refuge. However, because San Bernardino NWR was acquired for protection of the threatened and endangered Yaqui fishes, aquatic habitat development and improvements will take precedence over terrestrial habitat management should conflict arise (i.e., pumping and diverting water to grassland areas).

NAFTA -- NAFTA's overall short-term impacts (between 1 - 5 years following ratification) will probably not be substantial relative to natural resource issues in the southern Cochise County area. However, it should be emphasized that as Mexico's economy gains momentum from the trade agreement, consequent commercial and economic development will occur throughout the border areas, including the Agua Prieta/Douglas area. The largest potential impact from such development may be demands on limited groundwater supplies, especially in the San Bernardino Valley. Pumping for agricultural purposes alone has been a threat to the water resources. If future development occurs, undoubtedly additional water will be pumped, thus further compounding the problem.

It is therefore important to preempt any possible negative impacts through strategic planning. Additional information concerning future groundwater availability is essential prior to any scheduled development on either side of the border. Monitoring wells in Mexico would assist in obtaining the kind of information necessary regarding effects of pumping in Mexico on the overall water table. Additionally, strategic mapping of the aquifer, via the computer model previously mentioned, is paramount in order to predict any future negative impacts related to pumping on either side of the border. It is an important milestone in a long-range plan to protect the natural cienegas and springs that are critical to the protection and recovery of endangered species and to the conservation of natural diversity.

5. Compatibility and Public Use

Compatibility of Uses -- Law and policy allow the Service to permit a variety of uses on national wildlife refuges. Accordingly, these are uses on which the Service must make determinations of compatibility.[72] Within this framework, Service policy provides that an allowable use may be determined to be compatible if it will not materially interfere with, or detract from, the purpose(s) for which the refuge was established. Before a proposed use can be reviewed for compatibility, it must first be determined to be in compliance with applicable laws, Departmental and Service policies, and regulations. In addition, the manager must certify that adequate funding is available to manage any recreational programs offered that are not directly related to the primary purpose(s) for which the refuge was established. Finally, there are other considerations that affect the allowance of a particular use, aside from the compatibility determination process. These considerations include timing of the proposed use, enforcement requirements, and conflicts with other uses. In some of these circumstances, a use may be determined to be

[72]The authorities that mandate the requirement for determination of compatibility of uses are found in the Refuge Recreation Act and the National Wildlife Refuge Administration Act. See Part I, Unit 2, Section 2, No's 11 and 14.

inappropriate even if it is determined to be compatible when measured only in the context of the refuge's legal purposes.

Allowability of Public Uses on National Wildlife Refuges -- With regard to public uses on national wildlife refuges, the fourth goal of the National Wildlife Refuge System provides the following:

> "To provide an understanding and appreciation of fish and wildlife ecology and man's role in his environment, and to provide refuge visitors with high quality, safe, wholesome, and enjoyable recreational experiences oriented toward wildlife to the extent these activities are compatible with the purposes for which the refuge was established."[73]

Public Uses on San Bernardino and Leslie Canyon NWRs -- Allowed and compatible public uses that are currently offered on San Bernardino and Leslie Canyon NWRs include wildlife observation and photography, walking/hiking, and limited dove, quail, and cottontail hunting. Because the refuges receive limited visitation per year, impacts to refuge resources and objectives have been, and are expected to remain, minimal as a result of these activities. However, if public use activities increase, recreation management will need to increase accordingly.

Possible negative impacts to the refuge as a result of more public use include trampling of aquatic, riparian, and other habitats due to increased foot traffic, littering on refuge grounds, disturbance to native wildlife, and tampering with the archaeological and historic resources on the refuge. Another large concern is the possibility of exotic fish introductions which would pose a very serious threat to existing Yaqui fishes populations. In the event that recreational activities increase significantly, law enforcement, patrolling, and monitoring of the refuge will be increased accordingly and should problems arise, harmful activities will be evaluated and modified, or eliminated as deemed necessary. The refuge roads are routinely maintained for refuge operations, thus impacts to the roads from increased use will be minimal.

Specific public use action items will be subject to final determinations contained in a Public Use Management Plan yet to be developed.

6. Environmental Education and Public Outreach

As a natural resource management and protection agency, the Service plays an important role in communicating environmental issues to the public. Unless the public has an interest in plant and wildlife resources and environmental health in general, support for proposed refuge projects could be severely hindered. Although both the San Bernardino and Leslie Canyon NWRs only receive limited use, they still have the opportunity to contribute to this endeavor. Furthermore, the Yaqui Fishes Recovery Plan recommends that information and educational programs be developed and interpreted to the public for the protection of the Yaqui fishes.

There are several approaches to help accomplish this goal. First, the possibility exists for the Service to enter into a partnership with the Johnson Museum, owner of the Slaughter Ranch Headquarters Site and associated lands. The historical site is open to public visitation and could serve as an excellent educational opportunity for the Service to interpret Yaqui fishes ecology and management and endangered species preservation as a whole. The Service has met with the museum manager and has laid the groundwork for this cooperative effort in which an interpretive trail would be developed as well as other interpretive panels surrounding House Pond, which provides essential habitat for endangered Yaqui chubs and Yaqui topminnows. The self-guided trail would relay important messages such as factors that led to habitat destruction, restoration techniques, and ongoing terrestrial and aquatic habitat management practices. The Service could also actively promote the value of protecting overall biodiversity using the San Bernardino spring snail, the Mexican garter snake, and the Chiricahua leopard frog as prime examples, all of which are candidate species for listing and are found on the property. Finally, the cottonwood-willow stands surrounding the pond offer the

[73]Refuge Manual, 2 RM 1.4

ability to interpret the importance of preserving native vegetation in that they provide habitat for various neotropical birds, waterfowl, raptors, and other resident wildlife. The Service views this potential partnership as an excellent opportunity to help meet refuge public use and educational goals and objectives, while at the same time offering the Johnson Museum the benefit of increased visitation to its unique cultural resource.

A Public Use/Environmental Education Management Plan, which would detail specific action items, would need to be developed before such a partnership could be formed. This effort is currently ongoing and following the completion of the plan, the Service is strongly interested in pursuing this effort.

Second, by targeting the public school system through educational programs, refuge staff could reach an important sector of the public-- teenagers and younger children. In fact, one project proposal would allow students to actively participate in fish recovery through a stocking program. Endangered Yaqui fishes would be placed in the local high school pond with the students having the main responsibility for their well-being through the guidance of the refuge staff. Students would learn not only about Yaqui fishes ecology and habitat needs, but also the importance of species preservation, a message that is key to the goals of the Service.

Third, the opportunity exists to relay information about habitat changes and degradation in southeastern Arizona to private landowners, including those in Mexico. Tours of the refuges and presentations that interpret habitat and management practices are powerful tools the refuge staff can use to influence sound land use practices. Programs such as these should be implemented at the international scale as well, to include Mexican organizations such as SEDESOL and Centro Ecologico. Whenever possible, Partners programs that emphasize the ecosystem approach should be encouraged. Recommended topics and demonstrations include sound grazing and farming strategies, conservative use of the aquifer, and riparian protection/restoration.

Interpretive opportunities off refuge lands also exist. A small exhibit located at the refuge headquarters in Douglas could provide valuable educational messages. The office already has several aquariums that house Yaqui fishes and San Bernardino spring snails. Here, the refuge staff would be available to interpret Yaqui fishes and other refuge interests to those visitors stopping at the headquarters. Other activities the staff can do to achieve interpretive goals include giving presentations to local civic and special interest groups and setting up displays at local events.

7. Cultural Resources Preservation and Management

The Service has long recognized the important contributions that cultural resources provide to the refuge system. Along with the unique historical perspective they offer, cultural resources can also contribute significantly to our knowledge of past human occupancy and how former land use practices over centuries of time affected land and water conditions and their associated plant and animal populations. This information can be very useful in understanding current environmental conditions and ecological processes.

As stated in the Service Manual, it is the policy of the Service to "identify, protect, and manage cultural resources located on Service lands and affected by Service undertakings, in a spirit of stewardship, for future generations. Specifically, the Service will:

A. Manage these resources in such a manner that sites, buildings, structures, objects, and values of importance are sufficiently protected for present or future scientific study, public appreciation, and socio-cultural use.

B. Ensure that during the appropriate stages of decisionmaking for Service administered or assisted activities such as construction projects, land use or resource planning, real property acquisition or disposal, and grants and technical assistance to States, full

consideration is given to protecting cultural resources consistent with Federal statutes, regulations, and policies."[74]

Cultural Resources Management on San Bernardino NWR:

The following is a plan of action for San Bernardino NWR cultural resources. It is important to note that the strategies discussed below are only relevant to those sites that the Service owns or has jurisdiction over on San Bernardino NWR, and therefore are not applicable to the Slaughter Ranch Headquarters Site.

The cultural resource management objective of the refuge will be preservation-in-place. The refuge will continue to ensure compliance with 614 FW 1-5 of the Service Manual and all applicable Federal laws and regulations. The refuge will provide the fullest protection possible to the cultural resources under its jurisdiction, and ensure that standard procedures continue to be implemented to avoid the inadvertent loss of archaeological and historical sites. The refuge will continue to follow policy and procedure in the following areas: refuge construction projects; law enforcement; visitor use; special use permits - research referral; special use permits - non-Service lands use; reporting new cultural resources; reporting maintenance, stabilization, or protection needs; National Register nominations; and archives and collections.[75]

Due to the potential for buried Paleo-Indian or Archaic sites of major importance along Hay Hollow Wash and Black Draw, construction activity along these drainages should be performed in conjunction with archaeological monitoring. This monitoring will identify prehistoric activity surfaces, features, structures, or datable material for potential data recovery. Important paleoenvironmental data may also be lost if monitoring by an archaeologist is not performed.

Although most of the flood terrace of Black Draw, including the old field locations, appears devoid of cultural resources, dense vegetation in these areas precluded an intense survey, and considerable portions of the bosque could not be inventoried at all. Surface disturbing activities in these zones should be monitored by an archaeologist.

8. Interagency Coordination

The San Bernardino and Leslie Canyon NWRs are clearly affected by land and resource use policies implemented by surrounding landowners and jurisdictions (BLM, Forest Service, Arizona Game and Fish), including those on the Mexico side of the border. Although adjacent land use has primarily been ranching, it is difficult to project the effects of NAFTA on possible development for commercial purposes (i.e., industrial parks, roads, railroad spurs, etc.). It is suspected that any kind of development on either side of the border will involve major construction efforts that will rely on additional water pumping. All of this could impact the refuges main aquifer.

Refuge resource goals and objectives can only be accomplished with the cooperation of all interested jurisdictions and landowners located in the Area of Ecological Concern. It is essential that the refuges participate fully in efforts such as the Malpai Borderlands Group to develop broad-based conservation initiatives among landowners in the San Bernardino Valley and surrounding area. It is equally essential that the refuge manager stay apprised of initiatives under consideration by the County Planning and Zoning offices for additional infrastructure development in the Douglas area that is related to anticipated NAFTA growth.

Finally, cooperation with Mexico has been a very difficult endeavor, as they have no national counterpart to the Service. There is the opportunity, however, to work with SEDESOL and Centro Ecologico to develop conservation programs. Perhaps another answer lies in participating in a larger dialogue being developed by the Service with Mexico relative to NAFTA issues in general. In the long-term, the largest threat to the resource looms with

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[74]Service Manual, 614 FW 1.4.

[75]Please refer to Appendix F for a detailed discussion on Service policy related to these cultural resources issues.

development on the south side of the border with no concern for resource impacts to the north. Clearly, lines of communication must be established early in order to mitigate future depletion of water and other resources that are vital to the mission of the Service and the purposes of these refuges.

9. Land Protection

Throughout the country, managing our natural resources is becoming increasingly difficult due to the growing needs of society. Ecosystems are suffering in that natural processes are being interrupted and biodiversity is being lost at alarming rates. Through effective protection measures, however, the Service is working to reverse those trends. Land protection is an extremely important component of this "ecosystem approach" to managing our natural resources. A large part of this effort entails working cooperatively with local communities to maintain the integrity of the ecosystems upon which humans depend.

Relative to the San Bernardino and Leslie Canyon NWRs, land protection is needed to provide critical watershed protection for the maintenance of aquatic and desert riparian habitats; for the Service's initiatives on endangered species, biodiversity, and neotropical birds protection; and to provide for more efficient management of the refuges.

Part I, Unit 2, Section 5 discusses land ownership, acquisition history, and the rights attributed by law and title of the San Bernardino and Leslie Canyon NWRs. What follows is a summary of the various land parcels and tracts the Service is interested in protecting through various strategies including willing seller fee title acquisitions[76], conservation easements, withdrawal from public domain, Partners for Wildlife projects,[77] and other cooperative ventures. With the exception of the Slaughter Ranch Headquarters Site, all of the land parcels discussed below pertain to protection of Leslie Canyon NWR and surrounding areas.

A. San Bernardino NWR

Slaughter Ranch Headquarters Site -- When the Service purchased San Bernardino NWR from The Nature Conservancy in 1982, it subsequently sold a 131-acre parcel to the Johnson Historical Museum of the Southwest. The Museum's interest in the land stemmed from the historic Slaughter Ranch Headquarters, a National Historic Landmark, located on the parcel. The Service did, however, retain a conservation easement for the management of the fisheries that occupy House Pond. The provision, as detailed in the easement, states that the use of water on the site will not be withheld unless the Service determines that such activities will adversely effect the fish species occurring on the historic site. Otherwise, use of the water by the Johnson Museum is allowed. For both parties involved, the management agreement concerning House Pond has not always worked as well as it was intended. The Museum is rightfully interested in keeping the historic site aesthetically pleasing, which requires using the water supply to maintain lush green lawns. The Service is concerned with protecting not only Yaqui fishes and their habitat but also some candidate species. Obviously, the water supply is of critical importance to the continued existence of the Yaqui fishes that inhabit House Pond, and creates a situation that clearly calls for an improved agreement to satisfy management concerns for both the Johnson Museum and the Service.

Because of the incredible resource values that the property offers (habitat for Yaqui fishes, San Bernardino spring snails, Mexican garter snakes, Chiricahua leopard frogs, and a host of neotropical birds and other wildlife), the Service is interested in working cooperatively with the Johnson Museum in any efforts that would help to ensure further protection of the various habitats and their associated species.

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[76]Fee title acquisition would be on a willing-seller basis only. A willing seller is defined as a landowner who willingly agrees to a price settlement wherein the Service negotiates the sale of one, some, or all rights to the property. All purchases by the Service are based on fair market value as estimated by a certified appraiser.

[77]The Partners for Wildlife program improves and protects fish and wildlife habitat on private lands through alliances between the Service, other organizations, and individuals, while leaving the land in private ownership.

B. Leslie Canyon NWR

Proposed 24,000-Acre Protection Area

The Service has initiated a proposal to safeguard approximately 24,000 acres of land for the overall long-term protection of the watershed and additional lands associated with Leslie Canyon NWR (See Map #10). Much of these lands, particularly the upper watershed area, are susceptible to land uses (excessive cattle grazing, water consumption, residential development, mining) that could seriously affect the quality and quantity of water in Leslie Creek. Of particular importance for habitat preservation is the basin separating the Leslie Canyon NWR from the Coronado National Forest. The surface flow within Leslie Creek is entirely fed by groundwater from this basin. Groundwater over development within this basin would result in a drop in the groundwater table and a subsequent drying of the perennial flows within Leslie Creek. Land protection is therefore necessary to preserve Yaqui fishes habitat as well as the unique ash-willow-cottonwood stands that thrive in the area. Furthermore, a variety of other habitats, such as desert grasslands and juniper/scrub shrublands, are associated with the proposed acquisitions and would provide habitat for many wildlife species. Wildlife observed or expected to occur in the protection area include mule and white tail deer, javelina, coati mundi, cougar, golden eagle, various other raptors, and a wide array of small mammals and neotropical songbirds. Although not confirmed, the areas could also house endangered leopard frogs and lesser long-nosed bats.

Landownership as it exists today does not offer sufficient protection to the watershed and the associated endangered fishes habitat. Currently, the lands are divided among three separate ownerships including the Bar Boot Ranch (13,000 acres), the 99 Bar Ranch (7,200 acres), and several scattered BLM tracts (2,700 acres).[78] In efforts to provide enhanced protection to the various areas, the Regional Director approved the proposal and authorized the Service to do detailed planning studies, public involvement, and environmental assessments for these proposed protection areas. Various protection strategies the Service is exploring include Partners for Wildlife cooperative efforts, cooperative agreements, conservation easements, fee title acquisition by willing sellers, and withdrawal of public domain lands. Additionally, hard rock mineral rights should be acquired or withdrawn to protect the land from mining activities.

The discussion that follows is a summation of the three proposed protection tracts that comprise the larger 24,000-acre protection area. Also, a brief discussion is given for the former Resolution Trust Corporation tract that was included in the initial 24,000-acre proposal.

Scattered BLM Lands -- In their Resource Management Plan, the BLM Safford District has identified 2,700 acres of public domain lands that they intend to dispose of within the Leslie Canyon proposed additions study area. These lands, which are located northeast of Douglas in the Swisshelm Mountains, are scattered in isolated areas and are difficult for the BLM to manage. With respect to Leslie Canyon NWR, many of the tracts are located adjacent to current refuge boundaries, with some lying directly in the watershed. Acquisition of those tracts that directly contribute to the watershed would protect the watershed from uses that could seriously threaten the quality and quantity of the water, including mining, livestock grazing, development, and water consumption. In addition, they would allow for more efficient control of refuge boundaries. The current refuge boundaries are in very steep terrain, making fence maintenance operations extremely difficult. Without proper maintenance, stray cattle become a concern as they are able to meander onto the refuge. Acquiring these tracts then, would greatly improve management efficiency because the refuge's western boundary would run along the western foothills of the Pedragosa Mountains where the terrain is more amenable for building and maintaining fences.

In efforts to pursue the lands as additions to the refuge, the Service requested that the various tracts, along with Federal and private mineral rights, be withdrawn from public domain. The BLM in turn gave the Service the lead

[78]Also included in the 24,000-acre protection area was the former 1,200-acre Resolution Trust Corporation tract that was just recently purchased by The Conservation Fund and subsequently donated to the Service as an addition to Leslie Canyon NWR.

in going forth with the planning process that is required before the withdrawals can take place. The Albuquerque Realty Office has identified this as an important protection strategy and is looking at all viable options at this time.

Bartlett Tract Exchange -- The Service is currently negotiating a three-way land exchange between Leslie Canyon NWR, the owner of the 99 Bar Ranch, and a private landowner in Mexico. The exchange would entail the purchase, by the Mexican landowner, of a 330-acre parcel of the 99 Bar Ranch that lies adjacent to the northern boundary of Leslie Canyon NWR. The landowner in Mexico in turn plans to give the land to the Service in exchange for a 130-acre area west of Douglas, the Bartlett tract, that was donated to the refuge many years ago. The owner of the 99 Bar Ranch is interested in the exchange because he cannot efficiently graze cattle on this portion of his land due to the rough terrain and lack of water. The proposed land exchange will benefit the Service because this land would: (1) protect a wash draining into Leslie Creek to the benefit of Rio Yaqui fishes; (2) provide excellent habitat for other native wildlife; and, (3) make the refuge boundaries more manageable. Furthermore, this proposal will allow the Service to dispose of the Bartlett tract, which is marginal wildlife habitat at best and essentially serves no useful purpose to the refuge.

Because the 99 Bar Ranch occupies a good portion of the Leslie Creek watershed, the Service is interested in working cooperatively with the landowner to protect important habitats on the ranch. The perennial portion of Leslie Creek, located on the refuge, is dependent on the sub-surface waters that enter the basin on the Coronado National Forest, the Bar Boot Ranch, and the 99 Bar Ranch (See Map #11). If development or large-scale groundwater pumping were initiated in these areas, the perennial water of Leslie Creek could be severely impacted, as it is the sub-surface waters supplied by the basin that maintain the year-round flows. Overgrazing in this area could also detrimentally impact fish habitat. Grasslands and vegetative cover in the basin provide protective cover and allow infiltration of rainwater into the soil. The vegetation also acts as a buffer to the periodic floods that scour the area after heavy rainfall. With loss of vegetative cover, sediment loads and intensity of floods would increase, severely impacting the riparian zone.

The Service is interested in working cooperatively with the landowner through a variety of protection measures including conservation easements on land and water use, Partners for Wildlife projects, or offering technical assistance. The latter is an especially valuable tool that can benefit both landowners and wildlife. For example, the Service can provide assistance on a variety of issues including grazing plans that benefit both livestock and wildlife, wetland restoration, native plant restoration, and water management. Any land acquisitions would be explored on a willing-seller basis only.

Bar Boot Ranch -- The Bar Boot Ranch comprises a large portion of the proposed protection area, totaling approximately 13,000 acres. The majority of the ranch lies northeast of Leslie Canyon NWR and contributes significantly to the upper watershed..

As with the 99 Bar Ranch, the Bar Boot ranch can contribute significantly toward the overall protection of the watershed. Virtually all threats to the upper watershed would be eliminated if protective measures were implemented, providing invaluable protection for endangered fishes and riparian habitats. Again, the Service is interested in a variety of options for protecting the watershed including conservation easements, Partners for Wildlife cooperative efforts, technical assistance, and other agreements that concentrate their efforts on riparian and watershed enhancement and protection. Any land acquisitions would be obtained on a willing-seller basis only.

Former Resolution Trust Corporation Tract -- Included as part of the overall watershed protection strategy is the 1,200-acre former Resolution Trust Corporation tract recently acquired by the Service. The tract was purchased in October 1994 by The Conservation Fund, who subsequently donated it to the Service as an addition to the existing Leslie Canyon NWR. This tract, which is contiguous with the southern boundary of Leslie Canyon, virtually doubled the size of the refuge from 1,240 acres to 2,440 acres.

The addition of this tract to Leslie Canyon NWR will provide many benefits to the refuge. Most importantly, it will help protect a headwater tributary that flows into Leslie Creek from any harmful uses. In particular, it helps protect

part of the watershed from potential ground disturbing activities such as mining and development which could have a severe impact on wildlife and habitat resources in Leslie Creek. In addition, the acquisition provides the refuge an existing healthy, diverse plant and animal community. Several species of rare or uncommon cacti have been found on the land, as well as native agave plants, which provide a valuable food source for the endangered lesser long-nosed bat. Finally, the addition of this tract to Leslie Canyon NWR will provide for more efficient management control of the refuge boundaries and will serve as a buffer zone from nearby new residential developments.

10. Staffing and Funding

Staffing -- The small geographic size of San Bernardino NWR is potentially misleading. Since its inception, the refuge's principle task has been to be a primary contributor to the recovery of the threatened and endangered Yaqui fishes. With the addition of the Leslie Canyon NWR, these responsibilities have increased significantly, leaving the staff with less time to do both the necessary biological work and the more purely administrative tasks.

Until recently, the refuges staff consisted of four employees; the refuge manager, an office assistant, a maintenance worker, and a biological technician. However, with the loss of the biological technician in March, the staff is down to three employees, adding further constraint to the refuge manager's time. Additional staff is sorely needed. This is even more prevalent as the larger, more policy-oriented issues such as NAFTA and border economic and environmental issues in general continue to surface. Recently, the refuge received approval to hire a full-time biologist with expertise in fisheries and herpetology. This position is necessary in order to do the kind of biological field work necessary to ensure optimum protection of the refuges resources. The funds to hire a new PFT employee were made available through NAFTA funding.

