

Cabeza Prieta National Wildlife Refuge

*Comprehensive Conservation Plan
Wilderness Stewardship Plan and
Environmental Impact Statement*

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Comprehensive Conservation Plans provide long-term guidance for management decisions; set forth goals, objectives, and strategies needed to accomplish refuge purposes; and identify the Fish and Wildlife Service's best estimate of future needs. These plans detail planning program levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

READER'S GUIDE

The U.S. Fish and Wildlife Service (FWS or Service) will manage the Cabeza Prieta National Wildlife Refuge (NWR) in accordance with an approved Comprehensive Conservation Plan (CCP). The CCP provides long-range guidance on Refuge management through its vision, goals, objective and strategies. The CCP also provides a basis for a long-term adaptive management process including implementation, monitoring progress, evaluating and adjusting, and revising plans accordingly. Additional step-down planning will be required prior to implementation of certain programs and projects.

This document combines a Comprehensive Conservation Plan, Wilderness Stewardship Plan and Environmental Impact Statement (CCP/WSP/EIS). This revised Final CCP/WSP/EIS incorporates changes based on public and agency comments received during public review of the Draft CCP/WSP/EIS, released in March 2005. Following publication of the Final CCP/WSP/EIS, the Service will publish a Record of Decision (ROD) confirming that the preferred management alternative identified in the plan is suitable for implementation. At this point, Cabeza Prieta NWR will initiate implementation of the management plan detailed in Appendix M of the CCP/WSP/EIS. The following chapter and appendix descriptions are provided to assist readers in locating and understanding the various components of this combined document.

Chapter 1, *Introduction, Purpose and Need for Action*, includes general information about the National Wildlife Refuge System and Cabeza Prieta NWR, such as planning policy, regional context, history of refuge establishment, past management trends, designation of Federal Wilderness, and Cabeza Prieta NWR Vision Statement. This chapter also describes planning issues identified through public and agency scoping.

Chapter 2, *Management Alternatives*, describes each of the five management alternatives analyzed in the EIS. Alternative 1 is the “No Action” alternative, or current management practices at the refuge. Alternative 2 is a minimum intervention alternative, featuring very limited active management. Alternative 3 is the restrained intervention alternative, and focuses on a modest amount of active management. Alternative 4, the preferred alternative, features more active intervention than Alternatives 2 and 3. Alternative 5, maximum effort, features intensive management aimed at maximizing numbers of desert bighorn sheep and maximizing public use of the refuge.

Chapter 3, *The Affected Environment*, provides a baseline description of refuge resources. Resources include the physical environment, water resources, habitat and wildlife resources, refuge facilities, special management areas, cultural resources and the regional economy. This information provides the baseline against which each alternative's impacts are measured in Chapter 4.

Chapter 4, *Environmental Consequences*, provides an analysis of the impacts to each resource described in Chapter 3 that would result from implementing each alternative. Chapter 4 also describes cumulative impact and environmental justice considerations. This is probably the most important section of the EIS,

Appendix A: *Legal, Policy and Administrative Guidelines and Other Special Considerations*, provides additional background regarding the Federal laws, regulations and policies that govern administration of the National Wildlife Refuge System.

Appendix B: *Interagency Agreements* contains a current copy of the *Memorandum of Understanding among the United States Department of Homeland Security and United States Department of the Interior and United States Department of Agriculture Regarding Cooperative National Security and Counterterrorism Efforts on Federal Lands along the United States' Borders*, as signed in March 2006.

Appendix C: *Comments Received on Draft CCP/WSP/EIS*, contains verbatim transcripts of public hearing testimony and copies of written public comments received during the public and agency review period of the Draft CCP/WSP/EIS.

Appendix D, *Response to Public Comments*, contains summaries of substantive public and agency comments received, grouped by topic, along with the Service response to the comments.

Appendix E, *Plant Species Present at Cabeza Prieta National Wildlife Refuge*, is a list of all the plant species known to occur on the refuge. Invasive and exotic species are indicated in the text.

Appendix F, *Minimum Requirements Analyses for Refuge Management Actions in Cabeza Prieta National Wildlife Refuge Designated Wilderness*, generic MRAs for each class of management action proposed in Alternative 4 are included in this appendix. These analyses demonstrate the general compliance of the activity class with wilderness. Site and project-specific Minimum Requirements Analyses will still be completed for individual management actions.

Appendix G, *Compatibility Determinations for Public Uses at Cabeza Prieta National Wildlife Refuge*, contains completed determinations of the compatibility of each public use proposed in Alternative 4 with the refuge purposes.

Appendix H, *Bird Species Present at Cabeza Prieta National Wildlife Refuge*, is a list of all the bird species known to occur on the refuge. The frequency and season of occurrence of each species is also indicated.

Appendix I, *Mammal Species Present at Cabeza Prieta National Wildlife Refuge*, is a list of all the mammal species known to occur on the refuge.

Appendix J, *Amphibian and Reptile Species Present at Cabeza Prieta National Wildlife Refuge*, includes lists of all the amphibian and reptile species known to occur on the refuge.

Appendix K, *Social Impact Analysis Report*, is the full text of a report completed by the U.S. Geological Service analyzing the social impacts of the various refuge management alternatives. This report informs the social impact discussions of found in Chapter 4.

Appendix L, *Regional Economic Effects of Current and Proposed Management*, is the full text of a report completed by the U.S. Geological Service analyzing the economic impacts of the various refuge management alternatives. This report informs the economic impact discussions of found in Chapter 4.

Appendix M, *Comprehensive Conservation Plan Management Goals, Objectives and Strategies*, this appendix is the functional CCP. It presents the management regime of Alternative 4, the preferred alternative, in detail.

Appendix N, *Intra-Service Biological Opinion for the Cabeza Prieta National Wildlife Refuge Comprehensive Conservation Plan, Arizona*, is a review of the potential effects of implementing the CCP upon threatened and endangered species, as required under Section 7 of the Endangered Species Act.

Appendix O, *References Cited*, is the bibliography of the CCP/WSP/EIS.

Appendix P, *List of Preparers*, includes all the individuals or groups who assisted in preparation of the CCP/WSP/EIS.

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LIST OF ACRONYMS AND ABBREVIATIONS USED

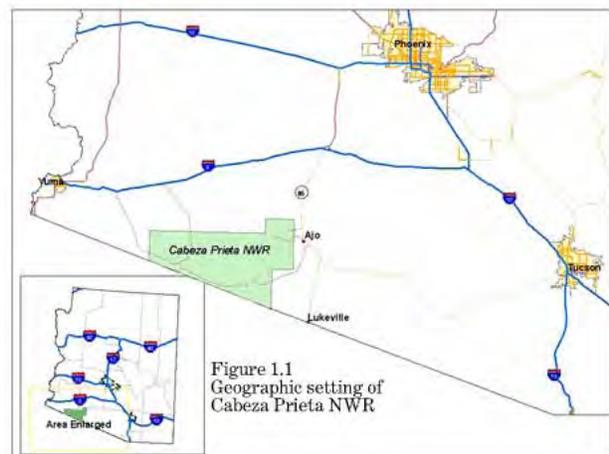
ABC	Arizona Border Control Initiative
ADA	Americans with Disabilities Act
AFS	Air Force Station
AGFD	Arizona Game and Fish Department
AGL	above ground level
AIDTT	Arizona Interagency Desert Tortoise Team
ARPA	Archeological Resource Protection Act of 1979
BANN	Border Anti-Narcotics Network
BEC	Barry M. Goldwater Executive Committee
BLM	United States Bureau of Land Management
BMGR	Barry M. Goldwater Range
BMP	Best Management Practices
CBP	United States Customs and Border Protection
CBP-BP	United States Customs and Border Protection, Border Patrol
CCP	Comprehensive Conservation Plan
CEQ	Council for Environmental Quality
dB	decibel
DEA	United States Drug Enforcement Agency
DEIS	Draft Environmental Impact Statement
DoD	United States Department of Defense
EA	Environmental Assessment
EHD	Epizootic Hemorrhagic Disease
EIS	Environmental Impact Statement
EOD	Explosive Ordnance Disposal
FAA	Federal Aviation Administration
FONSI	Finding of No Significant Impact
FWS	United States Fish and Wildlife Service
GIS	Geographic Information System
GSV	Gila, Salt, Verde Rivers Ecosystem Region
IEC	Inter-agency Executive Committee
LNT	leave-no-trace wilderness camping and travel
LSL	Length of Stay Limit
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MRA	Minimum Requirements Analysis
MSL	mean sea level
NEPA	National Environmental Policy Act of 1969
NCTC	National Conservation Training Center
NGO	non-governmental organization
NOI	Notice of Intent
NPS	National Park Service
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System
OMB	Office of Management and Budget
OPCNM	Organ Pipe Cactus National Monument
PVA	Population Viability Analysis
Service	United States Fish and Wildlife Service
SUP	Special Use Permit
UDA	Undocumented Alien
USAF	United States Air Force

USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USMC	United States Marine Corps
WSP	Wilderness Stewardship Plan
WTI	Weapons & Tactics Instructor

1.0 INTRODUCTION, PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

This document integrates a Comprehensive Conservation Plan (CCP), Wilderness Stewardship Plan (WSP) and Environmental Impact Statement (EIS) for Cabeza Prieta National Wildlife Refuge (NWR). See figure 1.1 for a map showing the location of the refuge in southwestern Arizona. The U.S. Fish and Wildlife Service (Service) is required to prepare Comprehensive Conservation Plans by the National Wildlife Refuge System Improvement Act (P.L. 105-57) passed in 1997. An Environmental Assessment (EA) or EIS is required for any major federal action by the National Environmental Policy Act of 1969 (NEPA). The CCP describes the desired future condition of the refuge and provides long-range guidance and management direction for the refuge. The EIS describes a range of alternatives, including the preferred alternative, for managing the refuge and the expected environmental consequences of each alternative.