Funding -- In the past, funding levels have been only adequate to allow the manager to focus on endangered species recovery issues. The acquisition of the Leslie Canyon NWR to the San Bernardino NWR management program, as well as the need to focus on developing the necessary relationships with other agencies, regional landowners, and organized efforts such as the Malpai Borderlands Group, will require additional fiscal resources. In the next 20 years, the refuge manager will be increasingly involved in implementing strategies that contribute to the resolution of conflicts between NAFTA-related border economic development and natural resource conservation in general.

Current funding levels will no longer be adequate to do the kind of resource conservation that will only result from good biological field work and more intense policy and program coordination with surrounding land owners, along with other State, Federal, and local governments.[79] It is projected that with the current staff of three FTE's, $215,000 is the minimum amount that the refuge can operate under. When the full-time biologist position is filled, optimum funding levels would be in the $230,000-250,000 range. This plan should be of some assistance in articulating the refuge's case for the necessary increases in operational, maintenance, and special project funds.

[79]Please refer to Part I, Unit 5, Ssection 2 entitled "Funding" for a breakdown of the fiscal resources allocated to the refuges for 1990-1994.

UNIT 2. Analysis of Biological Resources

This unit analyzes the existing biological data regarding primarily the Rio Yaqui fishes and their historic habitats found in the San Bernardino Valley of Arizona. Four Yaqui fish species are included here: the Yaqui chub, the Yaqui topminnow, the Yaqui catfish, and the beautiful shiner. This Unit also addresses the relationship between the dominant vegetative types and the associated fish and wildlife populations found within the Area of Ecological Concern. Finally, it offers specific management actions for habitat restoration and maintenance.

The suggested actions characterize the Service's general policy of conservation of biological diversity.

The following informal analyses are offered: (1) Analysis: Recovery and Maintenance of Native Populations of Yaqui Fishes and the Role of the San Bernardino and Leslie Canyon National Wildlife Refuges; and (2) Analysis: Plant and Animal Diversity.

(1) ANALYSIS: RECOVERY AND MAINTENANCE OF NATIVE POPULATIONS OF YAQUI FISHES AND THE ROLE OF THE SAN BERNARDINO AND LESLIE CANYON NATIONAL WILDLIFE REFUGES

The following analysis pertains to the recovery and maintenance of the native fishes of the Rio Yaqui Basin. The current status of the existing populations are discussed, followed by an in-depth analysis of the relationship between the Yaqui Fishes Recovery Plan and the role of the San Bernardino and Leslie Canyon NWRs in terms of their contribution towards the survival, recovery, and maintenance of Yaqui fishes. Four out of the eight native fish species known to historically inhabit the Rio Yaqui are listed as either threatened or endangered; namely, the Yaqui chub (endangered), the Yaqui topminnow (endangered), the Yaqui catfish (threatened), and the beautiful shiner (threatened). In addition, Mexican stonerollers, Yaqui suckers, longfin dace, and roundtail chubs, also native to the Rio Yaqui, are all listed as Candidate Candidate 2 species.

Many factors contributed to the decline of the Rio Yaqui fishes. In the late 1800s, intensive grazing and farming practices led to massive habitat destruction and water diversions. Inevitably, erosion and extensive pumping of the underground aquifers desiccated the valuable habitat that the Yaqui fishes depended on. Finally, drought and the introduction of exotics (mosquitofish, large mouth bass, channel catfish) has also played a major role in the decline of these four species.

Current Status

Yaqui Chub-- Nine populations of Yaqui chubs currently inhabit a variety of habitats including deep pools, ponds, and streams. They are able to withstand extreme fluxes in water flows; however, some minimal velocity is required. Chubs feed on algae, terrestrial and aquatic invertebrates, and arachnids.

These populations exist mainly due to reintroduction efforts by W. L. Minckley and Dexter National Fish Hatchery and Technology Center (DNFHTC) after a drought in 1969 almost extirpated chubs in the wild. Distribution includes Leslie Creek, House Pond, Twin Pond, North Pond, Mesquite Pond, Black Draw, Oasis Pond, 2 PHD Pond, and El Coronado Ranch (Turkey Creek and ponds).

Limited habitat and pumping from the underground aquifer continue to jeopardize Yaqui chubs. In the absence of predatory exotic fish, however, these populations maintain high numbers and natural recruitment does occur.

Yaqui Topminnow-- Yaqui topminnows currently maintain 15 populations, occupying ponds, well outflows, pool margins, and other warm, shallow waters with marginal flows. Their habitat usually contains dense mats of algae and debris where they feed on algae, vegetative materials, and aquatic invertebrates. Distribution includes Leslie Creek, Robertson Cienega, Tule Spring, Twin Pond, North Pond, Bunting Spring, Cottonwood Well, Middle Well, Cienega Well, House Pond, Oasis Pond, Bathouse Well, Astin Spring, Hay Hollow Windmill, and Mesquite Pond.

Historically, habitat loss through groundwater pumping and overgrazing caused their populations to decline. Today, however, the presence of mosquitofish, introduced for mosquito control, poses the greatest threats to topminnow populations.

Yaqui Catfish-- Populations of Yaqui catfish probably occurred in Black Draw on San Bernardino NWR; however they are now extirpated from the wild in the United States. Known habitat preference includes quiet, clear pools with gravel or sand bottoms with much submergent vegetation. Yaqui catfish more than likely prey on smaller Rio Yaqui fishes.

Loss of habitat and hybridization with introduced channel catfish led to the extirpation of Yaqui catfish in the United States. Currently, the only population in the United States exists at DNFHTC where they are being propagated for

their subsequent release into the wild. Genetic purity of the fish has been verified, and all hybrids have been separated from the pure catfish.

Beautiful Shiner-- Three populations of beautiful shiners inhabit San Bernardino NWR and are doing very well, as evidenced by the presence of numerous age classes. Very little is known about the biology of these fish; however, preferred habitat consists of streams and intermittent pools with a high percentage of riffle habitat. Distribution includes Twin Pond, Oasis Pond, and Mesquite Pond. In addition, the Guzman Basin subspecies is being raised at DNFHTC in an effort to establish a population in the Rio Mimbres drainage in New Mexico.

Yaqui Sucker, Mexican Stoneroller, Roundtail Chub, and Longfin Dace-- All four of these species historically occurred on San Bernardino and Leslie Canyon NWRs. Today, however, they are found mostly in Mexico, and all are listed as Candidate Category 2 species, meaning that more data are needed to determine their status. In addition to their Mexican populations, the longfin dace occurs on the refuges and the Mexican stoneroller maintains a population in Rucker Canyon, Arizona.

Introduction

This section of the Comprehensive Management Plan addresses those refuge management activities necessary for the delisting or downlisting of the Yaqui chub, the Yaqui topminnow, the Yaqui catfish, and the beautiful shiner.[80] These management efforts are consistent with, and focus on meeting, the objectives and strategies outlined in the Yaqui Fishes Recovery Plan.[81] While the recovery plan states more general methods to achieve restoration, this plan provides detailed management activities the refuges can contribute towards the goal of establishing viable, self-sustaining populations of Rio Yaqui fishes in the wild.

Because of their unique aquatic desert habitats, both the San Bernardino and the Leslie Canyon NWRs possess the opportunity to contribute greatly to the recovery of the threatened and endangered fishes of the Rio Yaqui. Perhaps the most valuable role they can play is to provide refugia for the fishes, as well as serve as a source of broodstock for their propagation in captivity. The former has been initiated simply by the acquisition of the two refuges into the National Wildlife Refuge System, while the latter is being accomplished by means of an ongoing captive breeding program in close association with DNFHTC.

Management Actions[82]

1. Cooperate on recovery with Mexico.

Unfortunately, due to the lack of available historic habitat in the United States, complete recovery of the Rio Yaqui fishes cannot be achieved without close cooperation with Mexico. Therefore, foremost to the restoration of the fishes is the need for a cooperative agreement with the Mexican government (i.e. SEDESOL) or other Mexican environmental agencies such as Centro Ecologico, to develop and implement a management plan for the protection of all Yaqui fishes. With the passage of NAFTA, this becomes all the more pressing due to the possible threat of development along the United States/Mexican border, thereby potentially jeopardizing valuable Yaqui fishes habitat.

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[80]The remaining four native fish species that historically occurred on the refuge, including Yaqui suckers, longfin dace, Mexican stonerollers, and roundtail chubs, were excluded from the Yaqui Fishes Recovery Plan and thus, are not included in the following discussion. They are all listed as Category Candidate 2 species, meaning that more data are needed to determine their present status. However, because they previously were natural components of the Area of Ecological Concern, their recovery will be considered inasmuch that such efforts will not interfere with the management and perpetuation of the more seriously threatened and endangered Yaqui fishes.

[81] Please refer to the plan for specific conditions and objectives to be met for the downlisting or delisting of these species can occur.

[82]The numerical outline directly follows that of the Yaqui Fishes Recovery Plan, while the lower case alphabetical letters represent recommended management strategies to meet the stated objectives.

In fact, the early effects of NAFTA are already taking place. The Mexican government is currently reconstructing the main highway between Agua Prieta and Chihuahua City in anticipation of increased commerce. The refuge's recent loss of artesian pressure appeared to be a result of the construction process. Fortunately, the effects were not long lasting, and flow has been restored. This event confirms the need to work extensively with Mexico to protect the aquifer. In addition, the need exists to work cooperatively with the Rancho de San Bernardino, southern neighbors to the refuge, to pursue an agreement on water pumping of the aquifer.

1.1 Pursue agreements and development of management plans for long-term survival of fishes of concern in Mexico.

a. Work cooperatively with SEDESOL and Centro Ecologico to develop management plans for all Yaqui fishes.

1.2 Develop and implement cooperative management plans.

a. Work with private landowners on both sides of the border to establish cooperative agreements on water and land use practices.

2. Manage existing habitats and populations.

Active management practices will need to continue throughout the entire recovery process to ensure long-term survival and maintenance of the Yaqui fishes community. Six methods for achieving this objective are addressed in the recovery plan.

2.1 Determine aquifer recharge zone, capacities and configuration, and characteristics of sub-surface flow.

a. Develop a computer model to determine the extent, sources, and behavior of the aquifer to aid in predicting impacts to refuge water resources should development occur.

b. Install pressure gauges on wells and peizometers within riparian areas to measure aquifer pressure and water table elevations, respectively. Use model to synthesize the monitored data and delineate the aquifer limits to be used in developing water management guidelines.

c. Develop international agreements on water use between the United States and Mexico.

2.2 Protect watershed and aquifer.

a. Acquire on a willing-seller basis, or establish conservation easements on private lands within the watershed to ensure sound land and water use practices.

b. Work cooperatively with the Malpai Borderlands Group to obtain easements on private lands in the Valley so that subdivision and development is halted.

c. Acquire or withdraw hard rock mineral rights to eliminate any potential mining activities in the watershed.

d. Develop a computer model of the aquifer to aid in establishing sound water management guidelines.

2.3 Determine amounts of water required to maintain listed species.

a. Determine water requirements necessary to sustain all species of Yaqui fishes.

b. Complete efforts to install a better monitoring system to record water usage to obtain accurate information (i.e., attach automatic data readers, peizometers, pressure gauges).

c. Continue monitoring well flow readings as needed.

2.4 Revise and continue implementation of San Bernardino and Leslie Canyon NWRs Master Plan.

2.4.1 Develop water-use plan for San Bernardino and Leslie Canyon NWRs.

2.4.2 Develop and implement genetic monitoring plans and schedules for each species.

a. Maximize genetic input into the captive breeding program (i.e., collect fish from the wild to introduce new genes into the captive populations or, if fish are available, periodically replace captive stock completely).

b. Compare/contrast wild and captive fish to determine genetic differences.

c. Construct pedigree charts for each species of Yaqui fish.

2.4.3 Develop and implement management plan for each species of concern.

2.5 Develop or enhance new and existing habitats; monitor success of habitat management.

a. Evaluate and monitor water quality to obtain baseline information including total dissolved solids, dissolved oxygen, and pH.

b. Clear out dense vegetation and emergents as appropriate.

c. Plant trees or construct erosion control devices as needed.

d. Remove exotics and pest species from critical areas.

e. Create new habitats including cienegas, ponds, pools, etc., as needed.

2.6 Eradicate and secure against reinvasion or new introductions of non-indigenous species.

a. Continue law enforcement efforts to halt any non-native introductions.

b. Maintain fish barrier at Black Draw and construct new ones as needed to prevent migration of non-native fish species into critical areas.

c. Create isolated ponds, each with the ability to be drained and filled independently, for easier removal of non-native fishes.

3. Determine biological requirements of listed species.

Very little is known about the natural history of the fishes of the Rio Yaqui. Therefore, gathering information concerning their biological requirements needs to be a priority in order to properly manage for these threatened and endangered fishes. The recovery plan examines five means for accomplishing this.

3.1 Examine and document life histories.

a. Continue use of graduate students or other appropriate researchers to study the biology of Yaqui fishes including reproductive habits, food habits, age and growth, and fish health.

3.2 Determine impacts of intra- and interspecific interactions in habitats occupied by combinations of species.

a. Determine population dynamics of all fish species.

b. Study the Yaqui catfish to determine its role as a possible predator on smaller Yaqui fishes.

c. Develop methods to prevent channel catfish from hybridizing with Yaqui catfish.

3.3 Determine habitat requirements and habitat utilization.

a. Conduct research to determine spatial/temporal patterns of habitat use at different life stages.

b. Determine habitat availability.

c. Conduct research to determine habitat preferences of Yaqui fishes.

3.4 Determine and delineate genetic composition of existing populations.

a. Continue Yaqui catfish research to determine genetic purity.

b. Continue beautiful shiner genetic research.

c. Perform genetic studies on the remaining threatened and endangered Yaqui fishes.

3.5 Monitor health of fish populations and occupied habitats.

a. Monitor seasonal and annual abundance trends of the Rio Yaqui fish community.

b. Monitor water quality to determine any negative effects to fish populations.

c. Identify areas of marginal use by Yaqui fishes that require maintenance.

4. Protect historic habitat of fishes of concern in the United States.

Vital to the recovery of Yaqui fishes is the protection of their historic habitat in the United States. The recovery plan lists four methods for accomplishing this. It should be recognized, however, that any management practices implemented to protect or improve Yaqui fishes habitat are done so only after careful consideration of the potential impacts to the resources.

4.1 Maintain levels and quality of subsurface waters sufficient to sustain springs and flow of artesian wells, thereby protecting surface waters.

4.1.1 Apply proper or enhanced land-use practices.

a. Remove undesirable woody vegetation to encourage native grass regrowth. This will reduce evapotranspiration and runoff, consequently increasing infiltration rates into the water table.

b. Clear out old vegetation and dense emergent vegetation from springs, artesian wells, and ponds as needed to maintain habitat.

c. Rehabilitate and repair artesian wells, ponds, and levees, as well as create new ponds and cienegas as appropriate.

d. Continue erosion control efforts on San Bernardino NWR (i.e., installation of gabion structures and black willow plantings) to rebuild the water table and allow for more recharge into the aquifer.

e. Maintain water levels in ponds by initiating use of electrical or solar-powered water pumps to regain flow of wells should artesian flow be lost.

f. Measure pond levels and spring flows in order to monitor success of actions.

4.1.2 Exclude development such as mining or irrigated agriculture.

a. Acquire or withdraw mineral rights where appropriate.

b. Establish conservation easements on land practices and water use with private landowners.

4.1.3 Forge agreements to assure aquifer water quality.

a. Work cooperatively with private landowners in the Valley, including those in Mexico, to establish conservation easements on land use practices that could harm water quality (i.e., grazing in riparian areas).

4.2 Work with water users and appropriate agencies and individuals to prevent overuse of water from essential aquifers.

a. Set up monitoring devices in Mexico in order to gauge the extent of water use and determine the effects of such usage on the San Bernardino aquifer.

b. Continue to work with the Malpai Borderlands Group to establish conservation easements on water use with private landowners in the Valley.

c. Develop and maintain a good working relationship with Mexico and other landowners adjacent to the refuge to initiate cooperative management efforts for the protection of Yaqui fishes habitat.

4.3 Obtain instream flow water rights for sufficient water to maintain surface flows in watercourses important to recovery.[83]

a. Determine if acquiring instream flow rights for Black Draw is feasible with the State of Arizona's Department of Water Resources.

b. Meet with landowners in the San Bernardino Valley to address concerns about competing water rights.

c. Determine if the refuge's requisites for sustaining the riparian habitats within Black Draw can be met through conservation easements and cooperative agreements with the private landowners of the Valley.

4.4 Acquire and protect, or protect through conservation agreements, habitat management plans, or other binding agreements the essential waters and habitats needed for long-term survival of fishes of concern.

a. Work cooperatively with the Johnson Museum in efforts to better manage and protect the fish populations inhabiting House Pond on the Slaughter Ranch Headquarters Site.

b. Acquire the scattered BLM lands adjacent to refuge boundaries.

c. Work cooperatively with private landowners in the Valley to establish conservation easements on water use and land use practices with the goal of working towards a sustainable ecosystem. Pursue acquisitions on a willing-seller basis only.

d. Construct erosion control structures as needed to control headcutting of stream channels.

e. Protect and maintain "core habitats" and special protection areas.

f. Protect existing water rights and secure additional water permits where appropriate.

g. Protect the San Bernardino aquifer from development.

5. Assess habitats for reintroduction and reestablish the species of concern within appropriate habitats in historic ranges.

Due to the limited amount of Yaqui fish habitat in the United States, additional areas within their historic range should be assessed for possible habitat improvements and/or introductions. These new sites should be distributed among a wide array of habitats. This will increase genetic diversity, enabling the fish populations to develop a higher resistance to environmental stresses. The recovery plan suggests the following:

5.1 Identify areas for possible reintroductions.

a. Develop selection criteria for suitable sites.

b. Survey the refuge to determine suitable habitats currently unoccupied by Yaqui fishes.

c. Improve habitats for Rio Yaqui fishes by developing new ponds, pools, cienegas, etc.

[83]Leslie Creek instream flow rights have already been acquired.

d. Stock/introduce Yaqui fishes into new areas identified or created.

e. Monitor stockings.

5.2 Develop culture techniques and effect reintroductions for Yaqui catfish.

5.2.1 Develop breeding protocol.

a. Cooperate with DNFHTC.

b. Breeding protocol should ensure that all available adult Yaqui catfish contribute to the production of fish to be used for restoration efforts.

c. Collect more broodstock for Yaqui catfish from the Rio Yaqui basin in Mexico.

5.2.2 Determine fish size, time of year, and stocking densities required to ensure survival.

5.2.3 Stock and monitor success of reintroductions.

5.3 Reintroduce, reestablish, and monitor populations of other species of concern.

5.4 Work with public agencies and private landowners to manage existing and reintroduced populations of fishes of concern.

a. Create a better working relationship with the Johnson Historical Museum for better management of Yaqui fishes inhabiting House Pond.

b. Facilitate communication efforts with public and private landowners, including those in Mexico, to ensure land practices are conducive to Yaqui fishes recovery.

c. Establish cooperative agreements with private and public landowners to facilitate sound Yaqui fishes management, including allowing the removal of non-native species.

d. Implement EIS's or EA's for all projects considered that could potentially impact Yaqui fishes or their habitat.

6. Develop information and education programs for all species, their habitats, and the ecosystem(s) upon which they depend.

The final step towards the recovery of Yaqui fishes is public education. Informing the public through information and education programs is a critical component for gaining support and oftentimes, makes proposed projects easier to implement. Such programs should be directed at the local, state, and national levels. Recommended refuge contributions include the following:

6.1 Develop comprehensive programs of information and education.

a. Establish an agreement with the Johnson Museum to use the Slaughter Ranch Headquarters Site as an interpretive and educational tool for the public.

b. Develop environmental education and interpretive programs geared towards children in elementary through high school levels. Stock fish in the local high school pond to use as an educational tool to teach students the value of threatened and endangered species.

c. Develop an outreach program to improve public appreciation of fish and wildlife resources and ecological values.

d. Develop educational programs geared towards private landowners, including those in Mexico, that explain the history of land management and watershed degradation in Arizona. Emphasize land use practices that are ecologically healthy through refuge tours and presentations that demonstrate riparian protection, conservative use of the aquifer, and sound grazing and farming practices. Offer technical assistance to promote sound management when appropriate.

6.2 Ensure broad dissemination of information in both English and Spanish.

a. Display and widely distribute pamphlets, brochures, and fact sheets that interpret Yaqui fishes ecology and management.

6.3 Establish and maintain archives of published and unpublished materials relevant to aquatic organisms and aquatic habitats of concern in permanent depositories.

Summary

As demonstrated, the San Bernardino and Leslie Canyon NWRs play an important role in the recovery of the Yaqui fishes. Presently, their most important contribution is to provide refugia. Additionally, they serve as a source of stock for the propagation of Yaqui fishes in captivity for their subsequent release into the wild to supplement existing populations. These should, however, only be the short-term objectives. In order to perpetuate these species of Yaqui fishes, Mexico must be involved. Because of the limited amount of available habitat left in the United States, emphasis needs to be placed on securing habitat in Mexico for its protection and management for the benefit of the fishes of the Rio Yaqui. Furthermore, future reintroductions should be distributed among a wide array of habitats, enabling the fish populations to develop a higher resistance to environmental stresses. Finally, protecting the San Bernardino aquifer from further development and from undesirable groundwater pumping is essential to the recovery of the Yaqui fishes. In this endeavor, education will play a key role. Unless the above mentioned objectives are achieved, these threatened and endangered fishes will never exist as viable, self-sustaining populations in the wild.

(2) ANALYSIS: PLANT AND ANIMAL DIVERSITY

The following analysis contains information regarding the recovery and maintenance of native habitats in relation to the Service's goal to preserve the natural diversity and abundance of fauna and flora on refuge lands. The dominant habitat types[84] along with their resident plant and animal species are discussed, followed by gross actions needed for their restoration.

As addressed earlier, poor grazing and farming practices, along with periodic droughts, led to the deterioration of the entire San Bernardino Valley. Undesirable woody species such as mesquite and acacia replaced native grasslands, while tumbleweeds and other weedy species invaded abandoned croplands. Severe erosion occurred, and much of the cienega and other desert riparian habitats were destroyed.

Chihuahuan Desert Scrub– Desert scrub is the dominant upland vegetation type, occupying approximately 39 percent (900 acres) and 52 percent (1280 acres) of San Bernardino and Leslie Canyon NWRs, respectively. Soils typically are thin and shallow and come from limestone or igneous origins (i.e., Malbray type), supporting a variety of plant species such as creosote, tarbush, white thorn acacia, ocotillo, snakeweed, and honey mesquite. Wildlife species common to this habitat type include mule and white-tail deer, coyote, javelina, badger, antelope squirrel, jackrabbit, cottontail, and a variety of reptiles, birds, and rodents. Formerly, much of these areas were classified as grasslands; however, the effects of fire suppression and intensive grazing in the past resulted in stimulating the invasion of the above mentioned woody species, many of which (creosote, tarbush, snakeweed) offer poor food and cover values to native wildlife. In addition, the expansion of mesquite trees is of concern because their root systems extend to considerable depths and tap into the water table, thereby reducing water levels and posing a threat to the Yaqui fishes.

Restoration of these damaged lands to revert them to their natural grassland state is therefore essential in preserving the biological diversity in this portion of the Area of Ecological Concern. A combination of mechanical control, such as bulldozing or root plowing,[85] to reduce the woody invaders, along with repeated prescribed burns (once every 3-5 years) to stimulate and maximize native grass stands should be considered. The expected outcome would be increased habitat for wildlife use, as well as an increase in water yield, as the reduction of woody vegetation should stimulate increases in water flow.

Desert Grassland– Desert grasslands make up approximately 577 acres (25 percent) of San Bernardino NWR and 1060 acres (43 percent) of Leslie Canyon NWR. Grasslands occur on the mesa, between vegetative communities forming mosaic patterns, and other isolated areas. Well-drained, deep, fine alluvium characterize these soils (i.e., Karro Loam, Riggs) and dominant grasses include tobosa, bush muhly, side-oats grama, black grama, burrowgrass, and alkali sacaton. Grasslands provide food and cover habitat for coyotes, deer, jackrabbit, cottontail, raptors, and a wide array of rodents including kangaroo rats, wood rats, grasshopper mice, deer mice, and several species of pocket mice.

As mentioned above, grasslands have been invaded by undesirable woody vegetation. Without control, woodlands will continue to expand at the expense of the more valuable herbaceous species, resulting in a decline in native biodiversity and water yield. While providing for an increased forage and cover base for native wildlife, encouraging native grass growth will also increase the infiltration rates and reduce runoff and evapotranspiration rates, all of which will help maintain spring flows that the Yaqui fishes and other wildlife depend on for survival. Additionally, grassland restoration would increase the quality and quantity of habitat for any future proposed aplomado falcon reintroduction.

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[84]Ibid., Gayle Marrs-Smith.

[85]Due to factors such as slope and rocky terrain, mechanical control will not always be a feasible method to achieve grassland restoration goals. Also, extreme caution should be given to the methods exercised so that the least amount of destruction is imposed upon the land.

Historically, fire played an important role in maintaining desert grassland habitat by preventing encroachment of woody shrubs and trees. However, past intense grazing practices which severely reduced fuel loads, coupled with fire suppression policies by certain land management agencies, has resulted in the exclusion of fire as a natural component of the ecosystem. The value of returning fire to the refuges as a management tool cannot be overemphasized. Paramount to this undertaking is the necessity of developing and implementing a fire management plan for the refuges, targeting specific areas where fire would prove beneficial. The following cooperative effort is another endeavor the refuges should actively participate in to achieve grassland restoration.

The Malpai Borderlands Group have introduced a promising venture to allow fire to play its natural role in the ecosystem. They propose to implement a prescribed natural fire management plan for a large area in southeastern Arizona and the bootheel of New Mexico that encompasses the San Bernardino NWR and all of the watershed that drains into the refuge. Their goal is "to restore and maintain the natural processes that create and protect a healthy, unfragmented landscape to support a diverse, flourishing community of human, plant, and animal life in the Borderlands Region."[86] Many of their specific objectives coincide with those of the refuge and are as follows:[87]

1. Restore historic biodiversity through reduction of density of woody species.

2. Restore historical habitat characteristics to improve wildlife diversity, with emphasis on threatened, endangered, and sensitive species.

3. Improve watershed stability and hydrologic function through improved herbaceous plant cover.

4. Create a fuel mosaic that will allow fire to resume a more natural role in ecosystem function.

Another ambition of the Malpai Borderlands Group is to sustain the "open space nature" of the land. They hope to achieve this by working with landowners in the area on a voluntary basis to obtain easements on private lands in the valley so that the land cannot be subdivided and developed. This will further protect native grassland habitat and will also aid in protecting the water supply of the aquifer, in turn benefitting Yaqui fishes and other native wildlife.

Mesquite Bosque– Mesquite bosque habitat occupies 508 acres (22 percent) of San Bernardino NWR.[88] Naturally, the dominant species is mesquite, followed by creosote, netleaf hackberry, catclaw, and little leaf sumac. These plants do well in deep, sandy soils next to water where they form dense, monotypic stands.

Mesquite bosque habitat offers high food and cover values for avifauna and terrestrial wildlife. Although much of its forage value is low, seeds and fruits from several of the associated vegetation community (mesquite, catclaw, hackberry) are an important component of many wildlife species diets, including deer, javelina, rabbit, quail, dove, kangaroo rats, and a variety of other small mammals. Problems arise though, when the stands become so dense that wildlife movement is severely restricted, thereby reducing food and cover values. Forage production of desirable understory vegetation also becomes hindered because they cannot adequately compete for the water resources.

Because these areas are an integral part of the San Bernardino NWR ecosystem, the goal here is not to eradicate mesquite bosque habitat, but rather to enhance its biological values. This can be done by maintaining openings to

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[86]Animas Foundation memorandum, dated February 11, 1994, entitled: The Creation of a Sustainable Open Space Future for the Lands of the American West.

[87]Animas Foundation memorandum, dated January 11, 1994, entitled: Baker Canyon Prescribed Burn.

[88]Leslie Canyon NWR does not have any mesquite bosque habitat.

encourage native grass and other understory plant growth, which should greatly increase wildlife diversity due to the increased availability of vegetative types. Furthermore, reduction of phreatophytic vegetation ("water loving" plants), namely mesquite, should increase water availability.

Clearing or thinning strategically selected areas of the mesquite thickets could be achieved through a combination of controlled burning, root plowing, and other mechanical control methods;[89] however, due to the erosion problems in this area, every site should receive careful consideration before any such activities occur. Finally, to ensure continued bank stabilization provided by the mesquite roots, no clearing should occur along the arroyo margins. Wildlife species expected to benefit from such efforts include deer, javelina, coyote, raccoon, skunk, rabbit, turkey, raptors, dove, quail, and a variety of rodents and migratory songbirds.

Fallow Fields-- Formerly irrigated pastures and croplands, these disturbed areas make up 11 percent (254 acres) of San Bernardino NWR,[90] many of which are overrun with weedy annuals and other undesirable forbs such as tumbleweed, russian thistle, and mustards. Soils are deep, well-drained, and are of the Riggs and Karro Loam type. Species expected to use this habitat type include skunks, cottontail, jackrabbit, quail, meadowlarks, and small rodents such as pygmy mice, silky pocket mice, and cactus mice.

Farming of these croplands was eliminated when San Bernardino was acquired into the Refuge System in 1982. Since then, the focus for these abandoned farm fields has been to revert them to their native grassland state. Given their weedy conditions, native grasses and forbs are out-competed, slowing down the natural revegetation process. Additionally, many of these fields have lost their fertility and natural seedbanks as a result of past agricultural practices. Active management is therefore recommended to speed up the process. Again, prescribed burns can aid significantly in achieving grassland restoration management goals. Specifically, the use of fire will: 1) reduce competition by eliminating undesirable weedy vegetation; 2) increase soil fertility by releasing plant nutrients into the soil; and, 3) aid in preparation of a seedbed for artificial seeding, if necessary. Wildlife populations stand to benefit because of the positive responses that vegetation exhibits towards fire, namely increased plant vigor and forage yield, improved palatability, and increased plant protein levels.

Before any such prescribed burn is implemented, a full site analysis should be conducted to ensure conditions are favorable for burning (i.e., timing, moisture, plant cover, etc.), but more importantly, to ensure the effects of fire are not harmful to other refuge components such as desired vegetation, wildlife populations, and watershed function. Finally, prescribed burns should not be implemented near stream banks, as removal of streamside vegetation would decrease nutrient input and food supplies to stream inhabitants, increase water temperatures, and accelerate erosion; thereby increasing sedimentation, all of which could detrimentally impact Yaqui fish populations.

Fire is not a cure-all, and other restoration techniques may have to be employed. To replenish depleted seedbeds, native grass seeds may have to be supplied. Also, if nutrient deficiencies still exist after burning, fertilizers may have to be applied, but only after careful consideration of the implications that such actions could have, especially on the watershed. Strip plantings of native grasses and forbs, followed by periodic irrigation to aid establishment will also help recovery of these areas to their natural condition. Irrigation cannot occur, however, at the expense of the Yaqui fishes community. Therefore, this practice should be employed only if excess water is available.

Preferably, plugs of native grasses and four-wing saltbush should be planted, as they will not require irrigation. The local high school, through its Vocational Education Program, has been actively involved in this endeavor. Plugs are

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[89]Payne and Bryant recommend rollerchopping (a tractor or bulldozer pulls a steamroller drum equipped with chopper blades which chop and crush vegetation) rather than rootplowing as the preferred method to control areas dominated by mesquite, as rootplowing can cause severe soil disturbance and erosion. Payne, Neil F. and Fred C. Bryant. 1994. Techniques for wildlife habitat management of uplands. McGraw-Hill, Inc. 840 pp.

[90]Leslie Canyon NWR does not have any fallow fields habitat.

grown in their greenhouse until they have an established root system and are then planted on the refuge. Unfortunately, good summer moisture dictates their survival, making this method unpredictable.

Mowing of the abandoned fields to reduce the weedy annuals and allow sunlight through has proven beneficial to the recovery process. This practice reduces competition from undesirable species and allows for the re-establishment of grasses and four-wing saltbush. Another method, although experimental, produced patches of various grasses. Strips of land were graded and then bladed to a slope so that rainwater would flow down the slope and accumulate where the seeds were planted. Other rainwater harvesting methods should also be explored. Once the weedy annual species have been displaced, wildlife diversity should increase significantly.

Riparian Forest/Woodland, Riparian Scrub, Marshland (Cienega), and Aquatic-- Although riparian areas only occupy 2 percent (55 acres) of San Bernardino NWR and 4 percent (100 acres) of Leslie Canyon NWR, ecologically they are perhaps the most significant in that they house the threatened and endangered Yaqui fishes, as well as a host of other wildlife species. Artesian wells and seeps provide the water that in turn creates these varied habitats including riparian forests/woodlands, riparian scrub, marshlands (cienegas), and aquatic areas. Soils range from the Riggs type (deep and well drained) for riparian forests/woodlands and riparian scrub to thick, dark, organic and often anaerobic soils for marshland or cienega habitats.

Unfortunately, these are also the areas that have been most severely degraded due to past disturbances. The riparian forests/woodlands and scrublands on San Bernardino NWR, namely the Black Draw and Hay Hollow Wash areas, have experienced extensive erosion and downcutting as a result of both natural processes and former grazing practices. Consequently, the water table that once supplied the water that created the cienega habitats dropped, resulting in the loss of much of these marshland environments. Additionally, cienegas were also greatly affected by past agricultural practices. Once covered with lush vegetation, these areas were drained and plowed for croplands or pasture, and now lay weed-covered.

Aquatic habitats, those areas in which the water is completely contained, include springs, ponds, pools, and streams. These are of course, the primary concern when considering the Yaqui fishes. Factors such as agricultural development, water pumping and diversions, and finally, overgrazing and the subsequent erosion have deteriorated these habitats. A combination of the above actions, along with the introduction of non-native fishes, resulted in a drastic decline in the Yaqui fishes community.

With the acquisition of the refuges however, many of the above-mentioned activities were halted and restoration has begun. The removal of cattle has enabled cottonwoods and willows to become reestablished in Black Draw and Hay Hollow Wash, thus curtailing erosion through improved bank stabilization. The construction of gabion structures and hand planting native vegetation has also aided the erosion problems. If the downcutting can be arrested, perennial flows would be restored resulting in increased water table levels. Any runoff flows would then eventually recreate the cienega habitats that were once prevalent in the floodplain areas of Black Draw and Hay Hollow Wash. Other factors that have played a key role in preserving valuable aquatic habitats include: 1) obtaining water rights for Leslie Canyon; 2) performing routine maintenance work (i.e., periodic removal of dense, aquatic vegetation) to ensure continued water flows; and 3) development of existing springs and wells to encourage constant flows through drilling of replacement wells, rehabilitating existing wells, and installing electrical or solar powered pumps.

Although the above-mentioned practices have had beneficial effects to aquatic and marshland habitats, the key to the future existence of these areas on the refuges as well as in the entire Area of Ecological Concern is to work cooperatively with the private landowners in the Valley, including those in Mexico, to establish conservation easements on land and water uses to ensure overall ecological health of the ecosystem. Finally, completion of the computer model of the San Bernardino Valley aquifer[91] will greatly enhance the ability to better manage for the water resources by enabling the refuges to develop more comprehensive water management guidelines.

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[91]Please refer to Part II, Unit 1, Section 4 for a complete discussion of the computer model of the aquifer.

Wildlife Diversity Associated with Riparian Habitats

The riparian zones of the San Bernardino and Leslie Canyon NWRs provide extensive food and cover values for wildlife, thus enhancing their utility and making them the most productive in terms of species numbers and diversity. In addition to terrestrial wildlife and avifauna use of riparian habitats, amphibians and fish also take refuge in these areas. Trees and other associated vegetation provide shade to cool water temperatures, stabilize banks to prevent erosion, and provide detritus and insects for stream inhabitants to feed upon. Finally, especially important in Arizona's dry, desert environment, these riparian areas provide travel corridors for more mobile species such as deer, coyote, fox, and raccoons and offer resting places due to their cooler microclimates.

As such, a host of wildlife species are associated with the various types of riparian habitats on San Bernardino and Leslie Canyon NWRs. The riparian forests/woodlands and scrublands provide habitat for virtually all of the wildlife residents on the refuge including deer, javelina, mountain lion (although rare), bobcat, coyote, fox, raccoon, skunk, turkey, and a variety of raptors and rodents.

Of noteworthy mention, however, are the neotropical birds that abound in the riparian woodlands of San Bernardino and Leslie Canyon NWRs. Initiated in 1980, a bird banding project has been conducted on the refuges every spring and fall and still continues to the present. Bird songs and calls, sightings, and captures over the years have revealed approximately 250 species using the refuges. The list is too exhaustive to include here; however, common birds include Vermillion flycatcher, ash-throated flycatcher, blue grosbeak, summer tanager, northern cardinal, phainopepla, mockingbird, Cassin's and western kingbirds, and many species of warblers and sparrows. A few uncommon species include painted redstart, magnificent hummingbird, and western tanager.

Although no formal analysis has ever been conducted with the banding data (i.e., population trends, species habitat use), the information is very useful in terms of species numbers and diversity present on San Bernardino and Leslie Canyon NWRs. Also, considering the overall declining trends in neotropical migrants, and given the high utilization of these habitats by many such species, the data can be used to warrant further protection of the riparian areas while striving for the Service's goal of preserving the natural diversity and abundance of all wildlife species.

Cienegas are also of vital importance to the native wildlife diversity on the refuges. Deer, raccoon, skunk, and various marshbirds such as great blue heron, great egret, and killdeer make use of these "wet meadows," as do a variety of amphibians. In addition, the San Bernardino spring snail and the Huachuca water umbel, both Candidate 2 species, take refuge in the shaded seeps the cienegas provide.

Aquatic areas provide the habitat for the threatened and endangered Yaqui fishes. Other wildlife utilizing aquatic habitats include various species of amphibians and reptiles such as leopard frog, Couch's spadefoot, western spadefoot, red-spotted toad, and checkered garter snake (uncommon). A host of bird life is associated with the pools, ponds, and other aquatic habitats on San Bernardino and Leslie Canyon NWRs. Waterfowl use the areas as a migratory stopover, making their numbers higher in the winter than in the summer months. Species include mallard, Mexican duck, ring-necked duck, northern shoveler, cinnamon teal, green-winged teal, blue-winged teal, American widgeon, gadwall, bufflehead, ruddy duck, American coot, snow goose, and sandhill crane.

Marsh and waterbirds using aquatic habitats on the refuge are represented by sora, Virginia rail, pied-billed grebe, western grebe, double-crested cormorant, belted kingfisher, and American bittern. American avocet, black tern, black-necked stilt, ring-billed gull, Wilsons phalarope, and red knot also make use of the refuges waters.

PART III: SYNTHESIS

GOALS, OBJECTIVES, AND STRATEGIES

1. Introduction

This section presents refuge goals, objectives, and strategies developed in consideration of: (1) the legal mandates reflected in Part I, Unit 2 of this document including statutes, policies, and other administrative directives; (2) the purposes for which the refuges were established; (3) the goals of the National Wildlife Refuge System; and (4) discussions comprising the Analysis portion of this document in relation to the defined issues. Programmatic objectives were developed in consideration of field level analysis offered by the San Bernardino and Leslie Canyon NWRs refuge manager. These objectives are intended to address the major issues that surfaced during the planning process.

2. Refuge Goals, Objectives, and Strategies

The list of 10 issues outlined in Part I, Unit 1, Section E are repeated on the following pages, each with a goal and a set of objectives and/or strategies. The objectives and strategies are not exclusive to any one issue, as many are considered in combination with other issues. For instance, the recovery of threatened and endangered native fishes is considered within the context of biological diversity and habitat management, water management, land protection, and environmental education. In fact, all of the issues are in some way interrelated.

As the planning horizon is 20 years, the Service has much latitude with respect to project phasing and implementation. Funding considerations will also affect accomplishment.

ISSUE #1: Ecosystem Sustainability

Goal Statement: To conserve fish and wildlife species and their habitats by protecting and restoring the function, structure, and species composition of the Area of Ecological Concern while still providing for sustainable socioeconomic use.

Objectives/Strategies:

(1) Help achieve ecosystem sustainability by creating partnerships and working cooperatively with the Malpai Borderlands Group for the overall protection of the watershed through establishing non-development and conservation easements on land and water use in the Valley.

(2) Strengthen the refuges contribution to the Malpai Borderlands efforts by continuing involvement in their coordinated efforts to improve watershed stability, hydrologic function, and historical habitat characteristics as well as to coordinate the refuges interests in relation to the goals of the project.

(3) While remaining sensitive to private property rights, continue efforts to work cooperatively with private landowners in developing protective measures for the watershed.

(4) Increase inventorying and monitoring efforts to demonstrate socioeconomic impacts on the resources. Synthesize data and apply appropriate management strategies to ensure ecosystem sustainability.

ISSUE #2: Biological Diversity and Habitat Management

Goal Statement: To restore and maintain the natural diversity of San Bernardino and Leslie Canyon NWRs Area of Ecological Concern.

Objectives/Strategies:

(1) Reverse the loss of natural biological diversity by striving to meet the objectives of Region 2's plan for restoring biological diversity to include: monitoring fish and wildlife populations, identifying factors contributing to species declines, implementing management actions that promote biological diversity, educating the public on the values of biodiversity, enhancing technical capabilities of Service employees related to conservation of biological diversity, and fostering partnerships to include international cooperative efforts.

(2) Enhance habitat diversity by restoring native habitats to their natural conditions. Implement special projects to include:

a) prescribed burns to stimulate native grass growth
b) mechanical control to remove or open up dense stands of woody, invader vegetation
c) planting plugs of desirable vegetation or seeding with native grass seeds
d) mowing of abandoned farm fields to reduce noxious weed cover
e) maintenance and construction of gabion structures, and hand planting of cottonwoods and willows to prevent erosion processes
f) maintenance of artesian wells to ensure water flows to critical habitats

(3) Preserve the natural diversity and abundance of neotropical birds and other native wildlife by maintaining the unique ash-willow-cottonwood riparian woodlands in the Area of Ecological Concern. The refuges should monitor for exotic plant infiltration accordingly.

(4) Restore the native, historic diversity of the Area of Ecological Concern by developing and implementing a prescribed natural fire management plan to reduce undesirable woody vegetation and stimulate native grass growth.

(5) Sustain sufficiently large and diverse habitats to maintain all plant and animal diversity by supporting the Malpai Borderlands Group in their efforts to obtain conservation easements on all private land in the valley so that subdivision and development cannot occur.

(6) Achieve broader ecosystem management goals of the Service by working cooperatively with all interests in the watershed, especially other landowners, through establishing conservation easements, partnerships, and other agreements that will lead to biodiversity preservation.

(7) Improve long-term viability of fish and wildlife resources by developing and fostering research that improves management and monitoring of fish and wildlife, certain types of habitats, and other elements that contribute to overall biological diversity.

(8) Achieve improved levels of international habitat conservation by enhancing dialogue with Mexico, using the appropriate channels and legal mechanisms, concerning biological diversity on the San Bernardino and Leslie Canyon NWRs.

(9) Enhance public awareness and appreciation of natural biological diversity by developing new and strengthening existing interpretive and educational programs that emphasize these values.

(10) Determine specific scientific research data needs for the San Bernardino and Leslie Canyon NWRs, produce an inventory of those needs, and develop a coordinated strategy for meeting those needs. Whenever appropriate, the inventory of needs should be prepared in cooperation with other resource management agencies and institutions of higher learning and research. Research is a specific priority and promotes a better understanding of the habitat requirements of the various threatened and endangered species.

ISSUE #3: Endangered Species Management

Goal Statement: To achieve threatened and endangered species recovery, as well as to assist in the recovery of all candidate species so that viable, self-sustaining populations are maintained in the Area of Ecological Concern.

Objectives/Strategies:

(1) Achieve Yaqui fishes survival, recovery, and maintenance by striving to meet the goals as outlined in the Yaqui Fishes Recovery Plan through implementing the recommended actions and strategies.

(2) Enhance viability of threatened and endangered species, with main consideration to be given to native Yaqui fishes, by determining specific scientific research data needs including biological requirements, food habits, reproductive habits, and habitat preferences. Manage endangered populations accordingly.

(3) Ensure viability of threatened and endangered species by preventing introduction of non-native species onto the refuges and exercising control methods on exotic species already introduced including bullfrogs, mosquitofish, Johnson grass, and salt cedar.

(4) Establish a cooperative agreement with the Mexican government and develop long-term management strategies to ensure proper management and habitat protection for threatened and endangered Yaqui fishes.

(5) Increase awareness of fish and aquatic values to overall biological diversity by developing new and strengthening existing interpretive and educational programs that emphasize aquatic fishery resources on San Bernardino and Leslie Canyon NWRs.

(6) Improve interjurisdictional and organizational knowledge and understanding of endangered fish and wildlife species through cooperative agreements with other jurisdictions. Cooperative special habitat development goals and objectives would be set for endangered species, threatened species, and species of special concern.

(7) Protect historic habitat of Yaqui fishes and other endangered wildlife. Strategies include: maintaining subsurface and surface water flows, protecting or acquiring essential habitats, maintaining "core habitats" and special protection areas, restoring native habitats, curtailing erosion processes, and preventing overuse of water from the aquifer.

(8) Ensure long-term survival of threatened and endangered Yaqui fishes by developing culture techniques in conjunction with Dexter National Fish Hatchery and Technology Center and stocking fish into suitable habitats when appropriate.

(9) Prepare appropriate refuge lands for the aplomado falcon through restoration of native grasslands and riparian woodlands to increase the quality and quantity of falcon habitat, should reintroduction occur.

(10) Increase candidate species populations by determining and implementing restoration methods for the Chiracahua leopard frog, Mexican garter snake, San Bernardino spring snail, and Huachuca water umbel. Monitor results for success or failure.