1.1.1 Goals of Refuge Planning

The goals of refuge comprehensive conservation planning as defined by policy at 602 FW1 (1.5) follow:

- A.** To ensure that wildlife comes first in the National Wildlife Refuge System.
- B.** To ensure that the Service manages the Refuge System for the conservation of fish, wildlife, plants, and their habitats and that refuge management achieves Service policies, the Refuge System mission, and the purposes for which the refuge was established.
- C.** To ensure that the administration of the Refuge System contributes to the conservation of the ecological integrity of each refuge, the Refuge System, and to the structure and function of the ecosystems of the United States.
- D.** To ensure opportunities to participate in the refuge planning process are available to other Service programs; Federal, State, and local agencies; tribal governments; conservation organizations; adjacent landowners; and the public.
- E.** To provide a basis for adaptive management by monitoring progress, evaluating plan implementation, and updating refuge plans accordingly.
- F.** To promote efficiency, effectiveness, continuity, and national consistency in refuge management.
- G.** To help ensure consistent System wide consideration of the six priority public uses -- hunting, fishing, wildlife observation and photography, and environmental education and interpretation-- established by the Refuge Administration Act and to ensure that these uses receive enhanced consideration over general public uses in the Refuge System.
- H.** To ensure that the Service preserves the wilderness character of refuge lands (2000).

1.2 PURPOSE AND NEED FOR PLAN ACTIONS

The refuge plays a critical role in the recovery and protection of rare and sensitive species such as the desert bighorn sheep and the federally endangered Sonoran pronghorn, as well as the conservation of a diversity of desert wildlife within the Sonoran Desert. Cabeza Prieta NWR, which contains the largest refuge wilderness outside of Alaska, presents issues related to appropriate levels of intervention for wildlife management in designated wilderness that have national significance for the Service. A CCP establishes refuge Goals, Objectives and Management Strategies. These planned actions are all designed to assist the refuge in achieving its formal purposes and the Mission of the National Wildlife Refuge System. This document proposes the implementation of a wide array of actions that lead to achievement of such purposes and mission.

Cabeza Prieta NWR was:

... reserved and set apart for the conservation and development of natural wildlife resources, and for the protection and improvement of public grazing lands and natural forage resources... Provided, however, that all the forage resources in excess of that required to maintain a balanced wildlife population within this range or preserve should be available for livestock... (Executive Order 8038 January 25, 1939)

Title III of the Arizona Desert Wilderness Act of 1990¹ supplemented the refuge purposes with an additional refuge purpose; the protection of the wilderness resource on 325,270 hectares (803,418 acres) in accordance with the Wilderness Act of 1964.

A CCP also sets guidelines for management of refuge resources, describes the desired outcomes for the next 15 years, and encourages refuge management in concert with an overall ecosystem approach. The CCP development process provides a forum for public participation relative to the type, extent, and compatibility of uses on refuges. As a majority of the refuge is designated wilderness, this plan addresses administrative needs for wilderness and serves as the refuge's Wilderness Stewardship Plan.

¹This purpose has been added as "supplemental to", or in addition to, the original purposes when the Arizona Desert Wilderness Act of 1990 was passed and signed into law.

1.3 NATIONAL WILDLIFE REFUGE SYSTEM MISSION, GOALS AND GUIDING PRINCIPLES

The National Wildlife Refuge System is the only Federally-administered system of lands managed primarily for the conservation of fish, wildlife, and plant resources. The Refuge System mission is a derivative of the Service mission. The Refuge System mission was clarified and formalized in October 1997, by passage of the National Wildlife Refuge System Improvement Act (P.L. 105-57).

The Act amends the National Wildlife Refuge System Administration Act of 1966 in a manner that provides an “Organic Act” in that it designates the fundamental guiding principles of the National Wildlife Refuge System. It ensures that the Refuge System is effectively managed as a national system of lands, waters, and interests for the protection and conservation of our nation’s wildlife resources. The Act states first and foremost that the mission of the Refuge System be focused on wildlife conservation, defining the Mission of the Refuge System as follows:

“To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.”

The Act gives guidance to the Secretary of the Interior in the overall management of the Refuge System. Besides a strong conservation mandate for the Refuge System, the Act’s other main components include:

- a requirement that the Secretary of the Interior maintain the biological integrity, diversity and environmental health (ecological integrity) of the Refuge System,
- the establishment of six priority recreational uses that should be considered for integration into refuge programs if determined compatible with refuge purposes and Refuge System mission,
- a new process for determining compatible uses of refuges that integrates public review, and
- a requirement for preparing comprehensive conservation plans.

The Goals of the Refuge System are defined in the Fish and Wildlife Service Manual (601 FW).

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

To perpetuate the migratory bird resource.

To preserve a natural diversity and abundance of fauna and flora on refuge lands.

To provide an understanding and appreciation of fish and wildlife ecology and the human role in the 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.

1.4 ECOSYSTEM APPROACH TO CONSERVATION AND THE GILA/SALT/VERDE ECOSYSTEM

The Service has adopted an ecosystem approach to fish and wildlife conservation to recognize the interdependence of all elements of the system, increase cooperation among Service programs, and increase partnerships to achieve conservation goals.

The Service identified and mapped 53 ecosystem units throughout the United States by grouping watersheds. Ecosystem Teams were established and directed to develop plans for each unit that describe ecological resources, issues relevant to the resources, and conservation strategies. The Gila/Salt/Verde Ecosystem (GSV) is one of the nine ecosystem units within the Southwest Region. It is named for three major watersheds located in southern Arizona and western New Mexico. Cabeza Prieta NWR is located within the GSV Ecosystem. See figure 1.2 for a map depicting the extent of the GSV and the refuge's location therein. Other units of the National Wildlife Refuge System within the GSV include: Kofa, San Bernardino, Leslie Canyon and Buenos Aires.



Figure 1.2 Gila/Salt /Verde Ecosystem and the Refuge

The diversity of the GSV Ecosystem required developing objectives and strategies for three different systems (Mountain, Grassland, and Desert). Objectives for the desert ecosystem are described under Objective 3. Cabeza Prieta NWR is charged with accomplishing certain action items under the second strategy of that objective through partnerships with other agencies, organizations, and individuals in the area. To the greatest degree feasible, these action items are incorporated into the refuge management alternatives described below in Chapter 2. Strategy 2 of Objective 3 of the GSV Ecosystem plan follows.

Objective 3: Protect, maintain, and restore Sonoran Desert ecosystems

Strategy 2: Protect, maintain, and restore ecosystem function for terrestrial habitats including Federally listed, candidate, and state listed species.

Action Item 1: Gather information on habitat use (and role of free water) and disturbances to Sonoran pronghorn through telemetry, behavioral, and habitat studies.

Action Item 2: Complete range wide Sonoran pronghorn surveys over six-year period to establish a trend for recovery purposes.

Action Item 3: Upgrade Geographic Information System (GIS) hardware and complete GIS data bank for pronghorn range.

Action Item 4: Initiate and design a comprehensive strategic regional plan for the area represented by the International Sonoran Desert Alliance (ISDA) which pulls together individual management plans.

Action Item 5: Clean up the abandoned military station on Childs Mountain.

Action Item 6: Consolidate communications sites on Childs Mountain to reduce the disturbed area.

Action Item 7: Determine presence and genetics of obligate rock dwelling reptiles to investigate effects of isolated desert mountain ranges.

Action Item 8: Initiate pilot study to determine genetics of isolated bands of bighorn sheep to determine degree of isolation for disease and transplant implications.

Action Item 9: Establish an interagency interpretive site in Ajo to cover area of ISDA concern.

Action Item 10: Locate and establish wildlife corridors that will link the protected areas of Organ Pipe Cactus National Monument (OPCNM) and Cabeza Prieta NWR with the core area of the Pinacate Biosphere Reserve. Reduce and mitigate wildlife barriers. Identify major invading exotic plant species.

Action Item 11: Support desert pupfish maintenance and habitat restoration on National Park Service lands and investigate feasibility of secondary populations on adjacent refuge lands (USFWS 1994).

1.5 HISTORY OF REFUGE ESTABLISHMENT, ACQUISITION AND MANAGEMENT

1.5.1 The Game Range

The Cabeza Prieta NWR was originally established as a “Game Range” by Executive Order 8038 signed by President Franklin D. Roosevelt on January 25, 1939. This Range was established primarily to assist in the recovery of the desert bighorn sheep, and partially in response to public demand generated by the Boy Scouts of America, Arizona Game Protective Association, and the Audubon Society. Throughout the earlier part of the 20th Century desert bighorn sheep populations continued to dwindle, despite legal protection. In the early and mid 1930s, staff of the U.S. Biological Survey; National Park Service (NPS); State of Arizona; and Mexican Government Department Forests, Fish and Game conducted surveys of Southwestern Arizona. These surveys recommended establishment of a game range or preserve to protect the natural resources of the Cabeza Prieta area (and other areas in southwestern Arizona) for protection of the desert bighorn sheep (Taylor 1935, McDougall 1935, and Pinkley 1935). See figure 1.3 for a map of the refuge.

Given the trend of decreasing desert bighorn sheep populations and public interest in conserving the species, active management to foster increased sheep numbers was seen as necessary. A strategy involving water structure development and active management of the rocky, arid sierras and intermittent drainage areas was implemented for species recovery throughout their historic range in Arizona. Kennedy, researching the status of desert bighorn sheep on the Kofa and Cabeza Prieta National Game Ranges, determined that developed waters and natural water sources contributed to desert bighorn sheep population growth on the Cabeza Prieta National Game Range during the 1950s (1958).

Between its establishment in 1939 and 1975, the Game Range was jointly administered by the Bureau of Sport Fisheries and Wildlife (now the U.S. Fish and Wildlife Service) and the Bureau of Land Management (BLM).