(11) In conjunction with Johnson Museum management, ensure continued survival of the San Bernardino spring snail by preserving the spring outflow located on the museum property to ensure habitat is provided for this candidate species. Explore the refuges for additional habitat and/or create suitable habitat for snail occupancy.

(12) Ensure continued survival of Chiracahua leopard frogs through bullfrog control efforts in order to prevent bullfrog invasion and predation in and around the newly established impoundments designed for the reintroduction and protection of the frogs. Continue working with the Arizona Game and Fish Department, the National Biological Service, the University of Arizona, and the Phoenix Ecological Services Field Office in the cooperative effort to capture leopard frogs and breed them in captivity for their subsequent release onto the refuges.

(13) Monitor NAFTA-related development (construction/infrastructure) on both sides of the border and determine potential impacts on the refuges and surrounding area resources. Provide recommended actions such as petitioning for NAFTA or other appropriate funds to implement recommended projects and protection strategies.

ISSUE #4: Water Rights, Water Management, and Wetlands Protection

Water Rights Goal Statement: To protect existing water rights holdings in the Area of Ecological Concern and obtain additional water rights, to the extent possible, to ensure continued water flows for the protection of native fish and wildlife species and their associated habitats.

Objectives/Strategies:

(1) Determine if acquiring instream flow rights for Black Draw is feasible with the State of Arizona's Department of Water Resources.

(2) Develop a strategy for the protection of surface and near surface flows within Black Draw on San Bernardino NWR. Include meeting with private landowners in the Valley to address valid concerns about competing water rights.

(3) Support the the Malpai Borderlands Group in their efforts to establish conservation easements on water use with private landowners in the Valley for the protection of the aquifer.

(4) Develop international land use and water management strategies for the protection of the water resources to propose for inclusion into future agreements between the United States and Mexico.

Water Management Goal Statement: To improve the efficiency of water delivery systems and more effectively gauge water use for the benefit and enhancement of native fish and wildlife species and their habitats.

Objectives/Strategies:

(1) Develop a water use plan for San Bernardino and Leslie Canyon NWRs.

(2) Improve, monitor, and maintain wells to ensure artesian flows and surface waters.

(3) Maintain subsurface waters to protect artesian well flows and surface waters. Strategies include: clearing out dense vegetation, initiating use of electrical or solar powered water pumps to regain flow of wells should artesian flow be lost; rehabilitating and maintaining artesian wells; and removing woody vegetation to encourage native grass regrowth, which will increase infiltration rates into the water table.

(4) Improve watershed stability and hydrologic function by implementing prescribed burns to improve grass and herbaceous plant cover.

(5) Establish monitoring devices (pressure gauges, peizometers) in Mexico and on the refuges to gauge the extent of water use and determine the effects of such usage on the aquifer.

(6) In cooperation with the University of Arizona Department of Hydrology, create a computer model of the San Bernardino Valley aquifer to aid in development of water management guidelines for the refuges.

(7) As detailed in the Preliminary Project Proposal, seek to protect additional lands through establishing conservation easements, partnerships, or other agreements regarding land and water use with private landowners in the Valley for the overall protection of the watershed. Pursue land acquisitions on a willing-seller basis only.

(8) Evaluate and monitor water quality to obtain baseline information including total dissolved solids, dissolved oxygen, and pH levels.

Wetlands Protection Goal Statement: To achieve wetlands protection, enhancement, and rehabilitation in the Area of Ecological Concern.

Objectives/Strategies:

(1) Improve wetland protection efforts through acquisition of water rights where possible.

(2) Enhance and maintain existing and former wetlands through special projects and habitat manipulation such as clearing out old, dense, emergent vegetation from springs, ponds, and wells.

(3) Continue erosion control efforts that contribute to rebuilding the water table, allowing for more recharge into the aquifer.

ISSUE #5: Compatibility and Public Use

Goal Statement: To achieve appropriate levels of wildlife observation, photography, hiking, and other recreational opportunities where such uses are legally compatible with the purposes for which the refuges were established and with the goals of the National Wildlife Refuge System; and to regulate, as provided by law, all activities, uses, and practices that are potentially harmful to refuge resources.

Objectives/Strategies:

(1) Ensure the primacy of wildlife and habitat resource protection by performing annual compatibility analyses on all secondary use activities that occur on the San Bernardino and Leslie Canyon NWRs.

(2) Ensure reasonable levels of wildlife observation, photography, hiking, and small game hunting opportunities that do not place harmful pressure on the wildlife populations and sensitive habitat areas and that do not conflict with other refuge goals and objectives.

(3) Ensure minimum impacts to refuge habitat and wildlife resources by monitoring recreational use and subsequent impacts on the refuge by the public and setting law enforcement/patrolling efforts accordingly.

(4) Ensure public safety by adequately maintaining refuge access roads and other public use facilities.

(5) Develop a Public Use/Environmental Education Management Plan for the San Bernardino and Leslie Canyon NWRs.

ISSUE #6: Environmental Education and Public Outreach

Goal Statement: To establish a program for public outreach, identify important public resources, and implement educational and interpretive programs for refuge habitat, wildlife, and cultural resources.

Objectives/Strategies:

(1) Improve public appreciation of wildlife resources and awareness of ecological values by developing an environmental education and public outreach program that demonstrates the role of San Bernardino and Leslie Canyon NWRs in such efforts. These efforts should include involving Mexican organizations such as Centro Ecologico and SEDESOL.

(2) Improve outreach to children and schools by designing an environmental education and interpretive program tailored to fit the needs of the local schools from elementary grades through high school levels. Included in this program would be the proposal to stock endangered Yaqui fishes in the local high school pond to teach students fish ecology and habitat needs as well as the importance of species preservation.

(3) Increase educational and interpretive opportunities by giving presentations to local interest groups and setting up displays and/or exhibits at local community events.

(4) To effect land use practices by private landowners, including those in Mexico, that are ecologically healthy through offering technical assistance and providing educational programs, such as giving presentations and tours of the refuges, that interpret sound grazing and farming strategies, conservative use of the aquifer, and riparian protection/restoration.

(5) Develop a Public Use/Environmental Education Management Plan for the San Bernardino and Leslie Canyon NWRs.

(6) In a partnership with the Johnson Museum, develop interpretive trail and other interpretive panels for the historical site to include themes such as Yaqui fishes ecology and management, candidate species awareness (San Bernardino spring snail, Mexican garter snake, Chiracahua leopard frog), biodiversity associated with cottonwood-willow riparian habitats, and cultural resources interpretation.

ISSUE #7: Cultural Resources Preservation and Management

Goal Statement: To protect, maintain, and plan for Service managed cultural resources on San Bernardino NWR for the benefit of present and future generations.

Objectives/Strategies:

(1) Ensure compliance with all Service and other applicable Federal laws and regulations to provide the fullest protection possible to the cultural resources on San Bernardino NWR and avoid the inadvertent loss of archaeological and historical sites.

(2) Fully utilize the expertise of the Regional Historical Preservation Officer to ensure appropriate measures are taken to protect the cultural resources on the refuge prior to any undertakings that could potentially affect those resources.

(3) Through administration of the appropriate special use permits, allow only necessary and appropriate research with respect to the cultural resources on the refuge to avoid unnecessary disturbance to such resources.

(4) Monitor visitor use and the associated effects of such use on the cultural resources located on the refuge through appropriate law enforcement efforts.

(5) Document any new cultural resources sites and objects found on the refuge and report them immediately to the Regional Historical Preservation Officer so that further investigation can be conducted in a timely manner.

(6) Ensure that any and all archaeological and historical materials and archives are maintained according to professional standards of curation for scientific use and public interpretation.

ISSUE #8 Interagency Coordination

Goal Statement: To strengthen interagency and jurisdictional relationships in order to coordinate efforts with respect to refuge and surrounding area issues, resulting in decisions benefiting fish and wildlife resources, while at the same time avoiding duplication of effort.

Objectives/Strategies:

(1) Strengthen the role of the Service in the Malpai Borderlands Group's land protection and habitat management efforts by continuing involvement in their coordinated efforts for overall land and water protection in the Valley.

(2) Improve interagency coordination, planning, communication, and decision-making by maintaining MOU's with the appropriate agencies, jurisdictions, landowners (including those in Mexico), and surrounding leaders to coordinate efforts on an array of issues including water management, endangered species management, fire management, habitat manipulation, and environmental education and interpretation.

(3) Establish cooperative agreements with Mexico and other private landowners adjacent to the refuges to initiate cooperative management efforts for the recovery and long-term protection of Yaqui fishes and their native habitatst.

(4) Strengthen coordination with the Johnson Museum to improve the management of Yaqui fishes inhabiting House Pond.

ISSUE #9: Land Protection

Goal Statement: To protect existing lands associated with the refuges and additional lands for the protection and maintenance of fish and wildlife resources; and to ensure the integrity of the refuges boundaries relative to adjacent lands.

Objectives/Strategies:

(1) Initiate necessary actions including planning studies, public involvement, environmental assessments, etc., in efforts to expedite protection strategies for the various lands associated with the proposed 24,000-acre protection area.

(2) Consider a range of protection strategies for the various land ownerships (Slaughter Ranch Headquarters Site, BLM lands, 99 Bar Ranch, Bar-Boot Ranch) including cooperative agreements, conservation/non-development easements, Partners for Wildlife programs, technical assistance, and withdrawal of public domain lands. Pursue acquisitions on a willing-seller basis only.

(3) Work cooperatively with the landowner of the 99 Bar Ranch to protect the perennial stretch upstream from Leslie Creek from development or uses which could threaten the year round flows.

(4) Ensure habitat protection from potential mining activities by acquiring all Federal and private mineral rights, including surface and sub-surface rights.

(5) Ensure more effective and efficient management control of Leslie Canyon NWR boundaries by obtaining the appropriate BLM lands that lie adjacent to the current refuge fenceline.

(6) Work with the Malpai Borderlands Group to sustain the "open space nature" of the land by encouraging conservation easements on all private lands in the valley so that subdivision and development is prohibited.

ISSUE #10: Staffing and Funding

Goal Statement: To effect improvements to staffing and funding that will result in long-lasting enhancement to habitat and wildlife resources in the Area of Ecological Concern, leading to the achievement of the goals of this plan and the goals of the National Wildlife Refuge System.

Objectives/Strategies:

(1) Expand biological capabilities of the refuges by continuing efforts to hire a permanent, full-time biologist with expertise in fisheries and herpetology ecology/management.

(2) Improve consistency of management of refuge programs by annually assessing individual program funding needs, prioritize them, and preparing a budget supported by the goals and objectives of this plan.

(3) Ensure Comprehensive Management Plan applicability and flexibility for future years by reviewing the document for currency (possibly updating it every 5 years), assessing objective achievement progress, and making suggested amendments to the document.

(4) Consistent with Regional requests, promote existing, continuing, and proposed Service programs, conduct compatibility reviews, and prepare annual narratives of refuge accomplishments.

PART IV: APPENDICES

APPENDIX A: MAMMAL INVENTORY

KEY:

= observed on refuges
* = expected to be on refuges

CLASS MAMMALIA (Mammals)

Order Insectivora (Insect Eaters)

Family Soricidae (Shrews)
* Gray shrew (Notiosorex crawfordi)

Order Chiroptera (Bats)

Family Phyllostomidae (Leafnose Bats)
* Leafnose bat (Macrotus californicus)
* Hognose bat (Choeronycteris mexicana)
# Longnose bat (Leptonycteris nivalis)

Family Vespertilionidae (Plainnose Bats)
* Yuma myotis (Myotis yumanensis)
# Cave myotis (Myotis velifer)
# California myotis (Myotis californicus)
* Small-footed myotis (Myotis subulatus)
* Long-legged myotis (Myotis volans)
* Fringed myotis (Myotis thysanodes)
* Keen myotis (Myotis keeni)
* Arizona myotis (Myotis occultus)
* Long-eared myotis (Myotis evotis)
* Silver-haired bat (Lasionycteris noctivagans)
* Western pipestrel (Pipistrellus hesperus)
# Big brown bat (Eptesicus fuscus)
# Western yellow bat (Lasiurus ega)
# Red bat (Lasiurus borealis)
# Hoary bat (Lasiurus cinereus)
* Spotted bat (Euderma maculata)
* Mexican big-eared bat (Plecotus phyllotis)
# Western big-eared bat (Plecotus townsendi)
* Pallid bat (Antrozous pallidus)

Family Molossidae (Freetail Bats)
Mexican freetail bat (Tadarida brasiliensis)
* Pocketed freetail bat (Tadarida femorosacca)
* Big freetail bat (Tadarida molossa)
* Western mastiff bat (Eumops perotis)

Order Carnivora (Flesh Eaters)

Family Procyonidae (Raccoons, Coatis, and Ringtails)
- # Raccoon (Procyon lotor)
- * Coati (Nasua narica)
- * Ringtail (Bassariscus astutus)

Family Mustelidae (Weasels, Badgers, and Skunks)
- * Longtail weasel (Mustela frenata)
- # Badger (Taxidea taxus)
- * Spotted skunk (Spilogale putorius)
- # Striped skunk (Mephitis mephitis)
- * Hooded skunk (Mephitis macroura)
- # Hognose skunk (Conepatus leuconotus)

Family Canidae (Dogs, Wolves, and Foxes)
- # Coyote (Canis latrans)
- * Kit fox (Vulpes macrotis)
- * Gray fox (Urocyon cinereoargenteus)

Family Felidae (Cats)
- # Mountain lion (Felis concolor)
- # Bobcat (Lynx rufus)

Order Rodentia (Gnawing Mammals)

Family Sciuridae (Squirrels)
- # Yuma antelope squirrel (Ammospermophilus harrisi)
- # Spotted ground squirrel (Spermophilus spilosoma)
- # Rock squirrel (Spermophilus variegatus)

Family Geomyidae (Pocket Gophers)
- * Valley pocket gopher (Thomomys bottae)
- # Pygmy pocket gopher (Thomomys umbrinus)

Family Heteromyidae (Pocket Mice and Kangaroo Rats)
- # Silky pocket mouse (Perognathus flavus)
- # Desert pocket mouse (Perognathus penicillatus)
- * Rock pocket mouse (Perognathus intermedius)
- # Bailey pocket mouse (Perognathus baileyi)
- # Hispid pocket mouse (Perognathus hispidus)
- # Bannertail kangaroo rat (Dipodomys spectabilis)
- # Ord kangaroo rat (Dipodomys ordi)
- # Merriam's kangaroo rat (Dipodomys merriami)

Family Cricetidae (Mice, Rats, Lemmings, and Voles)
- # Western harvest mouse (Reithrodontomys megalotis)
- # Fulvous harvest mouse (Reithrodontomys fulvescens)
- # Cactus mouse (Peromyscus eremicus)
- # Deer mouse (Peromyscus maniculatus)
- # White-footed mouse (Peromyscus leucopus)
- * Brush mouse (Peromyscus boylei)

Rock mouse (Peromyscus difficilis)
Pygmy mouse (Baiomys taylori)
House mouse (Mus musculus)
Northern grasshopper mouse (Onychomys leucogaster)
Southern grasshopper mouse (Onychomys torridus)
Whitethroat woodrat (Neotoma albigula)
* Mexican woodrat (Neotoma mexicana)
# Hispid cotton rat (Sigmodon hispidus)
# Least cotton rat (Sigmodon minimus)
* Yellownose cotton rat (Sigmodon ochrognathus)

Family Erethizontidae (Porcupine)
Porcupine (Erethizon dorsatum)

Order Lagomorpha (Pikas, Hares, and Rabbits)

Family Leporidae (Hares and Rabbits)
Blacktail jackrabbit (Lepus californicus)
Desert cottontail (Sylvilagus auduboni)

Order Artiodactyla (Even-Toed Hoofed Animals)

Family Tayassuidae (Javalina)
Javelina (Pecari angulatus)

Family Cervidae (Deer)
Mule deer (Odocoileus hemionus)
Whitetail deer (Odocoileus virginianus)

APPENDIX B : BIRD INVENTORY

CLASS AVES (Birds)

Order Podicipediformes (Grebes)

Family Podicipedidae (Grebes)
- Western grebe (Aechmophorus occidentalis)
- Eared grebe (Podiceps nigricollis)
- Pied-billed grebe (Podilymbus podiceps)

Order Pelecaniformes (Pelicans and Allies)

Family Phalacrocoracidae (Cormorants)
- Olivaceous cormorant (Phalacrocorax olivaceus)
- Double-crested cormorant (Phalacrocorax auritus)

Order Ciconiiformes (Herons, Storks, and Allies)

Family Ardeidae (Bitterns, Herons, and Egrets)
- Least bittern (Ixobrychus exilis)
- American bittern (Botaurus lentiginosus)
- Black-crowned night-heron (Nycticorax nycticorax)
- Green-backed heron (Butorides striatus)
- Cattle egret (Bubulcus ibis)
- Snowy egret (Egretta thula)
- Great egret (Casmerodius albus)
- Great blue heron (Ardea herodias)

Family Ciconiidae (Storks)
- Wood stork (Mycteria americana)

Family Threskiornithidae (Ibises and Spoonbills)
- White-faced ibis (Plegadis chihi)

Order Anseriformes (Waterfowl)

Family Anatidae (Swans, Geese, and Ducks)
- Tundra swan (Cygnus columbianus)
- Greater white-fronted goose (Anser albifrons)
- Snow goose (Chen caerulescens)
- Canada goose (Branta canadensis)
- Mallard (Anas platyrhynchos)
- Mexican duck (Anas platyrhynchos diazi)
- Gadwall (Anas strepera)
- Green-winged teal (Anas crecca)
- American wigeon (Anas americana)
- Northern pintail (Anas acuta)
- Northern shoveler (Anas clypeata)
- Blue-winged teal (Anas discors)
- Cinnamon teal (Anas cyanoptera)

Ruddy duck (Oxyura jamaicensis)
Fulvous whistling-duck (Dendrocygna bicolor)
Black-bellied whistling-duck (Dendrocygna autumnalis)
Wood duck (Aix sponsa)
Canvasback (Aythya valisineria)
Redhead (Aythya americana)
Ring-necked duck (Aythya collaris)
Lesser scaup (Aythya affinis)
Bufflehead (Bucephala albeola)
Common merganser (Mergus merganser)
Hooded merganser (Lophodytes cucullatus)

Order Gruiformes (Cranes, Rails, and Allies)

Family Gruidae (Cranes)
Sandhill crane (Grus canadensis)

Family Rallidae (Rails, Gallinules, and Coots)
Virginia rail (Rallus limicola)
Sora (Porzana carolina)
Common moorhen (Gallinula chloropus)
American coot (Fulica americana)

Order Charadriiformes (Shorebirds, Gulls, and Allies)

Family Recurvirostridae (Stilts and Avocets)
American avocet (Recurvirostra americana)
Black-necked stilt (Himantopus mexicanus)

Family Charadriidae (Plovers)
Killdeer (Charadrius vociferus)

Family Scolopacidae (Sandpipers, Phalaropes, and Allies)
Long-billed curlew (Numenius americanus)
Willet (Catoptrophorus semipalmatus)
Lesser yellowlegs (Tringa flavipes)
Solitary sandpiper (Tringa solitaria)
Spotted sandpiper (Actitis macularia)
Semipalmated sandpiper (Calidris pusilla)
Western sandpiper (Calidris mauri)
Least sandpiper (Calidris minutilla)
Baird's sandpiper (Calidris bairdii)
Wilson's phalarope (Phalaropus tricolor)
Long-billed dowitcher (Limnodromus scolopaceus)
Common snipe (Gallinago gallinago)
Red knot (Calidris canutus)

Family Laridae (Gulls and Terns)
Ring-billed gull (Larus delawarensis)
Black tern (Chlidonias niger)

Order Falconiformes (Diurnal Birds of Prey)

Family Cathartidae (American Vultures)
- Turkey vulture (Cathartes aura)
- Black vulture (Coragyps atratus)

Family Accipitridae (Eagles and Hawks)
- Golden eagle (Aquila chrysaetos)
- Bald eagle (Haliaeetus leucocephalus)
- Mississippi kite (Ictinia mississippiensis)
- Black-shouldered kite (Elanus caeruleus)
- Northern harrier (Circus cyaneus)
- Sharp-shinned hawk (Accipiter striatus)
- Cooper's hawk (Accipiter cooperii)
- Gray hawk (Buteo nitidus)
- Red-tailed hawk (Buteo jamaicensis)
- Swainson's hawk (Buteo swainsoni)
- Rough-legged hawk (Buteo lagopus)
- Ferruginous hawk (Buteo regalis)
- Common black-hawk (Buteogallus anthracinus)
- Harris hawk (Parabuteo unicinctus)
- Zone-tailed hawk (Buteo albonotatus)
- Osprey (Pandion haliaetus)

Family Falconidae (Caracaras and Falcons)
- Crested caracara (Polyborus plancus)
- American kestrel (Falco sparverius)
- Prairie falcon (Falco mexicanus)
- Peregrine falcon (Falco peregrinus)

Order Galliformes (Fowl-Like Birds)

Family Phasianidae (Quail and Turkeys)
- Montezuma quail (Crytonyx montezumae)
- Scaled quail (Callipepla squamata)
- Gambel's quail (Callipepla gambelii)
- Wild turkey (Meleagris gallopavo)

Order Columbiformes (Pigeons and Doves)

Family Columbidae (Pigeons and Doves)
- Mourning dove (Zenaida macroura)
- White-winged dove (Zenaida asiatica)
- Common ground-dove (Columbina passerina)
- Ruddy ground-dove (Columbina talpacoti)
- Inca dove (Columbina inca)

Order Cuculiformes (Cuckoos and Allies)

Family Cuculidae (Cuckoos and Roadrunners)
- Yellow-billed cuckoo (Coccyzus americanus)
- Greater roadrunner (Geococcyx californianus)

Order Strigiformes (Owls)

Family Tytonidae (Barn Owls)
Barn owl (Tyto alba)

Family Strigidae (Typical Owls)
Long-eared owl (Asio otus)
Great horned owl (Bubo virginianus)
Western screech-owl (Otus kennicottii)
Elf owl (Micrathene whitneyi)
Burrowing owl (Athene cunicularia)

Order Caprimulgiformes (Goatsuckers and Allies)

Family Caprimulgidae (Nightjars)
Common poorwill (Phalaenoptilus nuttallii)
Lesser nighthawk (Chordeiles acutipennis)

Order Apodiformes (Swifts and Hummingbirds)

Family Apodidae (Swifts)
White-throated swift (Aeronautes saxatalis)

Family Trochilidae (Hummingbirds)
Blue-throated hummingbird (Lampornis clemenciae)
Magnificent hummingbird (Eugenes fulgens)
Black-chinned hummingbird (Archilochus alexandri)
Costa's hummingbird (Calypte coatae)
Calliope hummingbird (Stellula calliope)
Broad-tailed hummingbird (Selasphorus platycercus)
Rufous hummingbird (Selasphorus rufus)

Order Coraciiformes (Kingfishers and Allies)

Family Alcedinidae (Kingfishers)
Belted kingfisher (Ceryle alcyon)
Green kingfisher (Chloroceryle americana)

Order Piciformes (Woodpeckers and Allies)

Family Picidae (Woodpeckers and Sapsuckers)
Gila woodpecker (Melanerpes uropygialis)
Northern flicker (Colaptes auratus)
Yellow-bellied sapsucker (Sphyrapicus varius)
Red-naped sapsucker (Sphyrapicus nuchalis)
Ladder-backed woodpecker (Picoides scalaris)

Order Passeriformes (Perching Birds)

Family Tyrannidae (Tyrant Flycatchers)
Western kingbird (Tyrannus verticalis)
Cassin's kingbird (Tyrannus vociferans)

Tropical kingbird (Tyrannus melancholicus)
Vermilion flycatcher (Pyrocephalus rubinus)
Gray flycatcher (Empidonax wrightii)
Dusky flycatcher (Empidonax oberholseri)
Hammond's flycatcher (Empidonax hammondii)
Willow flycatcher (Empidonax traillii)
Pacific slope flycatcher (Empidonax difficilis)
Cordilleran flycatcher (Empidonax occidentalis)
Brown-crested flycatcher (Myiarchus tyrannulus)
Ash-throated flycatcher (Myiarchus cinerascens)
Olive-sided flycatcher (Contopus borealis)
Western wood-pewee (Contopus sordidulus)
Eastern phoebe (Sayornis phoebe)
Black phoebe (Sayornis nigricans)
Say's phoebe (Sayornis saya)
Northern beardless-tyrannulet (Camptostoma imberbe)
Rose-throated becard (Pachyramphus aglaiae)

Family Alaudidae (Larks)
Horned lark (Eremophila alpestris)

Family Hirundinidae (Swallows)
Tree swallow (Tachycineta bicolor)
Violet-green swallow (Tachycineta thalassina)
Purple martin (Progne subis)
Bank swallow (Riparia riparia)
Northern rough-winged swallow (Stelgidopteryx serripennis)
Cliff swallow (Hirundo pyrrhonota)
Barn swallow (Hirundo rustica)

Family Corvidae (Jays, Magpies, and Crows)
Chihuahuan raven (Corvus cryptoleucus)
Common raven (Corvus corax)

Family Paridae (Titmice and Chickadees)
Bridled titmouse (Parus wollweberi)

Family Remizidae (Verdins)
Verdin (Auriparus flaviceps)

Family Aegithalidae (Bushtits)
Bushtit (Psaltriparus minimus)

Family Sittidae (Nuthatches)
White-breasted nuthatch (Sitta carolinensis)

Family Troglodytidae (Wrens)
House wren (Troglodytes aedon)
Bewick's wren (Thryomanes bewickii)
Marsh wren (Cistothorus palustris)
Canyon wren (Catherpes mexicanus)
Rock wren (Salpinctes obsoletus)

Cactus wren (Campylorhynchus brunneicapillus)

Family Muscicapidae (Kinglets, Gnatcatchers, Thrushes, and Allies)
Ruby-crowned kinglet (Regulus calendula)
Blue-gray gnatcatcher (Polioptila caerulea)
Black-tailed gnatcatcher (Polioptila melanura)
Western bluebird (Sialia mexicana)
Hermit thrush (Catharus guttatus)
American robin (Turdus migratorius)

Family Laniidae (Shrikes)
Loggerhead shrike (Lanius ludovicianus)

Family Mimidae (Mockingbirds, Thrashers, and Allies)
Northern mockingbird (Mimus polyglottos)
Sage thrasher (Oreoscoptes montanus)
Brown thrasher (Toxostoma rufum)
Curve-billed thrasher (Toxostoma curvirostre)
Crissal thrasher (Toxostoma crissale)

Family Motacillidae (Pipits and Wagtails)
American pipit (Anthus rubescens)

Family Bombycillidae (Waxwings)
Cedar waxwing (Bombycilla garrulus)

Family Ptilogonatidae (Silky Flycatchers)
Phainopepla (Phainopepla nitens)

Family Sturnidae (Starlings)
European starling (Sturnus vulgaris)

Family Vireonidae (Vireos)
Bell's vireo (Vireo bellii)
Solitary vireo (Vireo solitarius)
Warbling vireo (Vireo gilvus)

Family Emberizidae (Emberizids)

(Wood-Warblers)

Orange-crowned warbler (Vermivora celata)
Virginia's warbler (Vermivora virginiae)
Lucy's warbler (Vermivora luciae)
Black-throated blue warbler (Dendroica caerulescens)
Yellow-rumped warbler (Dendroica coronata)
Audubon's warbler (Dendroica auduboni)
Myrtle warbler (Dendroica coronata)
Black-throated gray warbler (Dendroica nigrescens)
Townsend's warbler (Dendroica townsendi)
Hermit warbler (Dendroica occidentalis)
Yellow warbler (Dendroica petechia)

MacGillivray's warbler (Oporornis tolmiei)
Kentucky warbler (Oporornis formosus)
Wilson's warbler (Wilsonia pusilla)
Northern waterthrush (Seiurus noveboracensis)
Common yellowthroat (Geothlypis trichas)
Yellow-breasted chat (Icteria virens)
American redstart (Setophaga ruticilla)
Painted redstart (Myioborus pictus)

(Tanagers)

Western tanager (Piranga ludoviciana)
Summer tanager (Piranga rubra)

(Cardinals, Grosbeaks, Buntings, and Allies)

Northern cardinal (Cardinalis cardinalis)
Pyrrhuloxia (Cardinalis sinuatus)
Black-headed grosbeak (Pheucticus melanocephalus)
Blue grosbeak (Guiraca caerulea)
Indigo bunting (Passerina cyanea)
Lazuli bunting (Passerina amoena)
Painted bunting (Passerina ciris)
Varied bunting (Passerina versicolor)
Dickcissel (Spiza americana)

(Towhees, Sparrows, Juncos, and Allies)

Green-tailed towhee (Pipilo chlorurus)
Rufous-sided towhee (Pipilo erythrophthalmus)
Canyon towhee (Pipilo fuscus)
Grasshopper sparrow (Ammodramus savannarum)
Vesper sparrow (Pooecetes gramineus)
Savannah sparrow (Passerculus sandwichensis)
Song sparrow (Melospiza melodia)
Lark sparrow (Chondestes grammacus)
Black-throated sparrow (Amphispiza bilineata)
Sage sparrow (Amphispiza belli)
Botteri's sparrow (Aimophila botterii)
Cassin's sparrow (Aimophila cassinii)
Rufous-crowned sparrow (Aimophila ruficeps)
Chipping sparrow (Spizella passerina)
Brewer's sparrow (Spizella breweri)
Black-chinned sparrow (Spizella atrogularis)
White-throated sparrow (Zonotrichia albicollis)
White-crowned sparrow (Zonotrichia leucophrys)
Gambel's white-crowned sparrow (Z. l. gambelii)
Golden-crowned sparrow (Zonotrichia atricapilla)
Lincoln's sparrow (Melospiza lincolnii)
Swamp sparrow (Melospiza georgiana)
Dark-eyed junco (Junco hyemalis)
Oregon junco (Junco hyemalis oreganus)

Gray-headed junco (Junco hyemalis caniceps)
Chestnut-collared longspur (Calcarius ornatus)
Lark bunting (Calamospiza melanocorys)

(Meadowlarks, Blackbirds, Orioles, and Allies)

Eastern meadowlark (Sturnella magna)
Western meadowlark (Sturnella neglecta)
Yellow-headed blackbird (Xanthocephalus xanthocephalus)
Red-winged blackbird (Agelaius phoeniceus)
Brewer's blackbird (Euphagus cyanocephalus)
Brown-headed cowbird (Molothrus ater)
Bronzed cowbird (Molothrus aeneus)
Great-tailed grackle (Quiscalus mexicanus)
Scott's oriole (Icterus parisorum)
Northern oriole (Icterus galbula)
Hooded oriole (Icterus cucullatus)

(Old World Sparrows)

House sparrow (Passer domesticus)

(Finches and Allies)

Pine siskin (Carduelis pinus)
American goldfinch (Carduelis tristis)
Lesser goldfinch (Carduelis psaltria)
Lawrence's goldfinch (Carduelis lawrencei)
Purple finch (Carpodacus purpureus)
Cassin's finch (Carpodacus cassinii)
House finch (Carpodacus mexicanus)

APPENDIX C: AMPHIBIAN AND REPTILE INVENTORY

KEY

= observed on refuges
* = expected to be on refuges

CLASS AMPHIBIA (Amphibians)

Order Caudata (Salamanders)

Family Ambystomidae (Mole Salamanders)
- # Tiger salamander (Ambystoma tigrinum)

Order Anura (Frogs and Toads)

Family Pelobatidae (Spadefoot Toads)
- * Plains spadefoot (Scaphiopus bombifrons)
- # Couch's spadefoot (Scaphiopus couchi)
- # Western spadefoot (Scaphiopus hammondi)

Family Bufonidae (Toads)
- # Sonoran desert toad (Bufo alvarius)
- # Great plains toad (Bufo cognatus)
- # Green toad (Bufo debilis)
- # Red-spotted toad (Bufo punctatus)
- # Woodhouse's toad (Bufo woodhousei)

Family Ranidae (True Frogs)
- # Bullfrog (Rana catesbeiana)
- # Chiricahua leopard frog (Rana chiricahuensis)
- # Lowland leopard frog (Rana yavapaiensis)

CLASS REPTILIA (Reptiles)

Order Testudines (Turtles)

Family Kinosternidae (Mud and Musk Turtles)
- * Yellow mud turtle (Kinosternon flavescens)
- # Sonoran mud turtle (Kinosternon sonoriense)

Family Emydidae (Pond Turtles)
- # Western box turtle (Terrapene ornata)

Family Testudinidae (Tortoises)
- * Desert tortoise (Gopherus agassizii)

Order Squamata (Lizards and Snakes)

Suborder Lacertilia (Lizards)

Family Gekkonidae (Geckos)
* Western banded gecko (Coleonyx variegatus)

Family Iguanidae (Iguanids)
* Zebra-tailed lizard (Callisaurus draconoides)
* Greater earless lizard (Cophosaurus texanus)
# Collared lizard (Crotaphytus collaris)
# Longnosed leopard lizard (Gambelia wislizenii)
# Lesser earless lizard (Holbrookia maculata)
# Texas horned lizard (Phrynosoma cornutum)
* Roundtailed horned lizard (Phrynosoma modestum)
# Regal horned lizard (Phrynosoma solare)
# Clark's spiny lizard (Sceloporus clarki)
* Desert spiny lizard (Sceloporus magister)
* Bunchgrass lizard (Sceloporus scalaris)
# Eastern fence lizard (Sceloporus undulatus)
# Tree lizard (Urosaurus ornatus)
* Sideblotched lizard (Uta stansburiana)

Family Anguidae (Alligator Lizards)
Madrean alligator lizard (Gerrhonotus kingi)

Family Helodermatidae (Gila Monster Family)
Gila monster (Heloderma suspectum)

Family Teiidae (Whiptails and Racerunners)
* Canyon spotted whiptail (Cnemidophorus burti)
* Sonoran spotted whiptail (Cnemidophorus sonorae)
# Desert grassland whiptail (Cnemidophorus uniparens)

Family Scincidae (Skinks)
* Great plains skink (Eumeces obsoletus)

Suborder Serpentes (Snakes)

Family Leptotyphlopidae (Slender Blind Snakes)
* Texas blind snake (Leptotyphlops dulcis)
* Western blind snake (Leptotyphlops humilis)

Family Colubridae (Colubrids)
* Glossy snake (Arizona elegans)
# Ringneck snake (Diadophis punctatus)
* Chihuahuan hooknosed snake (Gyalopian canum)
* Western hognosed snake (Heterodon nasicus)
# Night snake (Hypsiglena torquata)
# Common kingsnake (Lampropeltis getulus)
# Sonoran whipsnake (Masticophis bilineatus)
# Coachwhip (Masticophis flagellum)

Bullsnake (Pituophis melanoleucus)
Longnosed snake (Rhinocheilus lecontei)
* Graham patchnosed snake (Salvadora grahamiae)
# Western patchnosed snake (Salvadora hexalepis)
* Ground snake (Sonora semiannulata)
# Southwestern blackheaded snake (Tantilla hobartsmithi)
* Plains blackheaded snake (Tantilla nigriceps)
# Blacknecked garter snake (Thamnophis cyrtopsis)
# Mexican garter snake (Thamnophis eques)
# Checkered garter snake (Thamnophis marcianus)
* Lyre snake (Trimorphodon biscutatus)

Family Elapidae (Coral Snakes)

Western coral snake (Micruroides euryxanthus)

Family Viperidae (Vipers)

Western diamondback rattlesnake (Crotalus atrox)
Blacktailed rattlesnake (Crotalus molossus)
Mojave rattlesnake (Crotalus scutulatus)
* Massassauga (Sistrurus catenatus)

APPENDIX D: FISHES INVENTORY

KEY:

\# = native species currently on refuge
\+ = introduced species currently on refuge
* = native species extirpated from refuge

CLASS OSTEICHTHYES (Bony Fishes)

Order Cypriniformes

Family Cyprinidae (Carps and Minnows)
- \# Longfin dace (Agosia chrysogaster)
- * Mexican stoneroller (Campostoma ornatum)
- \# Beautiful shiner (Cyprinella formosa)
- \# Yaqui chub (Gila purpurea)
- * Roundtail chub (Gila robusta)

Family Catostomidae (Suckers)
- * Yaqui sucker (Catostomus bernardini)

Order Siluriformes

Family Ictaluridae (Bullhead Catfishes)
- * Yaqui catfish (Ictalurus pricei)

Order Atheriniformes

Family Poeciliidae (Livebearers)
- \+ Mosquitofish (Gambusia affinis)
- \# Yaqui topminnow (Poeciliopsis occidentalis sonorensis)

APPENDIX E: PLANT INVENTORY

ACANTHACEAE (Acanthus Family)

Anisacanthus thurberi -- Chuparosa, Desert honeysuckle
Carlowrightia arizonica
Elytraria imbricata -- Purple scaly stem
Ruellia nudiflora var. glabrata -- Longneck ruel
Siphonoglossa longiflora
Tetramerium hispidum

AIZOACEAE (Ice Plant Family)

Mollugo verticillata -- Indian chickweed
Trianthema portulacastrum -- Verdolago blanca

AMARANTHACEAE (Pigweed Family)

Alternanthera repens -- Khakiweed
Amaranthus palmeri -- Palmer's amaranth
Amaranthus Torreyi -- Torrey's amaranth
Gomphrena caespitosa -- Globe amaranth
Tidestromia lanuginosa -- Tidestromia

AMARYLLIDACEAE (Amaryllis Family)

Agave palmeri -- Century plant
Agave parryi -- Parry agave
Zephyranthes longifolia -- Rain lily

ANACARDIACEAE (Cashew Family)

Rhus choriophylla -- Mearn's sumac
Rhus microphylla -- Little leaf sumac
Rhus radicans var. rydbergii -- Poison ivy

APIACEAE/UMBELLIFERAE (Parsley Family)

Berula erecta -- Water parsnip
Cymopterus multinervatus -- Purple cymopterus
Daucus pusillus -- American carrot
Lilaeopsis recurva
Spermolepis echinata -- Scale seed

ARISTOLOCHIACEAE (Birthwort Family)

Aristolochia watsoni -- Indian root

ASCLEPIADACEAE (Milkweed Family)

Asclepias asperula -- Antelope horns milkweed
Asclepias nyctaginifolia -- Four O'Clock milkweed

Asclepias subverticillata -- Poison milkweed
Sarcostemma crispum = Funastrum crispum -- Climbing milkweed

ASTERACEAE/COMPOSITAE (Sunflower Family)

Acourtia nana = Perezia nana -- Dwarf desert holly
Acourtia wrightii = Perezia wrightii -- Desert holly
Ambrosia confertiflora = Franseria confertiflora -- Slimleaf bursage
Artemisia dracunculoides -- False tarragon
Artemisia ludoviciana -- Louisiana wormwood
Aster pauciflorus -- Marsh alkali aster, Purple aster
Aster subulatus var. ligulatus = Aster exilis -- Awlleaf aster
Aster tagetinus
Baccharis pteronioides -- Yerba de Pasmo
Baccharis salicifolia = Baccharis glutinosa -- Seep willow
Baccharis sarothroides -- Desert broom
Bahia absinthifolia var. dealbata -- Sageleaf bahia
Baileya multiradiata -- Desert marigold
Baileya pleniradiata -- Woolly marigold
Berlandiera lyrata -- Green eyes
Bidens laevis -- Bur marigold
Bidens leptocephala -- Spanish needles, Beggertick
Brickellia californica -- Pachaba, Brickelbush
Calycoseris wrightii -- White tackstem
Carphochaete bigelovii -- Bristlehead
Centaurea melitensis -- Malta star-thistle
Chaenactis stevioides -- Esteve's pincushion
Chrysothamnus nauseosus -- Rabbit brush
Cirsium neomexicanum -- New Mexico thistle
Cirsium ochrocentrum -- Sante Fe thistle, Yellow spine thistle
Conyza canadensis = Erigeron canadensis -- Horseweed
Conyza coulteri
Dyssodia acerosa -- Prickly fetid marigold, Spiny dogweed
Dyssodia pentachaeta -- Five-needle dogweed
Ericameria laricifolia -- Jimmyweed
Erigeron divergens -- Spreading fleabane
Eupatorium greggii -- Thoroughwort
Flourensia cernua -- Tarbush
Gaillardia pulchella -- Indian blanket
Gnaphalium chilense -- Small-flowered cudweed, Western cudweed
Gnaphalium purpureum -- Purple cudweed
Gnaphalium wrightii -- Cudweed
Gutierrezia microcephala -- Little head snakeweed
Gutierrezia sarothrae -- Snakeweed
Gymnosperma glutinosum = Selloa glutinosa -- Tatalencho
Haplopappus gracilis -- Annual goldenweed
Haplopappus tenuisectus -- Burroweed
Helenium thurberi -- Sneezeweed
Helianthus annuus -- Common sunflower
Helianthus ciliaris -- Blueweed, Plains sunflower
Heterotheca psammophila = Heterotheca subaxillaris -- Camphorweed
Hymenoclea monogyra -- Burro bush

Hymenothrix wislizeni -- Hymenothrix
Hymenoxys odorata -- Bitterweed
Isocoma heterophyllus = Haplopappus heterophyllus -- Jimmyweed
Lactuca serriola -- Wild lettuce
Leucelene ericoides = Aster hirtifolius -- White aster, Roseheath
Machaeranthera pinnatifida -- Spiny aster
Malacothrix fendleri -- Yellow saucers, Fendler's dandelion
Malacothrix glabrata -- Desert dandelion
Melampodium leucanthum -- Blackfoot daisy
Microseris linearifolia -- Silver puffs, Starpoint
Parthenium incanum -- Mariola
Pectis cylindrica
Pectis filipes -- Threadstem chinchweed
Pectis felipes var. subnuda -- Threadstem chinchweed
Porophyllum gracile
Sanvitalia aberti -- Sanvitalia, Abert's dome
Senecio douglasii var. douglasii -- Douglas'threadleaf groundsel
Senecio douglasii var. longilobus -- Threadleaf groundsel
Senecio douglasii var. monoensis -- Threadleaf groundsel
Solidago wrightii var. adenophora -- Goldenrod
Sonchus asper -- Spiny sow-thistle
Sonchus oleraceus -- Common sow-thistle
Stephanomeria pauciflora -- Desert straw
Stephanomeria tenuifolia -- Wire lettuce
Taraxacum spp. -- Dandelion
Thelesperma megapotamicum -- Green thread
Tragopogon spp. -- Goats-beard, Salsify
Trixis californica -- Trixis
Verbesina encelioides var. exauriculata -- Cowpen daisy
Verbesina rothrockii -- Crown beard
Viguiera dentata -- Giant goldeneye
Viguiera multiflora -- Showy goldeneye
Xanthium strumarium = Xanthium saccharatum -- Common cocklebur
Zinnia acerosa = Zinnia pumila -- Desert zinnia, White zinnia
Zinnia grandiflora -- Prairie zinnia, Plains zinnia

BIGNONIACEAE (Trumpet Creeper Family)

Chilopsis linearis -- Desert willow
Tecoma stans -- Yellow trumpet bush

BORAGINACEAE (Forget-Me-Not Family)

Cryptantha albida
Cryptantha angustifolia -- Narrow-leaved cryptantha
Cryptantha barbigera -- Bearded cryptantha
Cryptantha crassisepala -- Thick-sepaled cryptantha
Cryptantha micrantha -- Purple-rooted cryptantha
Cryptantha muricata
Cryptantha pterocarya -- Wing-nut cryptantha
Lappula redowskii -- White bristle stickseed
Lappula texana -- Stickseed

Lithospermum incisum -- Puccoon
Pectocarya platycarpa -- Broad-nutted comb bur
Plagiobothrys arizonicus -- Arizona popcorn flower
Tiquilia canescens = Coldenia canescens -- Dog's ear

BRASSICACEAE/CRUCIFERAE (Mustard Family)

Arabis perennans -- Rock-cress
Descurainia pinnata -- Yellow tansy mustard
Descurainia sophia -- Flixweed
Draba cuneifolia -- Whitlow grass, White draba
Lepidium lasiocarpum var. georginum -- Hairy peppergrass
Lepidium medium -- Long-petal peppergrass
Lepidium thurberi -- Thurber's peppergrass
Lesquerella fendleri -- Fendler's bladderpod
Lesquerella gordoni -- Gordon's bladderpod
Lesquerella purpurea -- Purple bladderpod
Nasturtium officinale = Rorippa nasturtium-aquaticum -- Watercress
Sisymbrium irio -- London rocket
Streptanthus arizonicus -- Twist flower, Arizona jewel-flower

CACTACEAE (Cactus Family)

Coryphantha vivipara var. bisbeeana -- Beehive nipple cactus
Echinocereus fendleri -- Strawberry hedgehog cactus
Echinocereus fendleri var. rectispinus -- Hedgehog cactus
Echinocereus pectinatus -- Rainbow cactus
Ferocactus wislizeni -- Arizona barrel cactus
Mammillaria gummifera -- Pancake cactus
Mammillaria heyderi var. Macdougalii -- Nipple cactus
Opuntia kleiniae -- Candle cholla, Pencil cholla
Opuntia leptocaulis -- Desert christmas cactus
Opuntia leptocaulis var. tetracantha -- Desert christmas cactus
Opunita phaeacantha var. disciata -- Engleman prickly pear
Opuntia phaeacantha var. major -- Engleman prickly pear
Opuntia spinosior -- Cane cholla, Handlegrip cholla
Opuntia violacea var. violacea -- Purple prickly pear
Peniocereus greggii var. greggii -- Deerhorn cactus

CAPPARIDACEAE (Caper Family)

Cleome multicaulis = Cleome sonorae -- Bee plant

CAPRIFOLIACEAE (Honeysuckle Family)

Sambucus mexicana -- Mexican elder

CELASTRACEAE (Bitter-Sweet Family)

Mortonia scabrella -- Mortonia

CHENOPODIACEAE (Goosefoot Family)