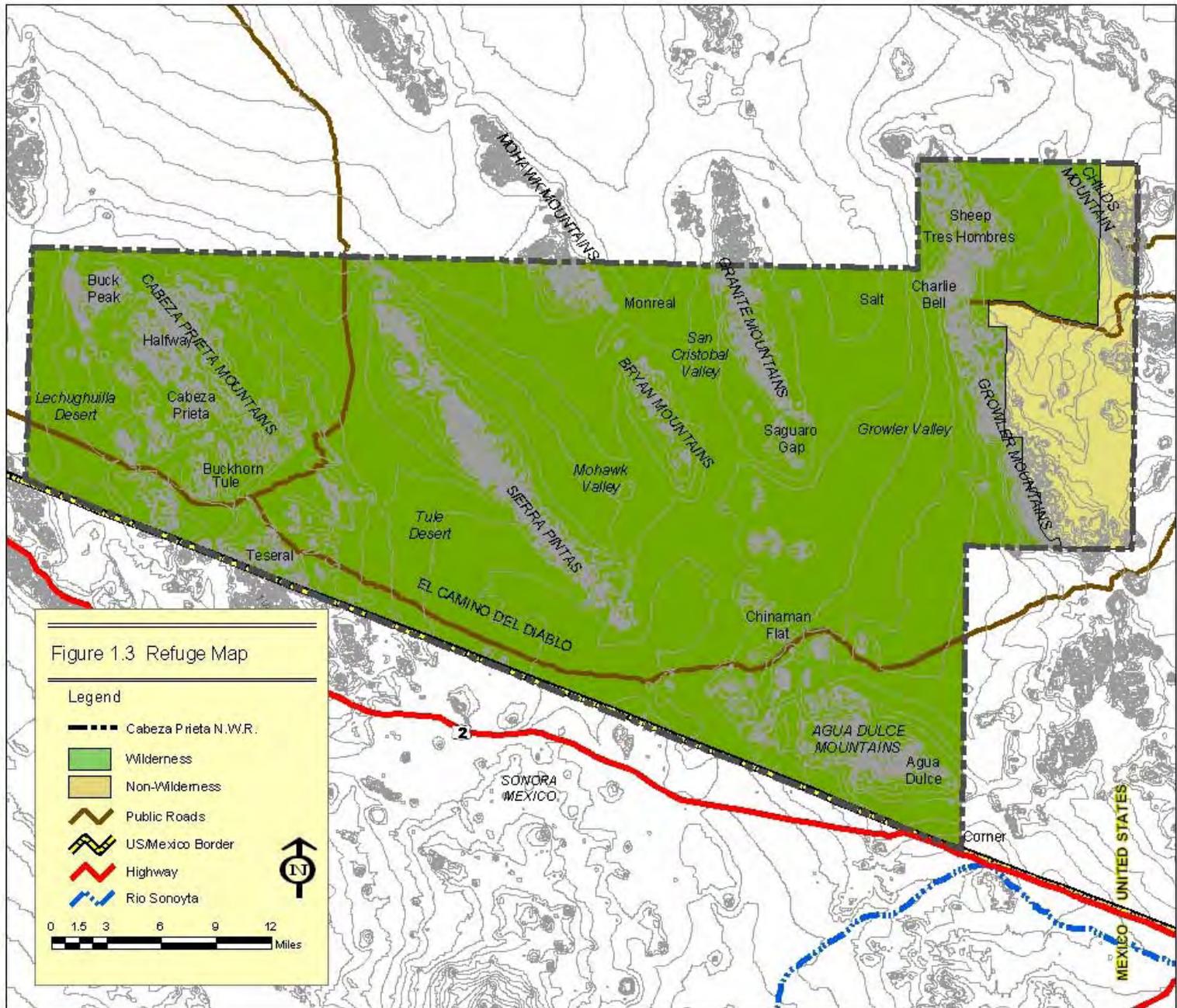
1.5.2 Military Lands Withdrawal

A series of four executive orders signed by President Franklin Roosevelt and two public land orders signed by the Secretary of Agriculture between September 5, 1941 and March 16, 1943 withdrew a block of land totaling 1,124,546 hectares (2,777,628 acres) for military flight training needs occasioned by World War II. Most of the airspace above Cabeza Prieta Game Range was included and active bombing started. During this time grazing, mining, and most refuge activities were curtailed for safety reasons. Most management studies had to be done by air or in the extreme eastern portion, which was not withdrawn. The bombing and aerial gunnery range was deactivated in 1946, but was reactivated in 1951 to serve training needs occasioned by the Korean Conflict. The military range has been maintained in use for military training since that time through a series of administrative and legislative actions.



Air Force F-16 flying over the refuge

USAF Photo



The Military Lands Withdrawal Act of 1999 (P.L. 106-65), the most recent action renewing the military lands withdrawal, did not include lands of Cabeza Prieta NWR within the BMGR. Airspace over the refuge, however, remains included within the BMGR, as does ground instrumentation used to monitor military aircraft. The Military Lands Withdrawal Act of 1999 also provides that upgrades to ground instrumentation on the refuge are allowed, so long as they “create similar or less impact than the existing ground instrumentation permitted by the Arizona Desert Wilderness Act of 1990.” A memorandum of Understanding (MOU) between the Department of the Air Force, the Department of the Navy (for the Marine Corps) and the Department of the Interior (for the Service) stipulates mutually agreed upon limitations of use. The MOU was signed in 1994, and was specifically authorized in the Act to facilitate governance of military use of the ground and airspace over the refuge wilderness.

1.5.3 National Wildlife Refuge Administration Act

The passage of the National Wildlife Refuge System Administration Act of 1966 opened many refuges to public recreation. Shortly after that, Cabeza Prieta NWR was opened to desert bighorn sheep hunting. Harvest levels are reestablished every three years based on aerial population surveys. Permit numbers have fluctuated from one in 1980 to seven in recent years.

1.5.4 From Game Range to National Wildlife Refuge

Public Land Order 5493 of March 21, 1975, amended the original Executive Order (8039), gave sole jurisdiction to the Service, and changed the name of the Game Range to Cabeza Prieta NWR. The refuge took over management of the grazing allotments on the refuge at this time. Although by this time refuge staff had become concerned about the effects of grazing on desert bighorn sheep habitat, the existing leases were not immediately terminated.

Subsequent to the land order, the Game Range Bill amendments to the National Wildlife Refuge Administration Act (P.L. 94-223, 90 Stat. 199 or “The Act of Feb. 27, 1976”) affirmed the Secretary of the Interior’s (i.e., the Service’s) responsibility to protect the integrity of the former Cabeza Prieta Game Range as a part of the National Wildlife Refuge System and the integrity of the original purposes for which the refuge was established. Under this law, all grazing leases issued by the BLM under their administration of the land were honored by the Service. Upon the expiration of each such lease the Service reviewed the lease and determined whether or not to renew it. The Act also prohibits the divestiture of lands within the National Wildlife Refuge System by the Secretary of the Interior without the express permission of Congress.

1.5.5 Grazing History

There were as many as six grazing allotments operating at one time on the Range. Grazing began as early as 1919 and came under the jurisdiction of the BLM when the Range was established in 1939. The enabling legislation specified that all forage resources in excess of that required to maintain a balanced wildlife population within the range would be available to livestock.

Most grazing occurred on the eastern portion of the Range where shallow wells could be dug. During the period of federal jurisdiction a total of seven ranchers held permits to graze livestock on the land that

became the refuge. The earliest permittees were Tom Childs and Jeff Cameron. Childs ranched about 100 head of cattle. Charlie Bell took over Child's lease in the 1930s and had a permit to graze 400 goats prior to the area becoming a game range. When the Game Range was established, goats and sheep were banned but Bell continued to run cattle. Benjamin Parra also obtained a permit for 100 head of cattle in 1940. Childs, Bell, and Parra lost their permits when the military withdrew lands for active bombing, but enforcement was lax. Childs and Bell continued to run cattle at their own risk. Alton Netherlin bought Parra's cattle in 1942 and leased the area around Papago Well, running as many as 700 head. Angel Monreal had a permit to graze 80-100 head but records do not indicate dates for his lease. Jim Havins ran a small herd in the area of Papago Well in the 1940s. Havins was asked to remove all structures around Papago Well in 1965, while Cameron was allowed to renew his lease until 1981. Cameron ran 154 head of cattle in 1964, and 150 head in 1970 (with up to 1,500 cows additionally brought in for short terms). When the refuge took over grazing management in 1975 Cameron's permit was set at 129 head. Since the Cameron permit expired in 1981 there has been no legal grazing on the refuge.

As early as 1946, refuge staff began to notice the impact livestock were having on wildlife forage. They observed that desert bighorn sheep were using the lower elevations in summer, feeding on ironwood beans and saguaro pulp. These plants were probably supplying much needed moisture during the dry season. Managers recommended stopping grazing to reduce competition for limited forage resources, as the cattle also used this forage.

A study commissioned in 1965 to determine the effect of grazing and wildlife competition noted "abusive use of perennial shrubs and other plants important to wildlife" but stopped short of recommending that grazing be discontinued (Harper and Wiseman 1965). In 1977 the Sonoran pronghorn recovery team recommended that grazing leases on the refuge be terminated to end a perceived displacement of pronghorn from suitable habitat by cattle (Phelps, 1977). When the refuge took over grazing permits in 1975, they offered to continue Cameron's lease under conditions that would permit the habitat to recover. The permit would be renewed for 1-3 years out of ten for a period of 60 days at a time. Cameron rejected the offer, arguing that the conditions were not economically feasible.

Congress then asked the Service to study the effects of grazing on the refuge. The Service initiated the study in 1983 in conjunction with the BLM (Cabeza Prieta NWR 1983). Permanent vegetation transects were set up on the old Cameron allotment to document recovery when cattle were removed. The BLM also set up another study on grazed land east of the refuge boundary to study competition with Sonoran pronghorn. The study showed 50 percent of a cow's spring diet was globe mallow, and their summer and fall diet was composed mostly of mesquite. It further concluded that little competition occurred between cattle and Sonoran pronghorn because cattle graze and pronghorn browse. Refuge biologists challenged this finding, arguing that strict classifications of browser and grazer were not accurate descriptions of the actual feeding habits of cattle and pronghorn.

In 1992, the Arizona Nature Conservancy conducted a vegetation impacts study on OPCNM after grazing was discontinued there (D'Antonio and Vitousek 1992). Noted increases in vegetation cover were influenced by unusual rainfall during the study years. Interestingly, rodent abundance declined and pocket mice in particular disappeared. However, in one study area, bannertail kangaroo rats returned after being absent the previous year. Their return was attributed to an increase in vegetation cover after removal of livestock.

1.5.6 Trespass Livestock History

Since refuge establishment, trespass cattle, both from adjacent grazing leases on BLM lands to the east and from Mexico, have been a continuing problem. A boundary fence was built on the east side in 1980, reducing trespass from the BLM lands. The largest problem came from the Gray Ranch, whose grazing lease was within OPCNM, adjacent to the refuge. Although their lease was for 1,050 head, refuge staff estimated there was three times that many. The refuge took the family to court in 1965 to settle this dispute. The family was given one year to remove their livestock, but it wasn't until the last Gray brother died in 1976 that all the cattle were removed.

Feral burros and wild horses from Mexico were also a major problem. Burros and horses selectively browse woody vegetation in riparian corridors, girdling paloverde and other trees that form important habitat. In 1944, over 100 horses and 125 burros were documented on the refuge in one day. The situation improved when fear of hoof and mouth disease prompted construction of 36 kilometers (22 miles) of border fence between 1948 and 1949. Rare sightings continued into the 1960s, but none in recent years, other than occasional burro tracks seen at Tule well.

Domestic goats, both as trespass livestock on the refuge and as livestock on ranches or farms near the refuge, are problematic to wild desert bighorn sheep. Goats provide a host for the larval stage of the parasitic bot fly. The bot fly larvae also parasitize desert bighorn sheep. In desert bighorn sheep the larvae cause chronic sinusitis, a debilitating, and often lethal, condition. Many sheep on the refuge suffer from chronic sinusitis, introduced by domestic goats on or near the refuge. Chronic sinusitis is a decimating factor to the refuge's desert bighorn sheep population.

1.5.7 Mining History

Many mines in northern Sonora and southern Arizona were developed during Spanish rule, but no such activity appears to have taken place on the refuge. The gold rush of 1849 led prospectors to cross the area on El Camino del Diablo, an ancient trail that passed through the southern part of the refuge. This original trail system, more a braided corridor of multiple paths than a single trail, is distinct from the modern refuge access road that shares its name and general location. A second wave occurred when gold was discovered in the Colorado Valley in the 1860s. Miners' graves are landmarks along the route.

The Game Range was left open to mining when it was established. Military withdrawal in the 1940s temporarily stopped all mining activity. The exact number of claims extant at that time is unknown. The Game Range listed 17 unpatented and one patented claim in 1971 (USDI, Bureau of Sport Fisheries and Wildlife 1971). The Bureau of Mines speculated that modern survey techniques might produce mineral potential and a study was mandated in 1979. Wilderness designation in 1990 closed future mineral explorations. Today, the only current claim is the non-patented San Antonio Mica Mine that produced mica for the Phelps Dodge Company in Ajo.



San Antonio Mica Mine

USFWS Photo

Mining has left its legacy in the form of numerous shafts, tunnels, water tanks, and other debris surrounding old mine sites. The remains now present complex issues for the refuge. They negatively impact wilderness character but may deserve protection as historic artifacts. Some structures may now provide habitat for some wildlife species, such as endangered bats, but may also pose a danger to other wildlife and humans.



(drawing by Bonnie Swarbrick)

1.5.8 The Endangered Species Act (ESA) and Sonoran Pronghorn

Sonoran pronghorn were one of the first species declared endangered. They were included in the first endangered species legislation, the Endangered Species Preservation Act of October 15, 1966, which published a list that included the Sonoran pronghorn on March 8, 1967. They were also included in Appendix D of the Endangered Species Conservation Act, August 25, 1970, and again under the Endangered Species Act of 1973. This act directed the Service to prepare recovery plans for all species declared threatened or endangered. Cabeza Prieta NWR was given the lead for recovery of the Sonoran pronghorn in 1988, thus elevating its status as a refuge management priority. The original recovery plan was completed in 1982 with the last revision occurring in 1998. Recovery plans were guided by a core working group until 1998 when a formal recovery team was established.

In 2001, a federal court remanded the 1998 *Final Revised Sonoran Pronghorn Recovery Plan* to the Service with instructions to reconsider two areas of the 1998 plan that the court found to be contrary to the Endangered Species Act. Specifically, the court required the Service to establish:

- (1) objective measurable criteria, which, when met, would result in a determination that the pronghorn may be removed from the list of endangered species or, if such criteria are not practicable, an explanation of that conclusion and

- (2) estimates of the time required to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal where practicable, or if such estimates are not practicable, an explanation of that conclusion.

A supplement and amendment to the 1998 Recovery Plan, providing the required information, was published in 2003.

1.5.9 Wilderness Designation

In 1974, 337,449 hectares (833,500 acres) of the refuge were proposed to be included as part of the National Wilderness Preservation System (Senate Committee on Energy and Natural Resources). The proposal excluded approximately 14,975 hectares (37,000 acres) along the southern boundary known as the Tule Well exclusion, and a 183 meter (600 foot) corridor along El Camino del Diablo and the Christmas Pass Road. The proposal included adding the 32,375 hectare (80,000 acre) area known as Tinajas Altas to the refuge and designating 29,421 hectares (72,700 acres) of the parcel as wilderness. Congress directed that the Service manage all areas proposed for wilderness as de facto wilderness pending study and final designation.

A BLM study prior to 1990 indicated that a majority of the Tinajas Altas area had been impacted by surface military training and no longer possessed high or threatened cultural, wildlife, scenic or botanical resource values. Tinajas Altas was removed from the 1990 final wilderness proposal due to this degradation. The final proposal included the Tule Well Exclusion, and narrowed the travel corridors to 61 meters (200 feet), resulting in a wilderness proposal of 325,133 hectares (803,418 acres).

The Arizona Desert Wilderness Act of 1990 (HR 2570 Title 3) designated about 93 percent of the refuge, or 325,133 hectares (803,418 acres) as wilderness (figure 1.4). This designation provides a supplemental (i.e., additional) refuge purpose. The refuge's wildlife management responsibilities remain unchanged, but must be implemented within the context of legal requirements spelled out in the Wilderness Act of 1964. While the Wilderness Act does not prevent activities essential to the refuge's purpose, it does affect the manner in which these activities occur. For example, a minimum requirements analysis (MRA) is required to demonstrate that management activities are necessary and appropriate within wilderness. Permanent roads are prohibited. Temporary roads, use of motor vehicles, motorized equipment, landing of aircraft, other forms of mechanical transport, and structures and installations are also prohibited, except as minimally required to administer the area as wilderness. Additionally, wilderness designation calls for expanded monitoring requirements on the effects of public visitation.

The Arizona Desert Wilderness Act of 1990 provided two specific provisions relating to Cabeza Prieta for military activities and law enforcement border activities. The Act reads:

Nothing in this title including the designation as wilderness of lands within the Cabeza Prieta NWR, shall be construed as—

(1) precluding or otherwise affecting continued low-level over flights by military aircraft over such refuge, or the maintenance of existing associated ground instrumentation...”

and

(2) precluding or otherwise affecting continued border operations by the Immigration and Naturalization Service, the Drug Enforcement Administration, or the United States Customs Service within such refuge [now Department of Homeland Security and its bureaus],

[both] in accordance with any applicable interagency agreements in effect on the date of enactment of this Act

The Act also allows the Secretaries of these agencies to enter into new agreements compatible with refuge purposes and in accordance with laws applicable to the Refuge System.

1.6 LEGAL AND POLICY GUIDANCE

Administration of refuge lands is guided by federal laws, by the mission and goals of the Refuge System, and by policy, Executive Orders, and international treaties. Short descriptions of the most important mandates and policies affecting this planning process for Cabeza Prieta NWR follow. Additional legal mandates can be found in Appendix A.

1.6.1 **The National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended, by the National Wildlife Refuge System Improvement Act of 1997 (H.R. 1420, 105th Congress)**

This law is the “organic act” for the National Wildlife Refuge System. The Act amends portions of the National Wildlife Refuge System Administration Act of 1966 and the Refuge Recreation Act, and gives the force of law to Executive Order 12996.

The Act clarifies that conservation of wildlife and its habitats is the first priority of the National Wildlife Refuge System.

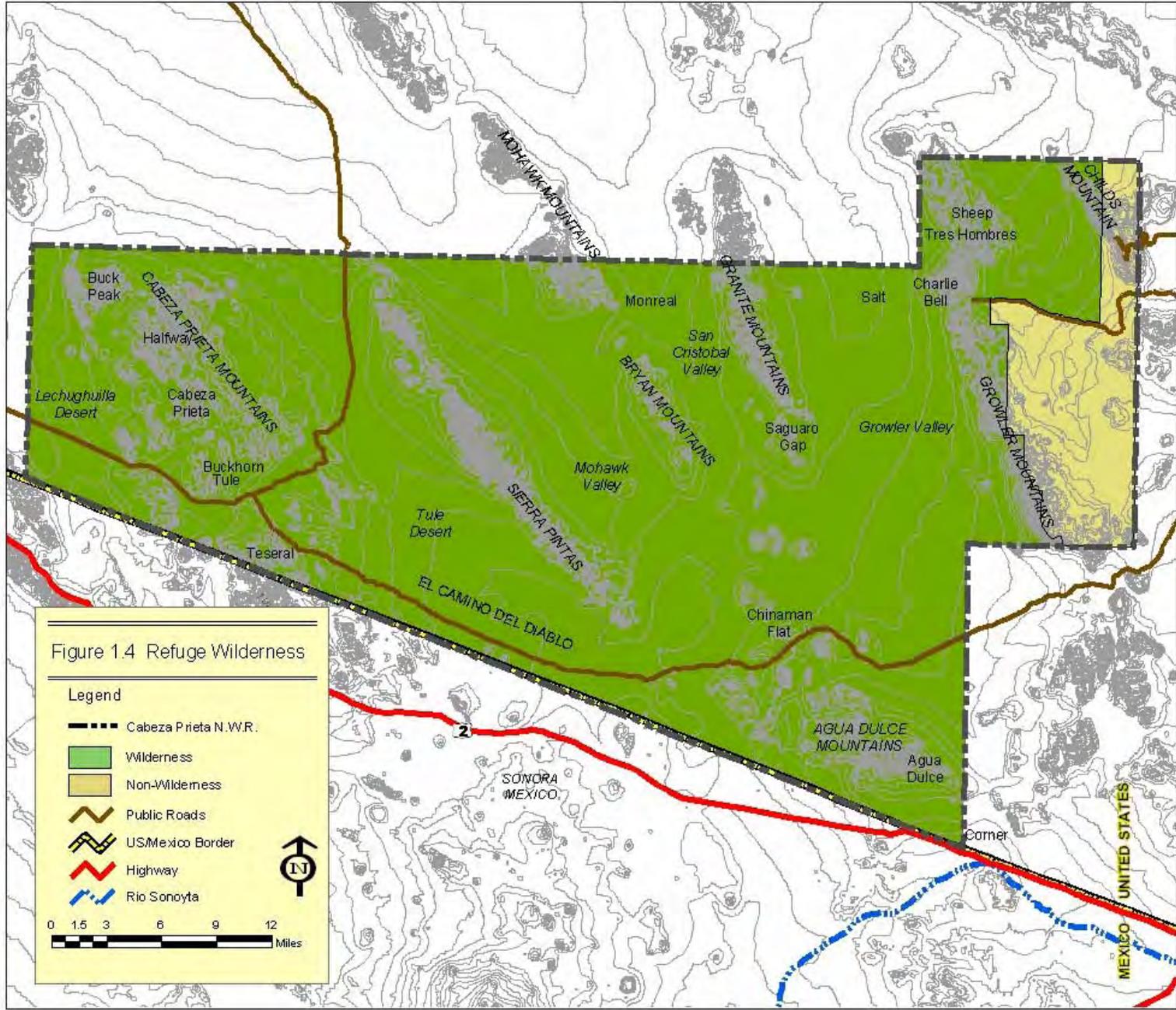
The Act unifies the Refuge System, calling for each refuge to be managed to fulfill the mission of the Refuge System, as well as specific purposes for which that refuge was established, and directing that each refuge shall be managed in a manner that maintains the biological integrity, diversity and environmental health (ecological integrity) of the Refuge System.