Atriplex canescens -- Four-wing saltbush
Atriplex elegans var. elegans
Atriplex elegans var. thornberi
Atriplex wrightii
Chenopodium spp.
Chenopodium fremontii
Chenopodium incanum var. elatum
Chenopodium leptophyllum -- Slimleaf goosefoot
Eurotia lanata -- Winterfat
Monolepis nuttalliana -- Poverty-weed
Salsola iberica -- Russian thistle, Tumbleweed
Suaeda torreyana -- Seep weed

COCHLOSPERMACEAE (Cochlospermum Family)

Amoreuxia palmatifida -- Arizona yellow show

COMMELINACEAE (Spiderwort Family)

Commelina erecta var. crispa -- Small-bracted dayflower

CONVOLVULACEAE (Morning Glory Family)

Convolvulus arvensis -- Field bindweed
Convolvulus equitans = Convolvulus incanus -- Hoary bindweed
Cuscuta umbellata var. reflexa -- Umbrella dodder
Evolvulus nuttalianus -- Silky evolvulus, Dwarf morning glory
Ipomoea barbatisepala -- Bristle cup morning glory
Ipomoea coccinea -- Scarlet morning glory
Ipomoea costellata -- Crestrib morning glory
Ipomoea leptotoma -- Hairy birds-foot

CUCURBITACEAE (Gourd Family)

Apodanthera undulata -- Melon loco
Cucurbita digitata --Finger-leaved gourd
Cucurbita foetidissima -- Buffalo gourd
Echinopepon wrightii -- Wild balsam apple
Ibervillea tenuisecta -- Globe berry, Deer apples

CUPRESSACEAE (Cypress Family)

Juniperus spp. -- Juniper
Juniperus monosperma -- One-seeded juniper

CYPERACEAE (Sedge Family)

Carex bolanderi -- Sedge
Carex praegracilis -- Sedge
Cyperus aristatus -- Yellow yew grass

Cyperus esculentus -- Sedge
Cyperus niger var. capitatus -- Flatsedge
Cyperus odoratus -- Flatsedge
Eleocharis parishii -- Spikerush
Scirpus americanus -- Bulrush

EPHEDRACEAE (Ephedra Family)

Ephedra trifurca -- Mormon tea, Long-leaved joint-fir

EUPHORBIACEAE (Spruge Family)

Acalypha lindheimeri -- Three-seeded mercury, Copper leaf
Acalypha neomexicana -- New Mexican copperleaf
Acalypha ostryaefolia -- Hornbeam
Argythamnia neomexicana = Ditaxix neomexicana
Croton corymbulosus -- Leatherweed
Croton pottsii var. pottsii -- Leatherweed
Euphorbia spp.
Euphorbia spp.
Euphorbia albomarginata -- Rattlesnake weed
Euphorbia eriantha -- Threaded spurge
Euphorbia exstipulata
Euphorbia florida
Euphorbia heterophylla -- Painted spurge
Euphorbia hyssopifolia -- Hyssop spurge
Euphorbia micromera -- Sonoran sandmat
Euphorbia prostrata = Euphorbia chamaesyce -- Ground-fig spruge
Euphorbia serpyllifolia -- Thymeleaf spurge
Euphorbia serrula -- Sawtooth spurge
Euphorbia setiloba -- Bristle-lobed sandmat
Jatropha macrorhiza -- Ragged jatropha
Tragia nepetaefolia -- Nose-burn

FABACEAE/LEGUMINOSAE (Pea Family)

Acacia constricta -- Whitethorn
Acacia millefolia
Acacia neovernicosa = Acacia vernicosa
Astragalus allochrous -- Halfmoon loco
Astragalus bigelovii -- Bigelow's locoweed
Astragalus nuttallianus -- Nuttall locoweed
Astragalus thurberi -- Thurber's locoweed
Astragalus wootonii
Caesalpinia gilliesii -- Bird of Paradise
Calliandra eriophylla -- Fairy duster
Cassia leptocarpa -- Twin leaf
Dalea formosa -- Feather peabush
Dalea pogonathera -- Bearded dalea
Eysenhardtia polystachya -- Kidney wood
Galactia wrightii
Hoffmanseggia glauca -- Hog potato

Lotus greenei -- Deer vetch
Lotus humistratus -- Hill locust
Melilotus albus -- White sweet clover
Melilotus indicus -- Sour clover
Melilotus officinalis -- Yellow sweet clover
Mimosa biuncifera -- Wait-A-Minute-Bush
Phaseolus angustissimus -- Slimleaf limabean
Prosopis glandulosa -- Honey mesquite
Prosopis velutina -- Velvet mesquite
Rhynchosia texana -- Rosary bean
Senna spp. = Cassia spp. -- Twin leaf
Senna bauhiniodes = Cassia bauhiniodes -- Twin leaf desert senna
Tephrosia tenella

FOUQUIERIACEAE (Ocotillo Family)

Fouquieria splendons -- Ocotillo

FUMARIACEAE (Fumitory Family)

Corydalis aurea -- Scrambled eggs, Golden smoke

GERANIACEAE (Geranium Family)

Erodium cicutarium -- Filaree

HYDROPHYLLACEAE (Waterleaf Family)

Eucrypta spp.-- Eucrypta
Eucrypta micrantha -- Small-flowered eucrypta
Nama hispidum -- Purple mat
Phacelia arizonica
Phacelia coerulea -- Blue scorpionweed
Phacelia crenulata -- Scalloped phacelia

JUGLANDACEAE (Walnut Family)

Juglans major -- Arizona walnut

JUNCACEAE (Rush Family)

Juncus balticus var. montana -- Wire rush
Juncus tenuis -- Rush
Juncus torreyi -- Torrey rush

KRAMERIACEAE (Ratany Family)

Krameria lanceolata -- Prostrate ratany

LAMIACEAE/LABIATAE (Mint Family)

Hedeoma nanum -- Moch pennyroyal

Marrubium vulgare -- Common horehound
Mentha spicata -- Spearmint
Salvia henryi -- Crimson sage

LEMNACEAE (Duckweed Family)

Lemna gibba -- Inflated duckweed
Lemna minor -- Water lentil, Lesser duckweed
Lemna minuta -- Duckweed
Lemna valdiviana -- Valdivia duckweed

LILIACEAE (Lily Family)

Allium spp. -- Onion
Allium macropetalum -- Wild onion
Asparagus officinalis -- Asparagus
Dasylirion wheeleri -- Sotol
Dichelostemma pulchellum -- Bluedicks
Nolina texana -- Beargrass
Yucca elata -- Soaptree yucca

LINACEAE (Flax Family)

Linum lewisii -- Blue flax

LOASACEAE (Stick-leaf Family)

Mentzelia albicaulis -- White stem stickleaf
Mentzelia multiflora -- Adonis blazing star
Mentzelia pumila -- Stickleaf, Blazing star

MALPIGHIACEAE (Malpighia Family)

Janusia gracilis -- Janusia

MALVACEAE (Mallow Family)

Abutilon incanum -- Indian mallow
Anoda cristata -- Spurred anoda
Anoda pentaschista
Hibiscus denudatus var. involucellatus -- Rock hibiscus
Malva spp. -- Mallow
Rhynchosida physocalyx = Sida physocalyx -- Bladderpod sida
Sida abutifolia
Sida procumbens
Sphaeralcea angustifolia var. cuspidata -- Narrow-leaf globe mallow
Sphaeralcea laxa -- Caliche globe mallow

MARSILEACEAE (Pepperwort Family)

Marsilea vestita = Marsilea mucronata -- Pepperwort

MARTYNIACEAE (Unicorn Plant Family)

Proboscidea arenaria -- Devil's claw
Proboscidea parviflora -- Devil's claw

MELIACEAE (Mahogany Family)

Melia azedarach -- Chinaberry

MORACEAE (Mulberry Family)

Morus microphylla -- Texas mulberry

NAJADACEAE (Naiad Family)

Najas marina -- Holly-leaved water nymph

NYCTAGINACEAE (Four-O'Clock Family)

Allionia choisyi -- Trailing Four O'Clock
Allionia incarnata -- Trailing windmills
Boerhaavia coccinea -- Red spiderling
Boerhaavia coulteri -- Coulter's spiderling
Boerhaavia erecta
Boerhaavia intermedia -- Five-winged ringstem
Boerhaavia wrightii -- Large-bracted boerhaavia
Commicarpus scandens

NYMPHAEACEAE (Water Lily Family)

Nymphaea odorata -- White water lily

OLEACEAE (Olive Family)

Fraxinus velutina -- Velvet ash
Menodora scabra -- Rough menodora

ONAGRACEAE (Primrose Family)

Calylophis hartwegii = Oenothera hartwegii
Epilobium adenocaulon -- Fireweed
Gaura coccinea -- Scarlet gaura
Gaura parviflora -- Velvet leaf gaura
Oenothera spp.
Oenothera brachycarpa -- Longfin evening primrose
Oenothera primiveris -- Large yellow desert primrose

OROBANCHACEAE (Broom-Rape Family)

Orobanche multiflora

OXALIDACEAE (Wood-Sorrel Family)

Oxalis spp. -- Wood sorrel

PAPAVERACEAE (Poppy Family)

Argemone spp. -- Prickly poppy
Argemone pleiacantha -- Bluestem prickly poppy
Eschscholtzia californica spp. mexicana -- Mexican gold poppy

PHYTOLACCACEAE (Pokeberry Family)

Rivina humilis -- Coralito

PLANTAGINACEAE (Plantain Family)

Plantago patagonica var. oblonga = Plantago purshii var. picta
Plantago purshii -- Pursh plantain, Woolly plantain
Plantago virginica -- Pale-seeded plantain

POACEAE/GRAMINAE (Grass Family)

Agropyron cristatum -- Crested wheatgrass
Agrostis exarata var. minor -- Spike bent grass
Agrostis semiverticillata -- Water bent
Aristida adscensionis -- Sixweeks threeawn
Aristida purpurea var. glauca -- Reverchon threeawn
Aristida hamulosa -- Hook threeawn
Arundo donax -- Giant reed
Bothriochloa barbinodis = Andropogon barbinodis -- Cane bluestem
Bothriochloa ischaemum = Andropogon ischaemum -- Bluestem
Bothriochloa saccharoides = Andropogon saccharoides -- Silver bluestem
Bouteloua aristidoides -- Sixweeks needle grama
Bouteloua barbata -- Sixweeks grama
Bouteloua chondrosioides -- Spruce-top grama
Bouteloua curtipendula -- Sideoats grama
Bouteloua eriopoda -- Black grama
Bouteloua repens = Bouteloua filiformis -- Slender grama
Bromus rubens -- Foxtail brome
Bromus tectorum -- Cheatgrass
Bromus wildenowii = Bromus catharticus -- Rescue grass
Chloris virgata -- Showy windmill grass
Cynodon dactylon -- Bermuda grass
Diplachne dubia = Leptochloa dubia -- Green sprangletop
Diplachne fascicularis = Leptochloa fascicularis -- Bead sprangletop
Distichlis spicata spp. stricta -- Inland saltgrass
Echinochloa colonum -- Jungle ricegrass
Echinochloa crus-gallii -- Barnyard grass
Elymus elymoides -- Bottlebrush squirreltail
Enneapogon desvauxii -- Spike pappusgrass
Eragrostis barrelieri -- Mediterranean lovegrass
Eragrostis cilianensis -- Stinkgrass

Eragrostis lehmanniana -- Lehmann lovegrass
Eragrostis lutescens
Eragrostis neomexicana -- New Mexico lovegrass
Eragrostis orcuttiana
Eragrostis pectinaceae -- Carolina lovegrass
Eragrostis superba -- Wilman lovegrass
Eriochloa lemmoni var. gracilis
Erioneuron avenaceum var. longiaristatum -- Large-flowered tridens
Erioneuron pulchellum -- Fluffgrass
Festuca pratensis -- Meadow fescue
Heteropogon contortus -- Tanglehead
Hilaria belangeri -- Curly mesquite
Hilaria mutica -- Tobosa
Hordeum spp. -- Barley
Hordeum jubatum -- Fox-tail barley
Hordeum leporinum -- Wild barley
Leptochloa filiformis -- Red sprangletop
Muhlenbergia asperifolia -- Scratchgrass
Muhlenbergia porteri -- Bush muhly
Muhlenbergia rigens -- Deergrass
Panicum hirticaule -- Mexican witchgrass
Panicum obtusum -- Vine mesquite
Paspalum dilatatum -- Dallis grass
Paspalum distichum -- Knotgrass
Phalaris caroliniana -- Carolina canary grass
Poa annua -- Annual bluegrass
Poa bigelovii -- Bigelow's bluegrass
Polypogon monspeliensis -- Rabbitfoot grass
Polypogon viridis -- Waterbent, Water polypogon
Schismus barbatus -- Mediterranean grass
Scleropogon brevifolius -- Burrowgrass
Setaria glauca = Setaria lutescens
Setaria grisebacchi -- Grisebach's bristlegrass
Setaria macrostachya -- Plains bristlegrass
Sitanion hystrix -- Squirreltail
Sorghum bicolor -- Sorghum
Sorghum halepense -- Johnson grass
Sporobolus spp.
Sporobolus airoides -- Alkali sacaton
Sporobolus contractus -- Spike dropseed
Sporobolus cryptandrus -- Sand dropseed
Sporobolus giganteus -- Giant dropseed
Sporobolus pulvinatus -- Sixweeks dropseed
Trichachne californica = Digitaria californica -- Arizona cottontop
Trichloris crinita -- Feather fingergrass
Tridens muticus -- Slim tridens
Vulpia octoflora -- Sixweeks fescue

POLEMONIACEAE (Phlox Family)

Allophyllum gilioides = Gilia gilioides -- Straggling gilia
Eriastrum diffusum -- Miniature wool star

Gilia rigidula var. acerosa -- Blue gilia, Blue bowls
Gilia sinuata -- Desert gilia
Gilia stellata
Ipomopsis longiflora = Gilia longiflora -- Blue trumpet
Phlox nana spp. glabella -- Sante Fe phlox

POLYGALACEAE (Milkwort Family)

Polygala lindheimeri var. parvifolia = Polygala tweedyi -- Milkwort
Polygala macradenia -- Milkwort
Polygala scoparioides -- Milkwort

POLYGONACEAE (Buckwheat Family)

Eriogonum abertianum -- Wild buckwheat, Abert's buckwheat
Eriogonum polycladon -- Sorrel buckwheat
Eriogonum wrightii -- Wright buckwheat
Polygonum argyrocoleon -- Silversheath knotweed
Polygonum lapathifolium -- Willow smartweed
Rumex spp.
Rumex crispus -- Curly-leaf dock
Rumex hymenosepalus -- Wild rhubarb

POLYPODIACEAE (Fern Family)

Cheilanthes feei -- Slender lip fern
Cheilanthes lindheimeri -- Fairy swords
Notholaena limitanea -- Cloak fern
Notholaena sinuata -- Wavy cloak fern

PONTEDARIACEAE (Pickerel-Weed Family)

Heteranthera limosa -- Mud plantain

PORTULACACEAE (Purslane Family)

Portulaca oleracea -- Common purslane
Portulaca retusa -- Western purslane
Portulaca suffrutescens
Portulaca umbraticola -- Chinese hat
Talinum angustissimum -- Flame flower
Talinum aurantiacum -- Orange flame flower
Talinum paniculatum -- Pink baby's breath

POTAMOGETONACEAE (Pondweed Family)

Potamogeton pectinatus -- Sago pondweed
Zannichellia palustris -- Common pool mat

RANUNCULACEAE (Buttercup Family)

Anemone tuberosa -- Desert anemone, Desert windflower

Clematis drummondii -- Texas virgin bower
Delphinium virescens spp. wootoni -- Plains larkspur
Myosurus minimus -- Mousetail

RHAMNACEAE (Buckthorn Family)

Ceanothus greggii -- Buck brush, Deer brier
Condalia spp.
Condalia spathulata -- Squaw-bush
Sageretia wrightii
Ziziphus obtusifolia = Condalia lycioides -- Graythorn

RUBIACEAE (Madder Family)

Galium aparine -- Goosegrass
Galium microphyllum -- Bedstraw

RUTACEAE (Rue Family)

Thamnosma texana -- Turpentine broom

SALICACEAE (Willow Family)

Populus fremontii -- Fremont cottonwood
Salix exigua -- Coyote willow
Salix gooddingii -- Goodding willow
Salix taxifolia -- Yew leaf willow

SANTALACEAE (Sandalwood Family)

Comandra pallida -- Bastard toadflax

SAPINDACEAE (Soapberry Family)

Sapindus saponaria var. drummondii -- Western soapberry

SAPOTACEAE (Sapote Family)

Bumellia lanuginosa var. rigida -- Buckthorn, Gum bumelia

SAURURACEAE (Lizard-Tail Family)

Anemopsis californica var. subglabra -- Yerba-mansa

SAXIFRAGACEAE (Saxifrage Family)

Fendlera rupicola -- Fendlerbush

SCROPHULARIACEAE (Snapdragon Family)

Castilleja lanata -- Indian paint brush
Castilleja sessiliflora -- Downy painted cup, Plains paint brush

Maurandya antirrhiniflora -- Snapdragon vine
Mimulus guttatus -- Yellow monkey flower
Mimulus rubellus -- Red-stemmed mimulus
Penstemon spp.
Penstemon dasyphyllus -- Beard tongue
Penstemon superbus -- Superb penstemon
Schistophragma intermedia
Veronica peregrina spp. xalapensis -- Necklace weed

SOLANACEAE (Potato Family)

Chamaesaracha coronopus -- Small ground cherry, Five-eyes
Chamaesaracha sordida = Chamaesaracha coniodes -- False nightshade
Datura meteloides -- Sacred datura, Indian apple
Lycium andersonii var. wrightii -- Anderson thornbush
Lycium pallidum -- Pale wolfberry, Rabbit thorn
Nicotiana trigonophylla -- Desert tobacco
Physalis acutefolia = Physalis wrightii -- Wright ground cherry
Physalis pubescens var. integrifolia -- Hairy ground cherry
Solanum americanum -- American nightshade
Solanum citrullifolium -- Watermelon nightshade
Solanum elaeagnifolium -- Horse nettle, Silver-leaf nightshade
Solanum rostratum -- Buffalo bur

TAMARICACEAE (Tamarix Family)

Tamarix chinensis = Tamarix pentandra -- Salt cedar

TILIACEAE (Basswood Family)

Corchorus orinocensis

TYPHACEAE (Cat-Tail Family)

Typha domingensis -- Cattail

ULMACEAE (Elm Family)

Celtis pallida -- Desert hackberry
Celtis reticulata -- Net-leaf hackberry

VERBENACEAE (Vervain Family)

Aloysia wrightii -- Organillo
Glandularia wrightii = Verbena wrightii -- Desert verbena
Tetraclea coulteri -- Tetraclea
Verbena gooddingii -- Goodding verbena
Verbena neomexicana -- Small hillside vervain
Verbena plicata -- Fanleaf vervain
Verbena scabra -- Sandpaper verbena

VISCACEAE/LORANTHACEAE (Mistletoe Family)

Phoradendron californicum -- Desert mistletoe

VITACEAE (Grape Family)

Vitis arizonica -- Canyon grape

ZYGOPHYLLACEAE (Caltrop Family)

Kallstroemia grandiflora -- Arizona poppy
Kallstroemia hirsutissima -- Carpetweed, Caltrop
Kallstroemia parviflora -- Warty carpetweed
Larrea tridentata -- Creosote bush
Tribulus terrestris -- Goathead

APPENDIX F: CULTURAL RESOURCES POLICY

As provided by 614 FW 1-5 of the Service Manual and all applicable federal laws and regulations, the Service's preservation in place objective will be handled in the following manner:

1. Refuge Construction Projects: In the sections of the refuge which have been intensively inventoried, the refuge will contact the Regional Historic Preservation Officer (RHPO) to ensure that appropriate steps are taken to identify and evaluate affected cultural resource properties prior to any construction undertakings which will affect those resources. The refuge will contact the RHPO to ensure that suitable mitigation and/or scientific data recovery for affected properties is provided when simple avoidance is not possible.

   In those sections of the refuge which have not been inventoried, the refuge will contact the RHPO to arrange for field survey or for on-site monitoring during construction, prior to initiation of any construction undertakings. Furthermore, if previously undetected cultural remains are encountered during construction, the refuge manager will contact the RHPO before proceeding further.

2. Law Enforcement: The refuge manager will enforce the provisions of the 1979 Archaeological Resources Protection Act (ARPA) and the regulations pursuant to the act: 43 CFR Part 7 and 50 CFR Part 27. Unauthorized removal of cultural remains from the refuge is prohibited. If illegal digging activities occur, additional protective measures may be necessary.

3. Visitor Use: Other than damage done to sites intentionally by pothunters, visitor use of the refuge is unlikely to cause any impact on the archaeological sites on the refuge. Attention will not be drawn to particular site locations, and information on site locations will not be disclosed.

4. Special Use Permits - Research Referral: Applications to do research are made under 43 CFR Part 7. The refuge manager will refer all research requests to the RHPO. If the Archaeological Resources Protection Act (ARPA) permit is issued, the refuge manager will attach special conditions and requirements under a special use permit. Archaeological researchers are required to have both the ARPA and special use permits.

5. Special Use Permits - Non-Service Land Use: Land use permits to private industry, organizations, and non-Service agencies for construction or development activities on the refuge may require a cultural resource survey. These types of permits are processed by the Regional Office. The RHPO will work with the permittee to arrange for the required studies and conduct all follow-up Section 106 consultation. The procedure will be basically the same as for the refuge construction projects.

6. Reporting Cultural Resources: Any cultural resource sites or objects found by or reported to the refuge manager should be reported to the RHPO. Every effort should be made to determine the location, nature, and extent of the site.

7. Reporting Maintenance, Stabilization, or Protection Needs: The refuge manager will recommend measures that may be needed to stabilize, maintain, or protect sites which are being impacted by natural or human factors.

8. National Register Nominations: A number of the known sites on the refuge may be eligible for listing on the National Register of Historic Places. Sites which may occur in sections of the refuge which have not been inventoried may also be eligible. No determination has been made on any one site.