The Act establishes the legitimacy and appropriateness of six wildlife-dependent recreational uses of the Refuge System when they are determined to be compatible: hunting, fishing, wildlife observation, wildlife photography, environmental education and interpretation.

These priority public uses shall receive enhanced consideration over other public uses in refuge planning and management. The following general hierarchy between refuge activities and public uses will apply: Priority 1 - activities necessary to fulfill the refuge purposes and the Refuge System mission; Priority 2 - provide opportunities for wildlife-dependent recreational uses, when determined to be compatible. All other public uses will be a lower priority.

Compatibility was more clearly defined as a determination that the use would not materially interfere with or detract from the fulfillment of the mission of the Refuge System or purposes of the refuge based on the sound professional judgment of the refuge manager. Sound professional judgment is a finding, determination, or decision that is consistent with the principles of sound fish and wildlife management and administration, available science and resources, and applicable laws.

The Act also provides that Comprehensive Conservation Plans shall be completed for all refuge units within 15 years from the date of enactment.



1.6.2 Wilderness Act of 1964 (16 U.S.C. 1131-1136)

The Statement of Policy of the Wilderness Act reads:

In order to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition, it is hereby declared to be the policy of the Congress to secure for the American people of present and future generations the benefits of an enduring resource of wilderness. For this purpose there is hereby established a National Wilderness Preservation System to be composed of Federally owned areas designated by Congress as "wilderness areas" and these shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness; and no federal lands shall be designated as "wilderness areas" except as provided for in this Act or by a subsequent Act. (Sec. 2 (a)).

The Act defines wilderness as

... an area where the earth and community of life are untrammelled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1)generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value (Sec.2 (c)).

Key concepts include:

- The purposes of this Act are within and supplemental to the purposes for which ... units of the national wildlife refuge system are established (Sec. 4 (a)).
- ... each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area and shall so administer such an area for such other purposes for which it may have been established as also to preserve its wilderness character (Sec. 4 (b)).
- Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and, except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized

equipment, ... no other form of mechanical transport, and no structure or installation within any such area (Sec. 4 (c)).

1.6.3 Arizona Desert Wilderness Act of 1990

Designated identified lands within Cabeza Prieta NWR as wilderness under Title III, to be administered in accordance with the Wilderness Act with special provisions to not preclude continued military or border law enforcement activities (previously described in Section 1.5.9, Wilderness Designation).

1.6.4 Endangered Species Act of 1973 (16 U.S.C. 1531-1543 87 Stat. 884) (P.L. 93-205)

The Endangered Species Act, as amended (Public Law 97-304 and the Endangered Species Act Amendments of 1982), did not specifically address the Refuge System, but does directly affect management activities within the Refuge System. The Act directs federal agencies to take actions that further the purposes of the Act and to ensure that actions they carry out, authorize or fund do not jeopardize endangered species or their critical habitat.

1.6.5 The Archeological Resource Protection Act of 1979 (ARPA) (P.L. 96-95, 93 Sta. 721, dated October 1979) (16 U.S.C. 470aa - 470ll)

ARPA requires a federal permit for the excavation, collecting, and removal of archeological resources from federal and tribal land. It prohibits vandalism of sites on federal and tribal land and the exchange or transport of illegally obtained archeological resources. ARPA violations are subject to civil and criminal penalties

1.6.6 Military Lands Withdrawal Act of 1986 (P.L. 99-606)

More than 93 percent of the refuge was withdrawn for military use as part of the Barry M. Goldwater Range (BMGR) (boundary corresponds with current wilderness boundary). Based on authorities granted in the Military Lands Withdrawal Act of 1986 (P.L. 99-606), a Memorandum of Understanding (MOU) between the Air Force and the Service was negotiated to clarify agency missions, objectives, and what activities would occur. The MOU, which was updated as recently as November of 1994, allows for military flights 457 meters (1,500 feet) above ground level (AGL) or 152 meters (500 feet), lower than the customary 610 meters (2,000 foot) AGL advisory issued by the Federal Aviation Administration (FAA). Military flights, along established training routes that are 7.4 kilometers (4 nautical miles) wide, have no minimum altitude restriction, per the agreement. The MOU also clarifies that the military's use of live fire would be confined to air-to-air weaponry and would be conducted at altitudes of 1,524 meters (5,000 feet) mean sea level (MSL) and higher after 60 days' written notice is provided the refuge manager. The military is using electronically scored aerial targets and will confine itself to that means unless mission requirements mandate the use of other methods. The military agreed that air-to-ground live fire will be restricted to designated tactical ranges outside the refuge. This act was to expire in 2001 unless renewed (see next paragraph).

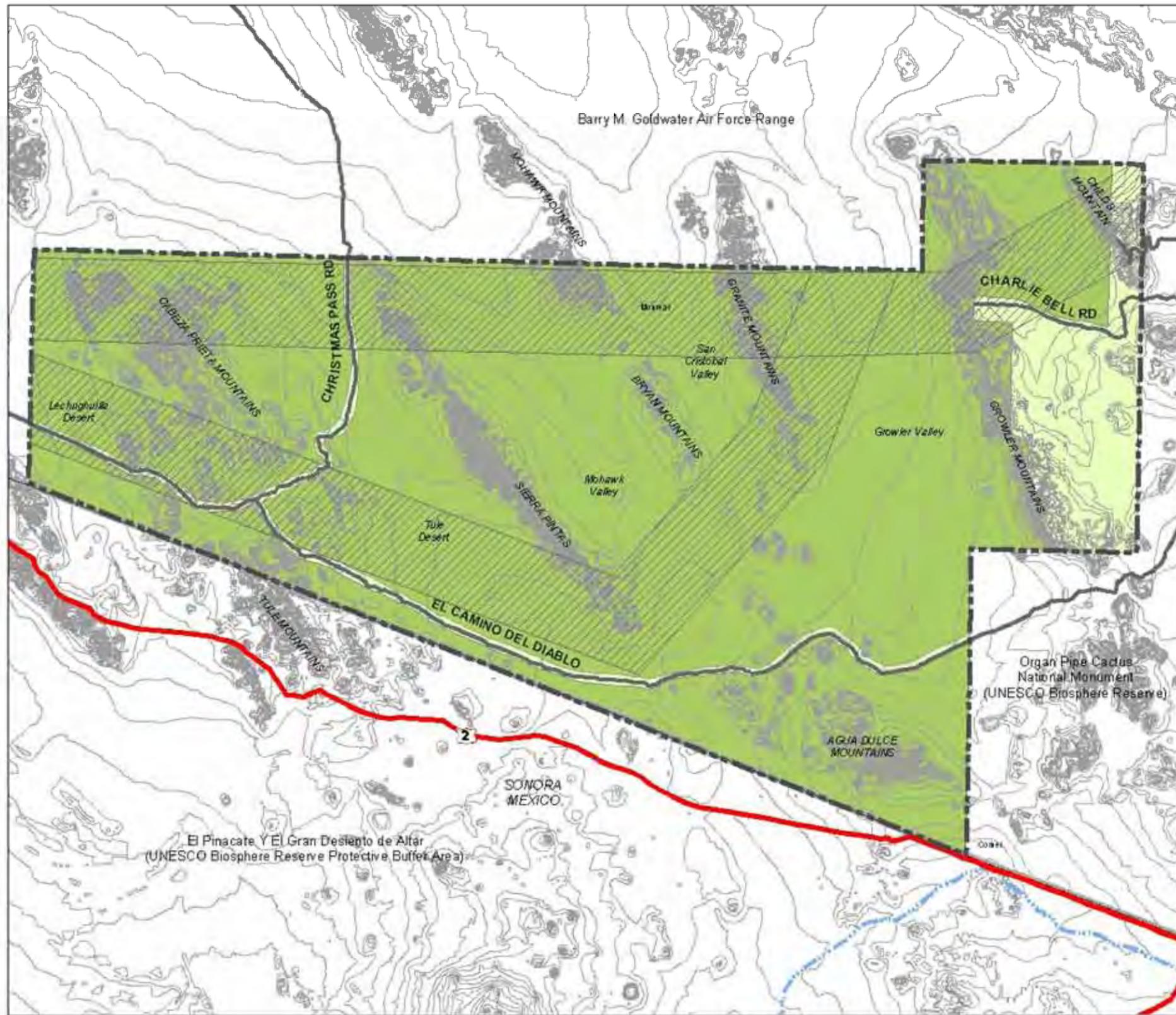


Figure 1.5 Low-Level Fixed Wing Overflight Corridors

Legend

- Cabeza Prieta N.W.R.
- Wilderness
- Non-Wilderness
- Public Roads
- US/Mexico Border
- Highway
- Rio Sonoyta
- 200' to 1500' AGL Flight Corridor

Sources: USFWS, 2003



**CABEZA PRIETA
NATIONAL WILDLIFE REFUGE**

COMPREHENSIVE CONSERVATION PLAN

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH & WILDLIFE SERVICE

1.6.7 Military Land Withdrawal Act of 1999 (Public Law 106-65)

This Act effectively removed Cabeza Prieta NWR from the BMGR, but under section 3032, provided for continued but limited military use of ground facilities on the refuge and extended the MOU of 1994.

The Act also provided for negotiated amendments to the 1994 MOU when the Secretaries of Navy or Air Force determine changes are essential to meet military aviation training needs to:

- Revise existing or establish new low-level training routes
- Establish new or enlarged areas closed to public use as safety zones
- Accommodate maintenance, upgrade, replacement or installation of existing or new associated ground instrumentation.

While this Act ended most military use of land resources on the refuge, the air space over the refuge remains part of the BMGR. Over flights were exempted from compatibility requirements as already provided for under the Refuge Improvement Act and the Arizona Desert Wilderness Act.