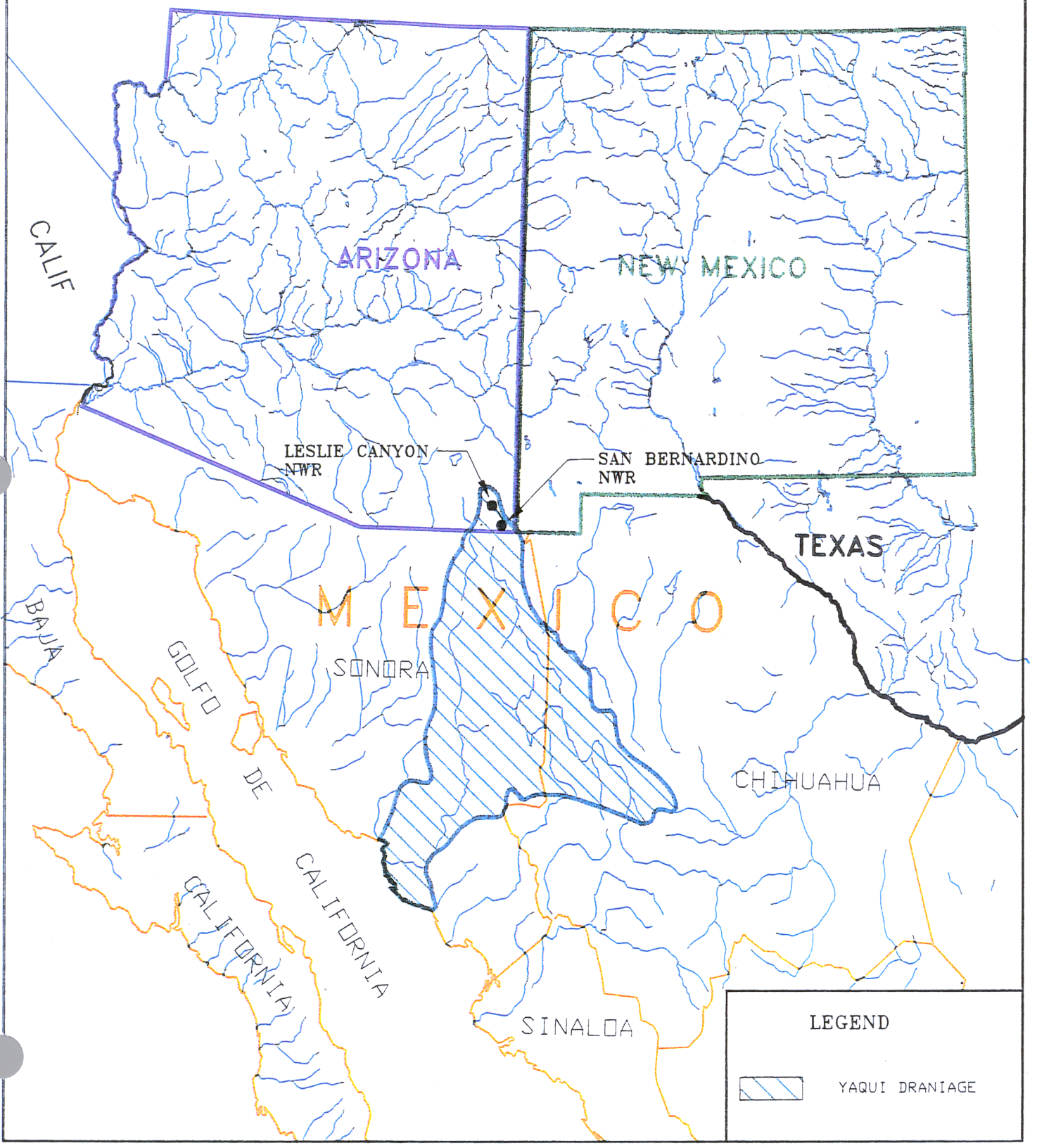
9. Archives and Collections: Archaeological and historical materials and archives shall be maintained according to professional standards of curation for scientific use and public interpretation. With few exceptions, refuge offices should not attempt long-term curation. Limited reference collections and small interpretive displays are permitted. The Regional Office is responsible for seeking agreements with public institutions to accept and curate archives and collections which are generated by Service activities and acquisitions. All collections remain the property of the U.S. Government.

   The archaeological collections and archival material made by the Arizona State Museum (ASM) for the refuge site survey are curated at the Museum (ASM) in Tucson.

PART V: MAPPING

MAP #1

YAQUI BASIN OVERVIEW



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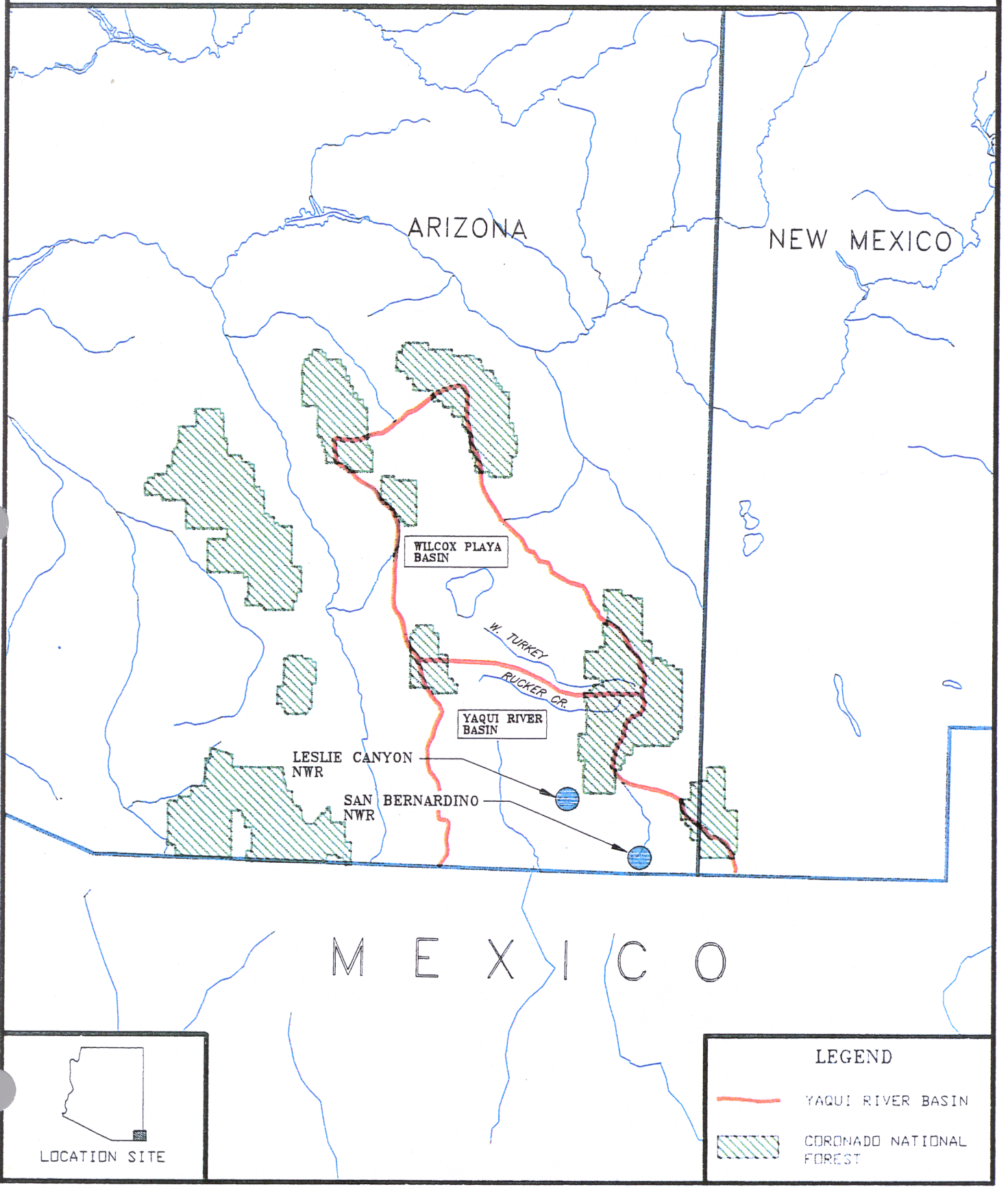
MAP #2

YAQUI BASIN OVERVIEW IN UNITED STATES



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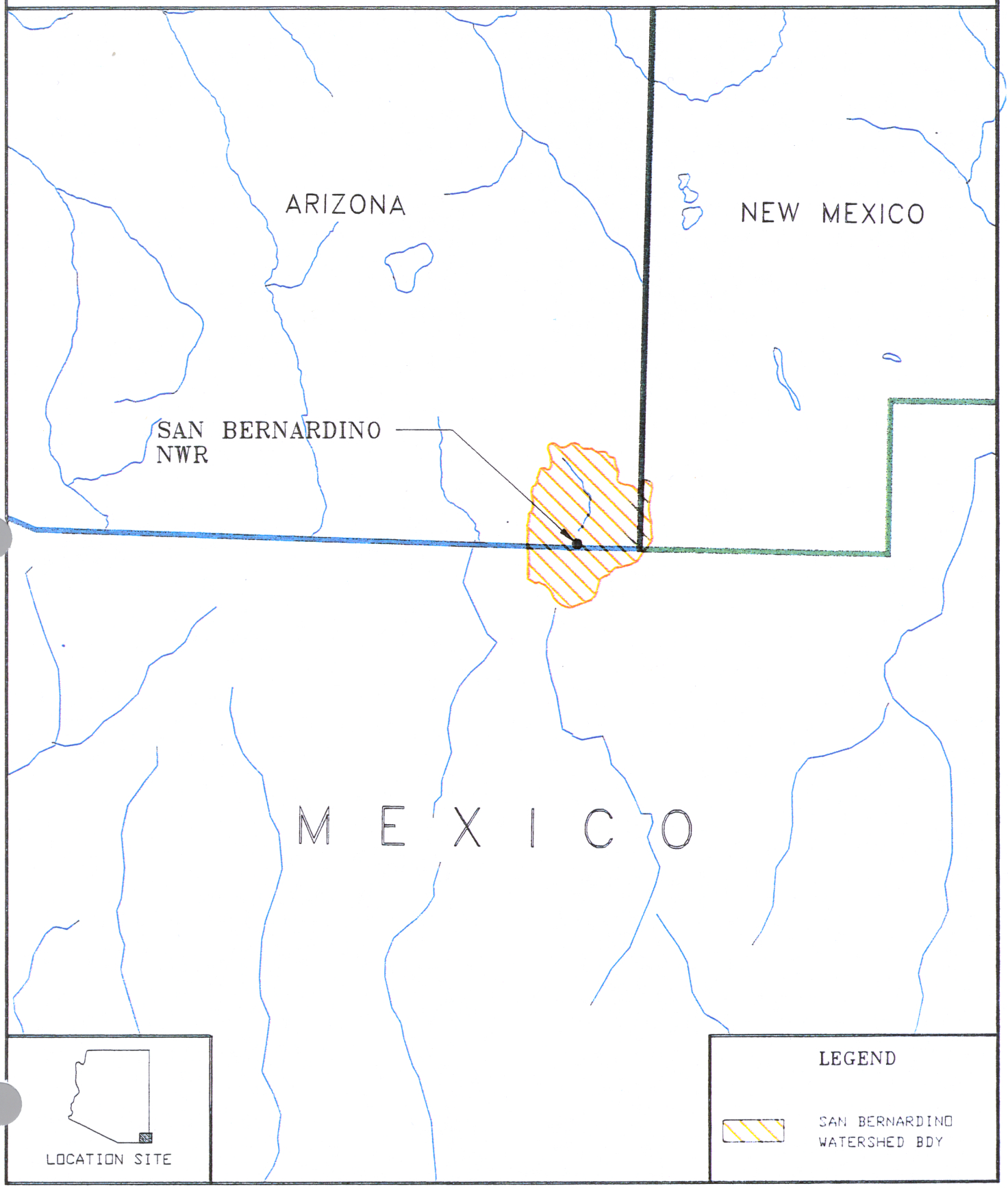
MAP #3

SAN BERNARDINO WATERSHED



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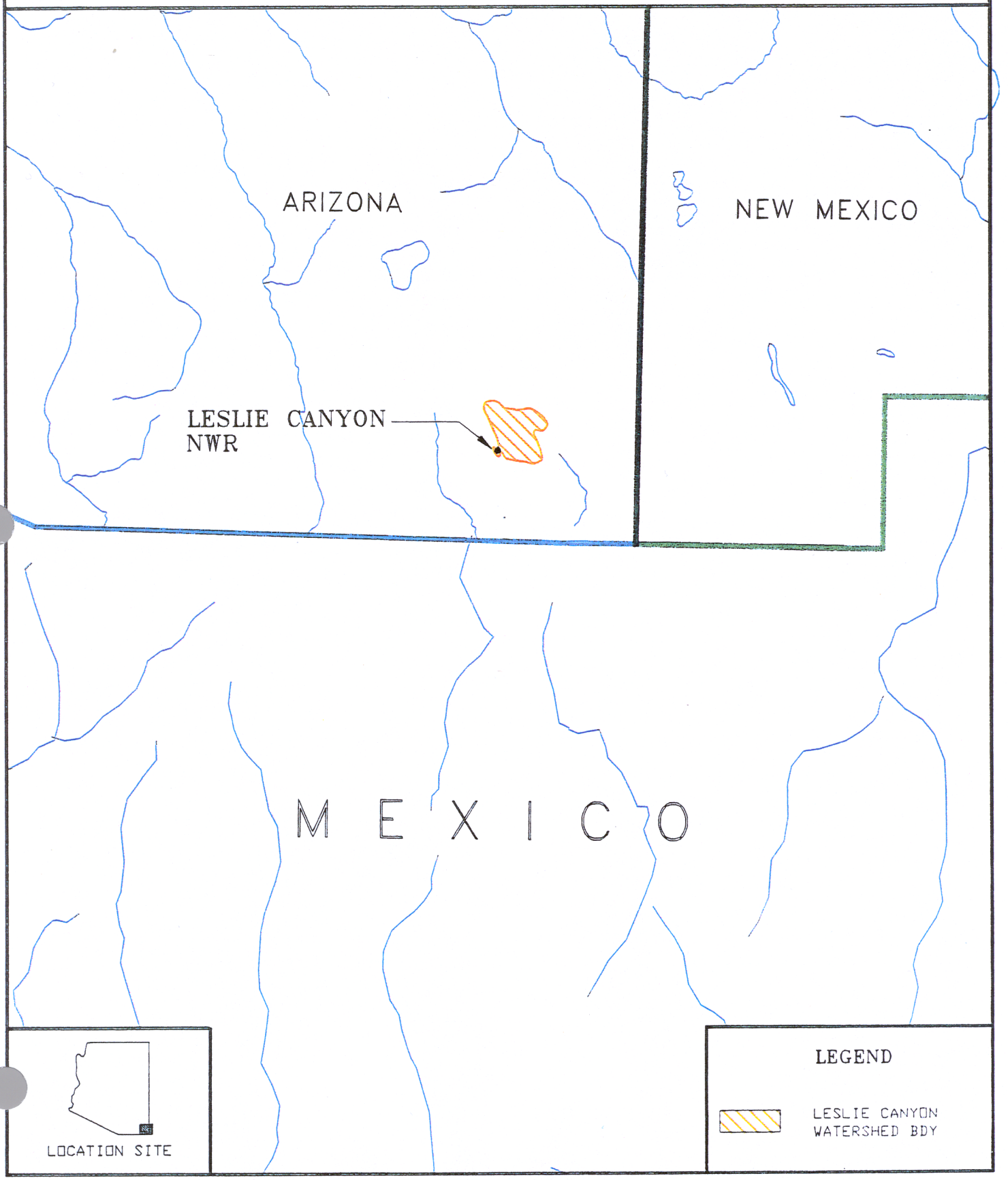
MAP #4

LESLIE CANYON WATERSHED



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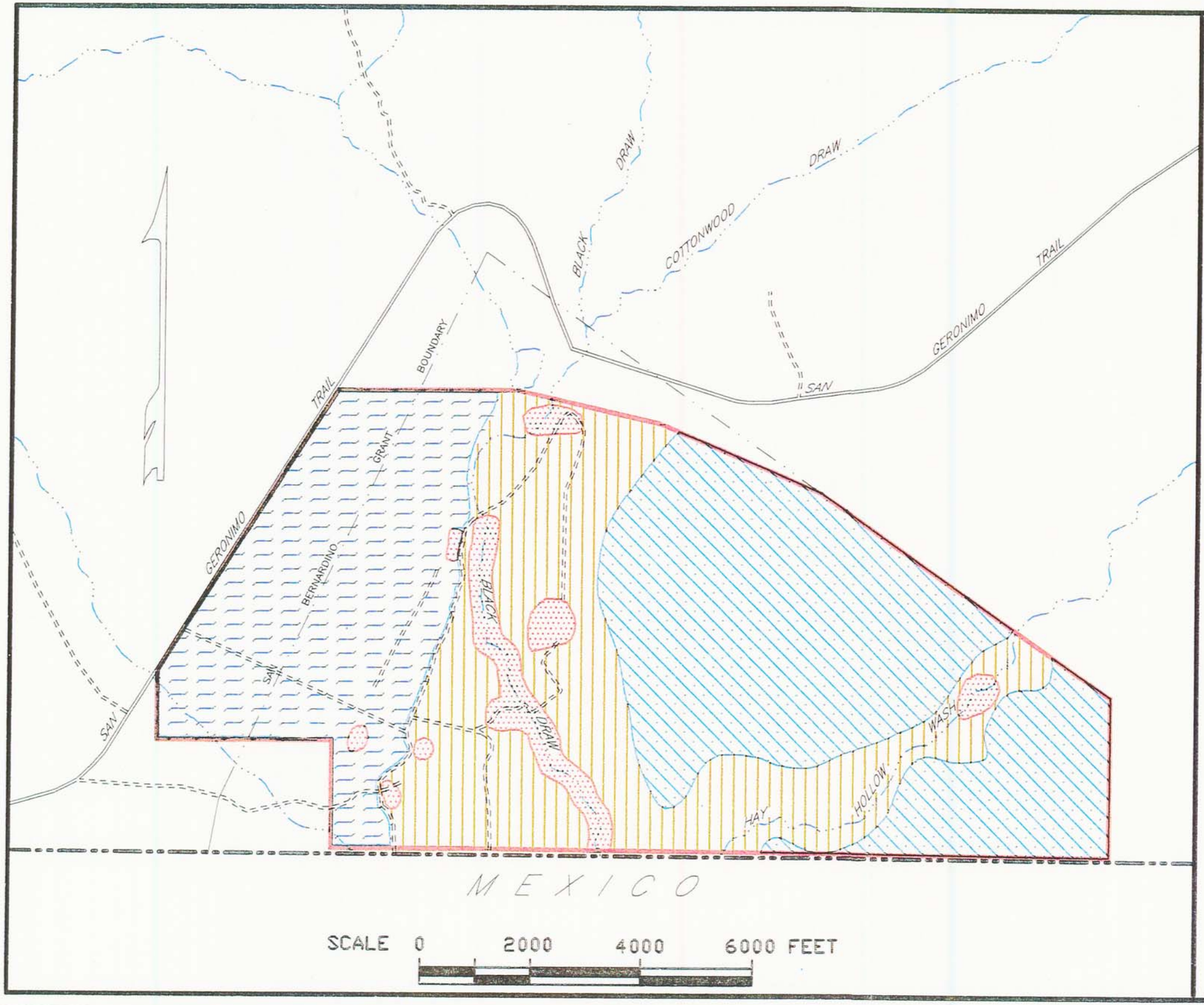
MAP #5

MANAGEMENT UNITS
SAN BERNARDINO NATIONAL WILDLIFE REFUGE



LEGEND

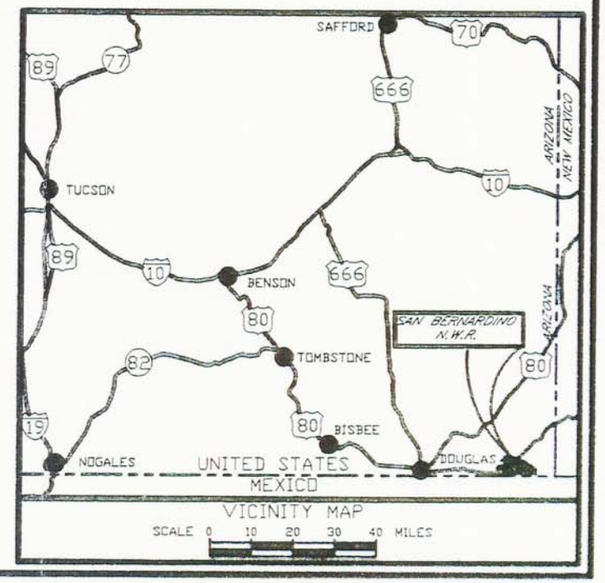
SUBUNIT I - WEST MESA
This area is predominantly tobosa grasslands mixed with acacia, black-brush and mesquite - covers old lava flows.

SUBUNIT II - FLOODPLAINS, BLACK DRAW, HAY HOLLOW WASH
Includes sacaton bottoms, mesquite bosques, riparian and aquatic areas. Most management activities are directed in this area.

SUBUNIT III - UPLANDS
Hills and ridges on east part of refuge covered predominantly with creosote, blackbrush, small mesquite, 4-wing saltbush and various grasses. Less management emphasis is anticipated in these areas. Some prescibed burning.