Amendments for upgrade or replacement of existing ground instrumentation or installation of new ground instrumentation are permitted to the degree that they are determined to individually and cumulatively create similar or less impact than existing ground instrumentation currently permitted by the Arizona Desert Wilderness Act.

1.6.8 American Indian Religious Freedom Act (1978) and Amendments of 1994.

Directs agencies to consult with native traditional religious leaders to determine appropriate policy changes necessary to protect and preserve Native American religious cultural rights and practices.

1.6.9 Executive Order 13007 - Sacred Sites (May 24, 1996)

Drafted and promulgated to promote accommodation of access to Native American sacred sites by Native American religious practitioners and to provide additional protection for the physical integrity of such sacred sites. The order supplements the protections afforded by the American Indian Religious Freedom Act Amendments of 1994, and the Religious Freedom Restoration Act of 1993. The Order charged the agencies to establish written guidance to ensure consistency with law and agency functions. That implementation document states under Section 5: "The Service will not allow the use of motorized vehicles in wilderness areas in the lower 48..." in reference to access to Native American sacred sites.

1.6.10 Other Guidance

1.6.10.1 Fulfilling the Promise

In 1998, as the Refuge System neared its 100th anniversary of 2003, the Service provided the opportunity for refuge managers, other employees, and conservation partners to chart a course for the next century at the first National Wildlife Refuge System Conference held in Keystone, Colorado. The participants reviewed the Refuge System's history and defined its future by reviewing a draft strategy called *Fulfilling the Promise*. An executive summary² listed 42 recommendations regarding wildlife, habitat, people, and leadership. An implementation team prepared a final document by the same title, which was released in 1999. *Fulfilling the Promise*³ serves as a vision document for the Refuge System and a guide for refuge management and planning.

1.6.10.2 Policy Manuals and Plan

Agency policy manuals and plans further define and interpret legal mandates for resource managers. The Service Manual and Refuge Manual are currently being reviewed and revised. Updated portions of the Manuals are available at the Service website⁴ Below is a list of some relevant policies and plans.

1.6.10.3 U.S. Fish and Wildlife Service Native American Policy (1995)

This Service policy defines the relationship between the Service and all Native American governments as "government to government." Issues relating to culture and religion will require the involvement of Native American governments in all Service actions and proposals that may affect Native American cultural or religious interests including archaeological sites. The chief strategy will be one of consultation.

1.6.10.4 Interagency Wilderness Strategic Plan 1995

As 1994 marked the 30th anniversary of the passage of Public Law 88-577, known as the "Wilderness Act," the federal agencies charged with the stewardship of the Wilderness Preservation System developed a broad strategic plan. The agencies include the Bureau of Land Management, the National Park Service, U.S. Forest Service, and Fish and Wildlife Service. By agreeing to the plan, the agencies rededicated and focused each agency's efforts to secure the benefits of wilderness as called for in the Wilderness Act. The Plan's management actions are identified and grouped into five broad topics: 1) Preservation of natural and biological values; 2) Management of social values; 3) Administrative policy and interagency coordination; 4) Training of agency personnel; and 5) Public awareness and understanding.

²<http://www.fws.gov/r9extaff/promise.html>

³<http://refuges.fws.gov/library/indes.html>

⁴<http://www.fws.gov>

1.6.10.5 Wilderness Stewardship Training

Training in Wilderness Stewardship is provided by the Arthur Carhart National Wilderness Training Center (Carhart Center) in Montana in conjunction with the Service's National Conservation Training Center (NCTC). The Carhart Center is jointly operated by the four federal agencies with Wilderness Stewardship responsibilities (Fish and Wildlife Service, U.S. Forest Service, Bureau of Land Management, National Park Service).

1.7 REFUGE PURPOSES

- The Cabeza Prieta NWR was established January 25, 1939, as Cabeza Prieta Game Range (Range) by Executive Order 8038: "for the conservation and development of natural wildlife resources, and for the protection and improvement of public grazing lands and natural forage resources...(and) that all the forage resources in excess of that required to maintain a balanced wildlife population within this range or preserve shall be available for livestock. . . .".
- Enactment of the Arizona Desert Wilderness Act of 1990 designated most of the refuge wilderness and created the supplemental refuge purpose of wilderness protection, in accordance with the Wilderness Act of 1964.
- In addition to the original refuge purposes and the additional wilderness purpose created by the Arizona Desert Wilderness Act of 1990, several federal policies, regulations, and laws affect refuge management activities. Preeminent among these is the Endangered Species Act of 1973, which mandates protection and recovery of threatened and endangered species.

1.8 REFUGE VISION STATEMENT

1.8.1 At Cabeza Prieta National Wildlife Refuge, wildlife conservation comes first.

Cabeza Prieta National Wildlife Refuge is dedicated first and foremost to conservation of wildlife and habitats. Situated on the international border, and located in the heart of the Sonoran Desert, the refuge is unlike any other wild place in the Western Hemisphere. More than 90 percent of this unit of the National Wildlife Refuge System has been officially designated a Wilderness Area by Congress. The refuge's high diversity of plant and animal species and varied geology make it an important component of the Sonoran Desert ecosystem. The Service's role at the refuge is to protect native wildlife and plant populations within the greater Sonoran Desert ecosystem.



Desert Bighorn Sheep at Cabeza Prieta

USFWS Photo

1.8.2 Proactive management is important to the recovery and conservation of endangered species

The refuge plays a continuing role in the protection and recovery of threatened and endangered species, including the Sonoran pronghorn and the lesser long-nosed bat. The refuge is a critical resource for the

recovery of the Sonoran pronghorn, an endangered sub-species of American pronghorn limited to two small remnant populations in the United States and Mexico. The refuge comprises nearly half the range of the U.S. population, and is central to its recovery. Cooperatively with partners, especially the Arizona Game and Fish Department (AGFD), the refuge will continue its commitment to biological data gathering, monitoring, and analysis so that current natural resource management questions can be answered and the future of threatened and endangered species such as the pronghorn will be more secure.

1.8.3 Refuge wilderness resources are protected for posterity

The refuge, with its vast wilderness including Sonoran Desert habitat, is permanently protected as a component of the National Wilderness Preservation System. Protection of the existing landscape and management of the refuge's wildlife populations are top priorities. Desert bighorn sheep are recognized as a wilderness resource, as well as a species basic to the original purpose of the refuge. Conservation of this species, and other native species, will require a cooperative effort between the refuge and its partners, especially with the AGFD, using the best available science, established practices and new approaches and techniques based on the most current research.



Cabeza Prieta Peak, showing the "Dark Head" from which the refuge takes its name

USFWS Photo

1.8.4 The beauty and solitude of the refuge will continue to be enjoyed by visitors.

The refuge is, and will remain, a place where visitors can enjoy the magnificence of the Sonoran Desert and experience wilderness solitude rarely found elsewhere in the Southwest. Refuge interpretive programs will continue to educate visitors and area residents about the unique resources of the Sonoran Desert and the mission of the refuge and the National Wildlife Refuge System.

Visitors to the refuge; whether enjoying an extended backpacking

trip, a day's drive on the Camino del Diablo, or an informational session at the visitor center; are drawn to its beauty and untrammled wilderness character. These traits will be protected through Service management and administration.

1.8.5 The refuge embraces cooperative working relationships with partners.

The refuge values its relationships with other natural resource agencies, tribal governments, non-governmental organizations, and local communities in accomplishing the refuge purposes and the National Wildlife Refuge System mission. Local communities will continue to identify and promote the region as a tourist destination. The unique resources and natural beauty of the refuge will continue to draw visitors. Refuge outreach and visitor services programs will continue to enhance the area's attraction to visitors from around the nation and foreign countries. The refuge will continue to be an ideal site for cooperative scientific study and research leading to the conservation of Sonoran Desert resources.



Volunteers clear brush along Charlie Bell Road

USFWS Photo

1.9 REFUGE MANAGEMENT DIRECTION: GOALS AND GUIDING PRINCIPLES

The following four goals are proposed for Cabeza Prieta NWR. They are consistent with the refuge purpose, the Refuge System mission and goals, the National Wildlife Refuge System Administration Act of 1996, as amended, Service policy, the Wilderness Act of 1964, the Arizona Desert Wilderness Act of 1990, and the Service's Gila/Salt/Verde Ecosystem Team goals. The goals are to be considered as integrated goals containing elements of each, rather than being mutually exclusive of each other⁵. Specific objectives to be achieved to realize these goals, as well as implementation strategies for each objective have been developed. The objectives and strategies for implementing Alternative 4, the preferred alternative, are presented in Appendix M. Management actions proposed in support of the goals are described in Chapter 2, Alternatives.

1.9.1 Wildlife and Habitat Management

Protect, maintain, enhance, and/or restore the diversity and abundance of wildlife species and ecological communities of the Sonoran desert represented at Cabeza Prieta NWR.

- Intact habitats are key to viable wildlife populations.
- The refuge must integrate its responsibilities for trust species and biodiversity to meet Refuge System and ecosystem goals.
- Management should mimic, where possible, natural processes.
- The refuge needs sound scientific data in order to evaluate management options and prioritize activities.

1.9.2 Wilderness Stewardship

Protect and conserve refuge wilderness employing strategies of wildlife and plant conservation that will conserve, maintain and where possible, restore the wilderness character of Cabeza Prieta NWR.

1.9.3 Visitor Services Management

Provide visitors with compatible, high quality wildlife-dependent recreational and educational experiences designed to foster better appreciation, understanding, and protection of the plant, animal and wilderness resources.

- Compatible wildlife-dependent recreation and education are appropriate public uses with priority given to hunting, fishing, wildlife observation, wildlife photography, environmental interpretation, and education.
- Visitors find national wildlife refuges welcoming, safe, and accessible with a variety of opportunities to enjoy and appreciate America's legacy of wildlife.
- The heritage and future of the Refuge System is intertwined with the support of concerned citizens.

⁵ Following each goal is a list of management principles and requirement developed for the Service's vision document *Fulfilling the Promise* and other sources.

1.9.4 Cultural Resources Management

Protect, maintain, and interpret cultural and historic resources on Cabeza Prieta NWR, in cooperation with Tribal governments and the State of Arizona to benefit present and future generations.