SPECIAL PROTECTION AREAS

REFUGE BOUNDARY



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LAND OWNERSHIP MAP
LESLIE CANYON NATIONAL WILDLIFE REFUGE

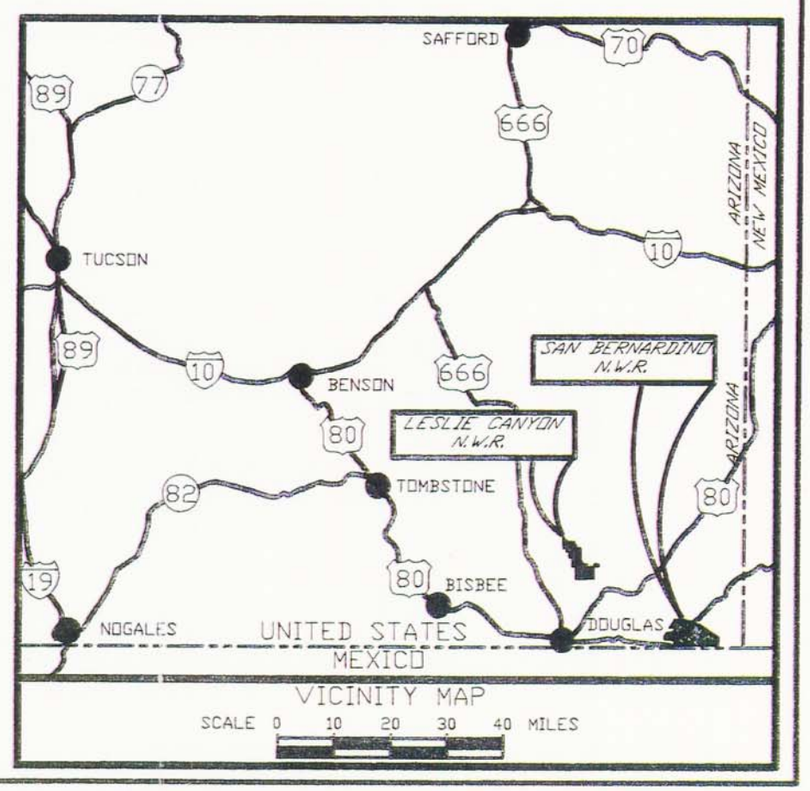
LEGEND

- LESLIE CANYON NATIONAL WILDLIFE REFUGE
- BLM
- STATE
- 99 BAR RANCH
- BAR BOOT RANCH
- CORONADO NATIONAL FOREST BOUNDARY
- 24,000 ACRE PROPOSED PROTECTION AREA
- ROADS

SCALE 0 7000 14000 21000 FEET

SCALE 0 1 2 3 4 5 KILOMETERS

LESLIE CANYON



VICINITY MAP

SCALE 0 10 20 30 40 MILES

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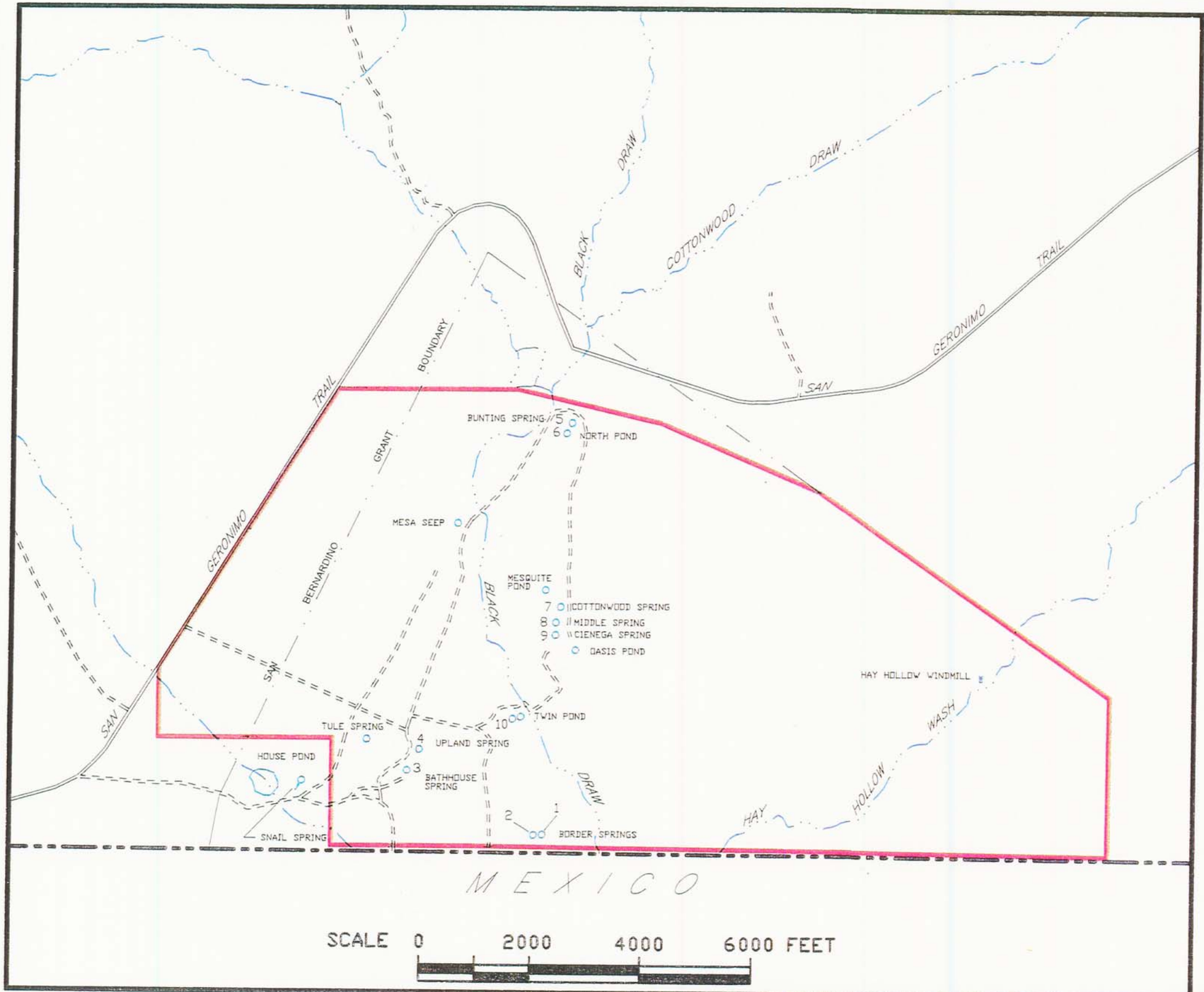
MAP #9

WELL SITES AND AQUATIC SYSTEMS
SAN BERNARDINO NATIONAL WILDLIFE REFUGE



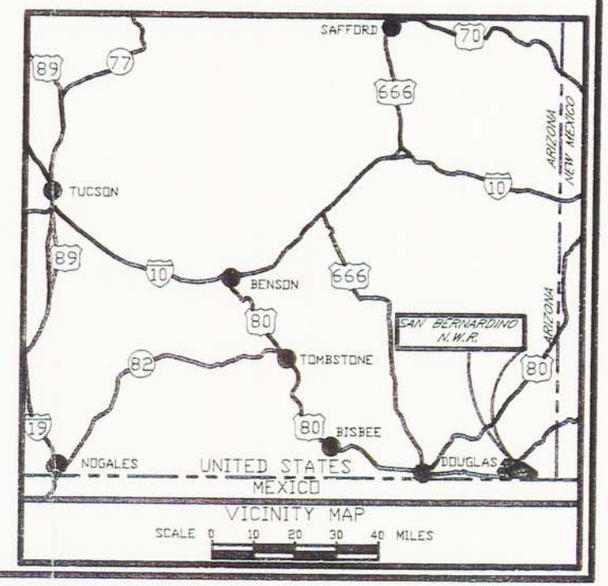
LEGEND

WELL NAMES

1 - EAST BORDER
2 - WEST BORDER
3 - BATH HOUSE
4 - UPLAND
5 - BUNTING
6 - NORTH POND
7 - COTTONWOOD
8 - MIDDLE
9 - CIENEGA
10 - TWIN POND

REFUGE BOUNDARY

Map of the refuge and locations of current wells. Black Draw is perennial along the solid lined stretch.



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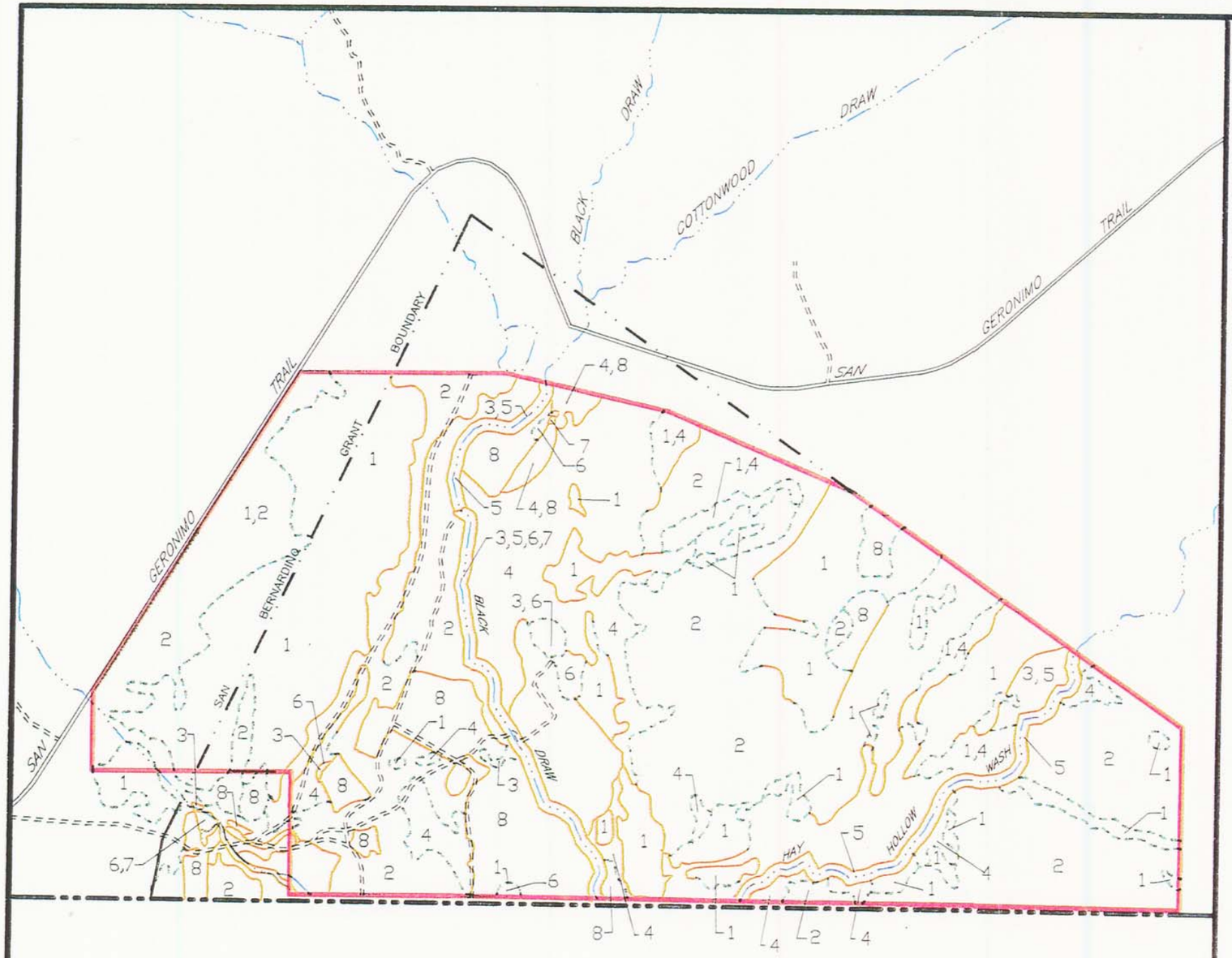
MAP #8

VEGETATIVE HABITATS OF SAN BERNARDINO NATIONAL WILDLIFE REFUGE



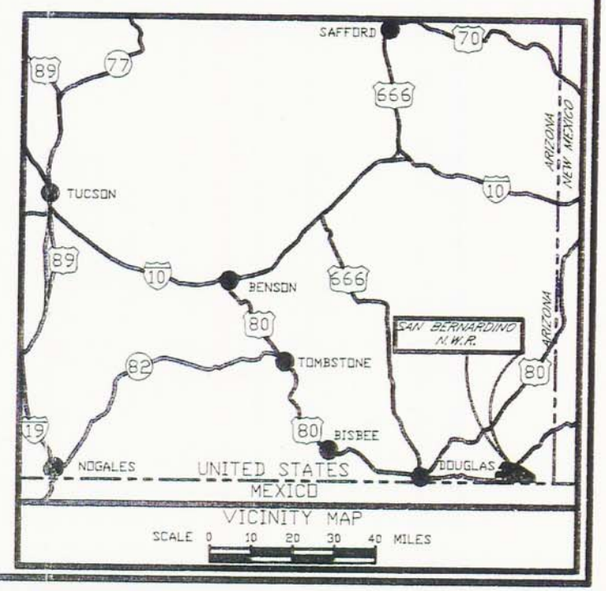
MAJOR VEGETATION TYPES

1) DESERT GRASSLAND = (25%)
2) CHIHUAHUAN DESERT SCRUB = (39%)
3) RIPARIAN FOREST / WOODLAND = (0.7%)
4) MESQUITE BOSQUE = (22%)
5) RIPARIAN SCRUB = (1%)
6) MARSHLAND = (0.6%)
7) AQUATIC = (0.1%)
8) FALLOW FIELD = (11%)

CLEAR CHANGE IN VEGETATION

DIFFUSED CHANGE IN VEGETATION

REFUGE BOUNDARY



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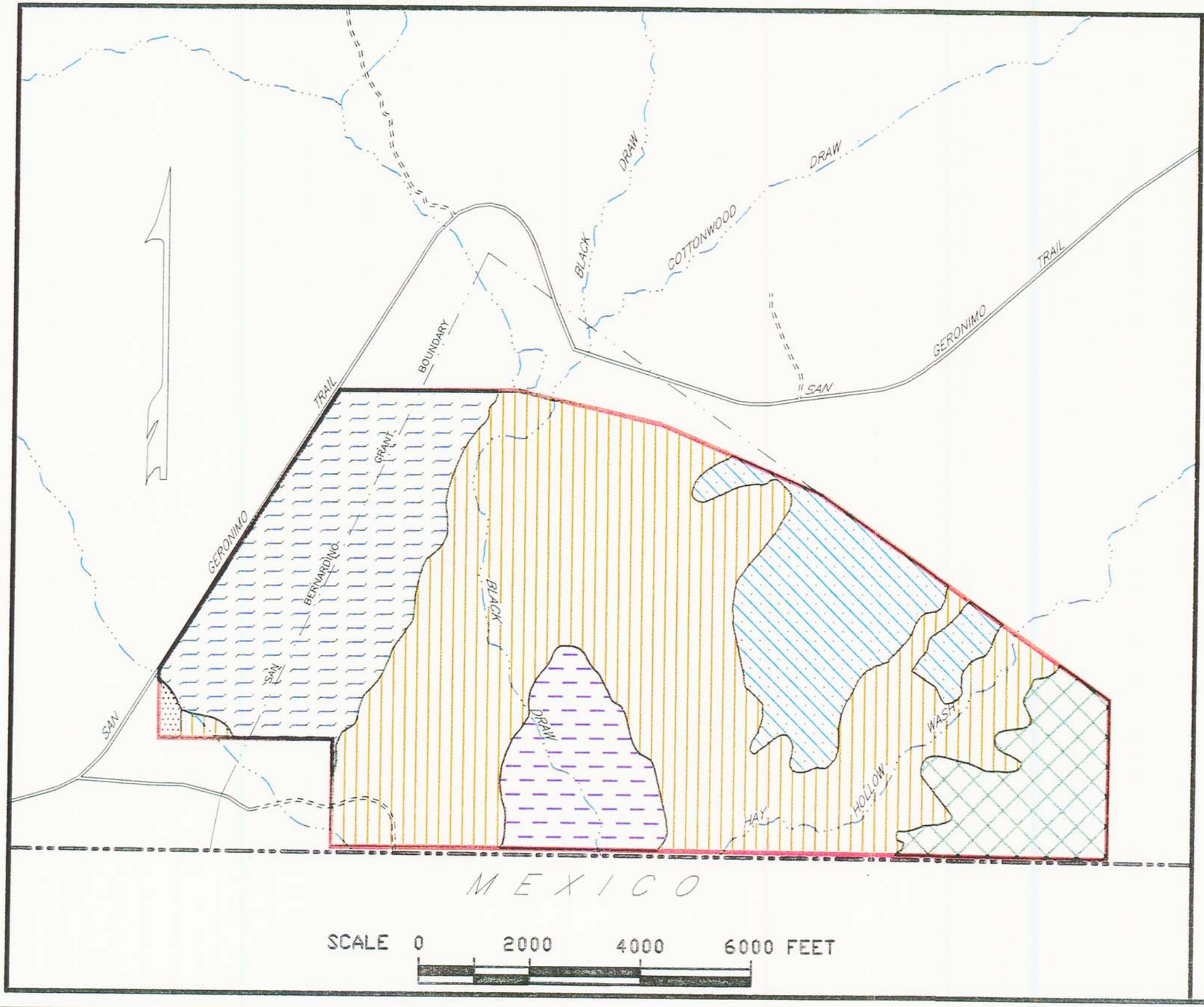
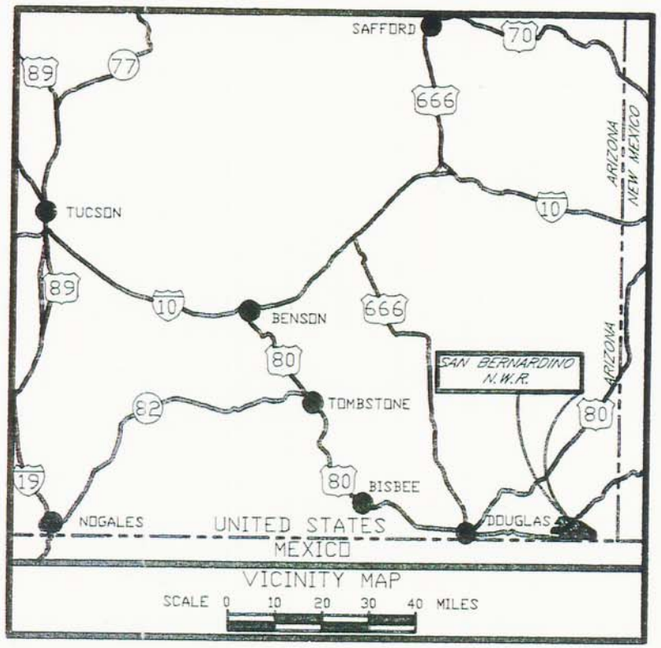
MAP #7

SOILS MAP
SAN BERNARDINO NATIONAL WILDLIFE REFUGE



LEGEND

- 310 - KARRO LOAM (299.63 AC.)
- 350 - RIGGS (1221.86 AC.)
- 370 - STRONGHOLD (181.21 AC.)
- 420 - BONITA CLAY (175.81 AC.)
- 850 - GADWELL (T)-CARALAMPI COMPLEX (7.70 AC.)
- 1050 - BONITA (483.27 AC.)
- REFUGE BOUNDARY



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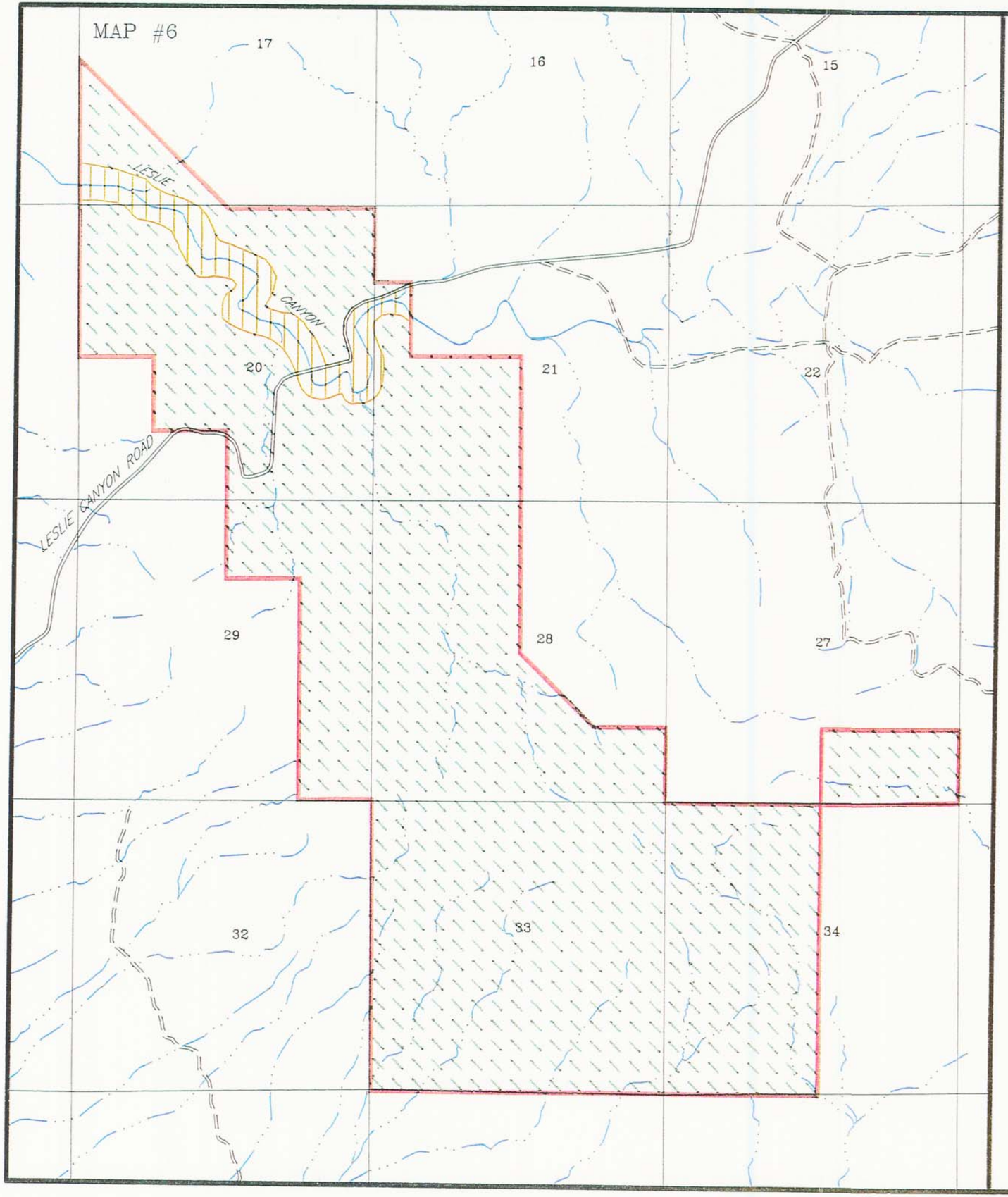
MAP #6



MANAGEMENT UNITS
LESLIE CANYON
NATIONAL WILDLIFE REFUGE

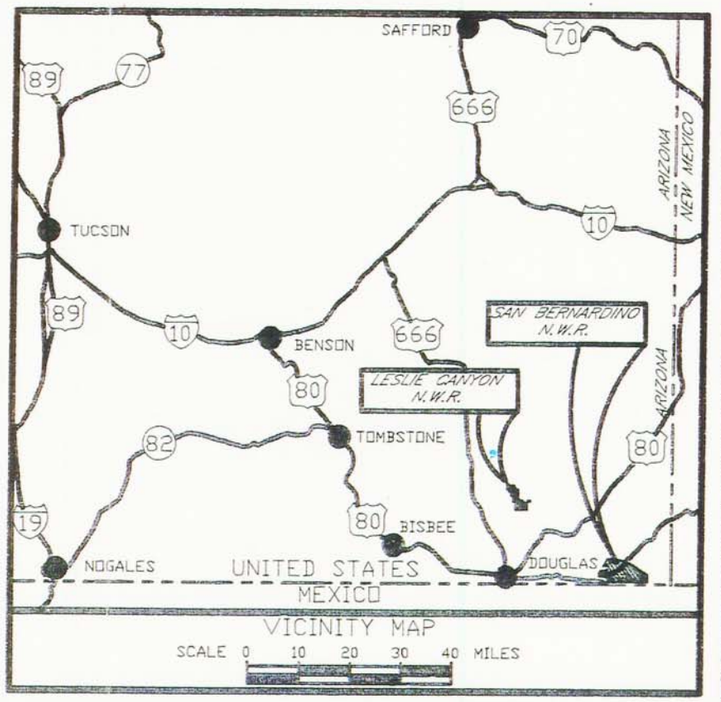
SUBUNIT I - ENDANGERED FISH MANAGEMENT AREA
Riparian habitat along Leslie Creek.
Most management occurs here.

SUBUNIT II - UPLANDS
Make up the majority of the refuge.
Less management emphasis other
than prescibed burning.

SPECIAL PROTECTION AREAS
All of Subunit I along Leslie Creek.

SCALE 0 2000 4000 6000 8000 FEET

SCALE 0 .5 1 2 KILOMETERS



DRAWN BY RAFAEL F. FERNANDEZ 1994

MAP #11

PERENNIAL PORTION OF LESLIE CREEK
LESLIE CANYON
NATIONAL WILDLIFE REFUGE

PERENNIAL STRETCH

IMPORTANT PROTECTION AREA -
Year round flows in Leslie Creek are dependent upon the sub-surface waters supplied by the basin. Development, ground water pumping, or overgrazing in this area could impact perennial flows.

REFUGE BOUNDARY

SCALE 0 2000 4000 6000 8000 FEET

SCALE 0 .5 1 2 KILOMETERS