- Comply with Section 106 of the National Historic Preservation Act and enforce the Archeological Resources Protection Act to protect sites and objects from construction impacts or illegal activities.
- Archeological research proposals will be in compliance with the Archeological Resources Protection Act and will undergo formal review by regional recognized tribes.
- The location of sites will not be disclosed.
- Report site and object discoveries and report specific site maintenance, stabilization, and protection needs to the Service's Regional Office.
- Observe and honor the provisions of the American Indian Religious Freedom Act and Executive Order 13007 to guarantee access by tribal members to sacred sites and to traditional cultural properties.
- Limit archives and collections to the minimal amounts essential for Refuge record keeping and for basic public interpretation. All other collections will be housed in public repositories and may become candidates for repatriation to regionally recognized tribes.

1.10 STEP-DOWN PLANS

Step-down management plans detail and describe specific activities necessary to achieve objectives or implement management strategies identified in the CCP. The Service has chosen to incorporate the Wilderness Stewardship Plan in this CCP. Other step-down plans to be prepared for the refuge include a habitat management plan, visitor services management plan, inventory and monitoring plan, safety plan and integrated pest management plan. Step-down plans may require additional NEPA compliance and the opportunity for public review.

1.11 DESCRIPTION OF THE PLANNING PROCESS

1.11.1 Notice of Intent for Environmental Impact Statement and CCP

Between 1994 and 1997 the Service prepared the *Final Programmatic Environmental Assessment for the Future Management of Cabeza Prieta National Wildlife Refuge and Draft Comprehensive Conservation Plan*. In 1999, the Department of the Interior withdrew that document and requested that the Service prepare a new CCP for the refuge. In January 2000 the Service's Southwest Regional Director determined that an Environmental Impact Statement should be prepared for the CCP because of the national significance of the wilderness and other refuge resources, and the potential impacts of implementing the alternatives analyzed. A Notice of Intent (NOI) to prepare an EIS and CCP was published in the Federal Register April 14, 2000. The NOI identified issues that had been developed during the EA process, outlined four potential alternatives that had been discussed up to that date, and requested public input on these preliminary issues and range of alternatives through written comments. It also announced the dates and locations for three Open Houses to be held in June 2000. The written comment period was open for 30 days, but comments were received through the end of the Open Houses in June. An interdisciplinary team was selected to assist in preparation and review of the EIS/CCP.

1.11.2 Refining Issues Through Public and Agency Scoping

Throughout the EIS effort the Service has periodically mailed planning updates to more than 1,000 organizations, agencies and individuals. The updates reiterated information presented in the NOI, provided information about plan development status, and invited input through written comments and open houses or public meetings. Open houses were held in Yuma, Ajo, and Tucson in June 2000. Attendance for each was 34, 5, and 56 respectively. The Service also received over 600 written responses. Agency scoping meetings were held with U.S. Border Patrol, OPCNM, Pima County, and the Tohono O'odham Nation. The refuge participated in joint scoping with BMGR and serves on their EIS team. A round of informal public meetings was held as follows: January 7, 2003, in Tucson; January 8, 2003, in Ajo and January 9, 2003, in Yuma. As a result of public scoping, a few new issues were added and others were re-worded. Although most respondents were satisfied with the range of alternatives, a large group expressed its desire to expand active management, while another group pressed for complete elimination of all vehicular traffic.

1.11.3 Gathering Information, Assessing Resource Relationships, Analyzing Environmental Effects and Rewriting the Plan

The planning team reviewed and revised the issues, developed a range of management alternatives, suggested additional investigations needed for an EIS, and reviewed the analysis of effects for each alternative in the Draft EIS, CCP and WSP. The Service solicited comments on the Draft EIS, CCP and WSP from members of the public, local, state and federal agencies, and NGOs between May 5 and September 14, 2005. In addition to the opportunity to submit written comments during this period, interested parties were also invited to attend public hears held at Tucson (July 25, 2005), Sells (July 26, 2005), Ajo (July 27, 2005), and Yuma (July 28, 2005), Arizona. Comments received are presented as Appendix C to this document. Revisions made in response to comments are contained in the EIS, WSP and CCP text and summarized at Appendix D. Upon release of the Final EIS there will be a 30 day comment period, followed by a formal Record of Decision issued by the Service's Southwest Regional Director.

1.11.4 Guidance Used for Preparation of a CCP/WSP/EIS

The process used for the development of this CCP/WSP/EIS has been guided by:

- The provisions of the National Wildlife Refuge Improvement Act of 1997 (P.L. 95-616),
- the original purposes for which the Cabeza Prieta NWR was established (Executive Order 8038),
- the supplemental purpose of endangered species recovery added by the Endangered Species act of 1973, as amended,
- the supplemental purposes of wilderness administration added by virtue of the Arizona Desert Wilderness Act of 1990 designation,
- the provisions of the National Environmental Policy Act of 1969 (NEPA) and Council for Environmental Quality (CEQ) Regulations for Implementing NEPA (43 CFR 1500-1508),
- the Refuge Planning Chapter of the Fish and Wildlife Service Manual (Part 602 FW 2.1),
- the Wilderness Management Planning Chapter from the Refuge Manual (6RM Chapter 8), and
- the reports and recommendations of the Promises Implementation Teams.

1.12 PLANNING ISSUES

Issues, concerns, and opportunities were identified through discussion with the planning team, key contacts, a focus group, and through the public scoping process. The following issues were identified. The questions that follow each issue are not exhaustive, but only representative of questions and concerns that have been brought forward in this planning effort.

1.12.1 Wildlife and Habitat Management

The refuge was originally established for the conservation and development of natural wildlife resources and will continue to be managed for wildlife first. While emphasis will be placed on maintaining and enhancing habitat for desert bighorn sheep and the endangered Sonoran pronghorn, conservation and management of all native wildlife species and their habitats will continue to be one of the primary goals of the refuge.

- What were natural wildlife population levels prior to European influence?
- What effect has the introduction of domestic animals and grazing had on native wildlife and habitats?
- What, if any, level of habitat manipulation is appropriate?

1.12.2 Managing Healthy Ecosystems

Two goals of the Refuge System are to manage for healthy natural populations of native flora and fauna and to contribute to broader ecosystem goals.

- What were natural conditions on the refuge prior to European settlement?
- To what extent should the refuge attempt to recreate those conditions?
- What inventories and monitoring studies need to be conducted to determine refuge resource conditions and their status over time?
- Are there threats to the ecological integrity of the ecosystem? If so, what should be done to address these threats?
- How should the refuge contribute to migratory bird conservation?
- What are the priorities for research?
- What role should the refuge play in promoting a wider understanding and cooperative management of the Sonoran Desert Ecosystem?



(drawing by Bonnie Swarbrick)

1.12.3 Endangered Species Management

The refuge provides protection and habitat for the endangered Sonoran pronghorn and lesser long-nosed bat. The Refuge assumed leadership of the Sonoran pronghorn recovery effort in the United States in 1988. Past management for the pronghorn included removing livestock grazing from the refuge, removing and/or modifying fences to allow for pronghorn movement, adding water developments, fencing parts of the boundary to prevent trespass from neighboring cattle, and various studies of pronghorn movements and habitat use. Recently, experimental forage enhancement plots and addition of more water developments has been proposed. Little management activity, other than surveys and monitoring of roosting sites, has occurred for the lesser long-nosed bat.



- What role should radio collaring of animals on the refuge play in recovery of the Sonoran pronghorn?
- Are there critical pronghorn use areas and are they adequately protected?
- What is the role of developed waters and forage enhancement plots in pronghorn recovery? Are there any adverse aspects of developed waters or forage enhancements on pronghorn?
- What types of potential partnerships with Mexico would best assist in recovery?
- What role should the refuge play in experimental management strategies?
- What role should the refuge play in recovery of the lesser long-nosed bat?

1.12.4 Desert Bighorn Sheep Management

The refuge provides important habitat for desert bighorn sheep. The protection and conservation of desert bighorn sheep were central to refuge establishment. Previous refuge management for desert bighorn sheep included removal of livestock grazing, water developments, and control of hunting. Debate over the necessity of water for desert bighorn sheep survival and population health, refuge access in the wilderness area to maintain and/or haul water to developments,



(drawing by Bonnie Swarbrick)

creation of new waters versus removal of some or all of the existing water developments, continues to be at the heart of issues raised about refuge management of this species.

- Should a numerical population goal for desert bighorn sheep on the refuge be established?
- If so, what population goal is appropriate?
- What should this goal be based on? What was the population prior to European settlement of the area? What changes have taken place since settlement that affect desert bighorn sheep numbers?
- What is the role of water developments in desert bighorn sheep management on the refuge? What level of their use is necessary for a healthy population?

- What management strategies are necessary to achieve the population goal?

1.12.5 Predator Management

Predator control is a component of population management. Existing policy outlines acceptable methods and situations for predator control. Refuge policies prohibit the use of poisons for control of mammals or birds, and prohibit the use of chemicals that can cause secondary poisoning.



(drawing by Bonnie Swarbrick)

- What role, if any, should control of coyote, mountain lion and bobcat play as a management option on the refuge to protect Sonoran pronghorn, desert bighorn sheep and other wildlife populations?
- How does predator control fit with wilderness management principles?
- Should current policies on predator control be re-visited as new information about predator/prey relationships comes to light?

1.12.6 Wilderness Stewardship

Cabeza Prieta Wilderness is the largest refuge wilderness in the contiguous 48 states. In *Fulfilling the Promise*, the Service calls for elevating the status of wilderness areas by “acknowledging wilderness as a unique resource, the management of which is a specialized discipline.” Natural populations of native wildlife are important to the wilderness resource, as are solitude and self-sustaining ecological processes.

Wilderness designation does not lessen the priority of the original refuge purposes, but it adds securing an enduring resource of wilderness, and preservation of wilderness character as additional purposes. These, in turn, require managerial restraint. All management activities in wilderness are subject to a MRA to assure appropriateness.

The refuge staff, AGFD, and refuge permittees (researchers, volunteers working on projects) may use mechanical or motorized transport and/or motorized equipment in the wilderness for management purposes subject to the Wilderness Act and Service policy. The use of mechanical/motorized equipment in wilderness by these entities is evaluated through MRA. DHS bureaus (U.S. Customs and Border Protection [CBP] and CBP Office of Border Patrol [CBP-BP]), may drive in the wilderness to accomplish their missions, in accordance with any interagency agreements, per special provisions in the Arizona Desert Wilderness Act of 1990.

- What wildlife and habitat management activities are appropriate for the wilderness area?
- Has anything negatively affected or degraded wilderness resources or character? If so, what rehabilitation projects or management changes are needed to restore wilderness resources or character?
- How can the refuge best manage wildlife and wilderness resources and character?
- Is long-term, continuous management intervention appropriate in wilderness?

1.12.7 Wildlife Dependent Visitor Services

The Refuge Improvement Act identified hunting, fishing, wildlife observation, wildlife photography, environmental education and interpretation as priority public uses on refuges when found to be compatible with refuge purposes. Under current management the refuge is open to several of these uses. Its size, remoteness, wilderness character, and desert environment offer a unique experience for visitors.

1.12.7.1 Recreation in Wilderness

The Wilderness Act allows for public recreation and education by recognizing that wilderness provides “outstanding opportunities for solitude or a primitive and unconfined type of recreation” and calls for wilderness areas to be “administered for the use and enjoyment of the American people in such a manner as to leave them unimpaired for future use and enjoyment as wilderness.” Furthermore, Service policy recognizes sensitive areas may need to be protected from overuse, and allows for regulated use through permit or complete closure (6 RM 8.9A).

- What level of public use is sustainable and desirable in the wilderness?
- What management methods are appropriate for controlling public use in wilderness?
- How should the refuge best monitor visitor impacts?
- What should trigger remedial actions and public information campaigns?

1.12.7.2 Permitting and Access

Permits were established in 1975 at the request of the U.S. Air Force to inform the public of military hazards (e.g., unexploded ordnance) they may encounter on military withdrawal lands and to obtain hold harmless signatures. They also serve to establish initial contact with the public, ensure that visitors are aware of refuge and wilderness regulations, provide the refuge with public use data, and inform visitors of the natural hazards of the desert environment.

- Should the refuge continue to have a visitor permit system? If so, how should it be structured? Should it be separate from the Barry M. Goldwater Range permit?
- How can the refuge limit visitor impacts, while providing a quality visit?
- Should access to wilderness be zoned?
- Should the refuge visitor center hours be extended?



A group of hikers receives information from refuge staff

USFWS Photo

1.12.7.3 Motorized Access and Vehicle Restrictions in Non-Wilderness

Visitors and local residents have expressed an interest in additional vehicular access to non-wilderness areas of the refuge.

- Should the refuge seek to increase visitor use from current numbers?
- Should the refuge provide a non-wilderness road that does not require 4WD or a high-clearance vehicle?
- Should the refuge rehabilitate Copper Canyon Road in cooperation with the BLM for use as a public tour loop?

1.12.7.4 Hunting

The refuge is currently open to desert bighorn sheep hunting for which the State issues limited permits each year. In addition to the actual hunt, permittees usually make several scouting trips in advance of the season. Desert bighorn sheep hunters must obtain a special use permit for their hunts.

- What type of hunting experience should be offered at the refuge?
- Is hunting for deer and/or small game appropriate at the refuge?
- Are there any wildlife conservation conflicts with the current hunt program?



Successful desert bighorn sheep hunter on the refuge

USFWS Photo

1.12.7.5 Environmental Education and Interpretation

The refuge has an office/visitor center located in Ajo that offers an orientation video and exhibits. Visitor services also include a watchable wildlife area on Child's Mountain with interpretive panels and shade structures. This facility is open by arrangement only for guided tours. The refuge has an Outdoor Recreation Planner as well as several volunteers who staff the visitor center, conduct tours, and offer monthly natural history programs coordinated by the Cabeza Prieta Natural History Association during the winter season.

- What projects and activities should the refuge initiate to increase understanding and protection of Sonoran Desert resources and the role the Service plays in support of the ecosystem?



Guided tour group at the Childs Mountain Overlook

USFWS Photo

- Should the refuge develop educational programs specific to wilderness values, solitude, and the conservation of wilderness resources in general?



A party of car campers near
El Camino del Diablo
USFWS Photo

1.12.7.6 Other Public Uses: Backpacking and Camping

Other uses that are permitted because they are related to participation in priority public uses or are enhanced by a wilderness setting include hiking and backpacking (including camping), and commercial recreation operations.

- What types of recreational uses should the refuge allow other than the six priority public uses?
- What educational efforts should be undertaken to minimize the impacts of these activities?
- What level of recreational use monitoring is appropriate?
- What level of border law enforcement activity or illegal cross-border travel detracts from visitor experiences?

1.12.8 Cultural Resource Management

The refuge has many sites of cultural and /or historical significance.

- What actions should the refuge take to better identify, document, interpret, and protect cultural and historical resources?
- How should the refuge identify American Indian interests and what cooperative efforts can be considered and set in place prior to taking action?
- What can the refuge do to provide access for Native Americans to sacred sites?

1.12.9 Border Law Enforcement

CBP-BP, Customs, and DEA (currently CBP and CBP-BP) were given special provisions by the Arizona Desert Wilderness Act of 1990 to permit continued enforcement activities. The number of illegal border crossings has climbed steadily over the past several years, and impacts to refuge resources, both from illegal traffickers and the agents performing their duties, are evident.

- To what degree are illegal drug trafficking, illegal immigration and associated law enforcement activities impacting wildlife, habitat and the visitor experience?
- To what degree should the refuge monitor these effects?
- What cooperative efforts can be implemented to reduce impacts?
- Should the refuge develop humanitarian waters or other rescue features in the refuge wilderness?

1.12.10 Military Use

The refuge was not included in the last military withdrawal, but language in the Arizona Desert Wilderness Act does stipulate continued military use (over flights and limited ground use). The Act amends the current MOU with the military and provides for amendments to revise low-level training routes; to establish new or enlarged buffer zones closed to the public; and to accommodate maintenance, upgrade, replacement, or installation of existing or new ground instrumentation (i.e. communication sites) that does not increase impacts already permitted under the Arizona Desert Wilderness Act of 1990.

- What effect does military over flight activity have upon native wildlife?
- What would be the effect of any decrease in flight-level restrictions?
- What buffer zones are needed to ensure public safety?
- What changes are being proposed and how will these affect refuge resources?
- How can the refuge reduce impacts caused by authorized military operations (tow dart and other debris removal, accident response protocol, entry without permit, expansion of low level flights)?

1.13 ISSUES NOT SELECTED FOR DETAILED ANALYSIS

The following areas of concern have been noted by the Service. Some issues raised early in the EA process were resolved through separate Environmental Analysis, others are resolved by current policy or law and implementation of the CCP would have no impact on these issues. Finally, there is a group of issues that are beyond the scope of this plan. The issues and their resolution are discussed briefly below.

1.13.1 Issues Completed Under Separate Environmental Assessments

1.13.1.1 Air Force Station (AFS) at Childs Mountain

The Air Force issued a draft EA in July 1995 proposing to demolish and remove a large portion of abandoned facilities at the Ajo Air Force Station located on Childs Mountain. A Finding of No Significant Impact (FONSI) was issued in January 1996. The FONSI states that “. . . because of the remoteness of Childs Mountain, there are no surrounding activities that would increase the impacts of the proposed demolition action. Implementation of the proposed action does not include any growth-inducing impacts. If anything, the demolition and removal of the Ajo AFS would decrease the ongoing military activities in southern Arizona.” The final EA and FONSI are hereby incorporated by reference.

1.13.1.2 FAA Surveillance Radar on Childs Mountain

The FAA released an EA and FONSI in February 1998 as part of its national program to modernize the Joint Use En Route Radar Systems along the perimeter of the continental United States. The ARSR-4 radar facility serves as a civilian and military aircraft tracking system and as a border surveillance system for CBP-BP. The EA discussed the potential impacts that might occur during the construction and operation of the proposed ARSR-4 facility at Childs Mountain. The FAA constructed an ARSR-4 facility on the summit of the mountain, and in the process removed Building 56, a large “hardened structure” designed

to withstand nuclear warfare. The work was managed under an MOU between the FAA, Military and USFWS. The final EA and FONSI are hereby incorporated by reference.

1.13.1.3 Watchable Wildlife Site on Childs Mountain

An Environmental Assessment for construction of a Watchable Wildlife Site on Childs Mountain was completed in October 1998 and is incorporated by reference. The site includes interpretive panels, shade structure, improved parking area, a graveled trail and rock work. Caution was used to protect existing vegetation and construction was timed to reduce impacts to desert bighorn sheep in the area. Access to the area is controlled by a locked gate and a permit and military hold harmless agreement is required. In fiscal year 2003 approximately 300 people visited the summit.



Interpretive Panel at Childs Mountain Watchable Wildlife Site

USFWS Photo

1.13.2 Issues Covered by Existing Policy, Law, or Regulations and Common to All Alternatives

1.13.2.1 Border Law Enforcement Activities

Some participants wanted to close all administrative trails within wilderness to vehicular use. The Arizona Desert Wilderness Act of 1990 allows the Border Patrol (currently BBP-BP), Customs and DEA to continue to conduct illegal alien and drug interdiction activities on the refuge including motor vehicle use in wilderness. These activities are governed by mutual agreement and outlined in an existing MOU. DHS, responding to great increases in illegal border traffic in recent years, and the hazards that undocumented aliens (UDAs) and other illegal traffickers face in crossing the Sonoran Desert, developed the Arizona Border Initiative in March of 2004. This initiative greatly increased the border law enforcement resources present in southern Arizona, in an effort to reduce the tide of illegal cross-border traffic. The initiative also calls for expanded use of motorized law enforcement vehicles in the wilderness.

The refuge recognizes the need for border enforcement to deter illegal traffic, which is responsible for significant habitat damage, disturbance of wildlife and degradation of wilderness character, and to prevent potential threats to public safety. The refuge will continue to work cooperatively with CBP-BP, CBP, and DEA to deter illegal drug trafficking and alien trespass, but will work to reduce impacts caused by this authorized use.



Abandoned bicycle
USFWS Photo

A national MOU was established in among DHS and Department of the Interior and Department of Agriculture bureaus that manage land (Appendix B) in March 2006. This MOU supersedes earlier agreements. In 1999, Tucson Sector Border Patrol and FWS Region 2 produced the training video, *Patrolling in a Desert Ecosystem* that addresses environmental concerns. Each station in the Tucson Sector was provided a copy and all agents viewed it. New agents are required to view the video when they arrive at their new duty station. The Tucson Sector has given a copy to the Yuma Sector, which may also adopt the same procedures. Additionally, the refuge conducts orientations

for new CBP-BP agents as needed to inform agents of endangered species, wilderness, and other environmental issues.

1.13.2.2 Fire Management

General Service policy is to control all wildfires in the Refuge System, including those within designated wilderness areas (6RM 7) unless an approved fire management plan provides for nonsuppression under certain circumstances (low risk of fire spreading to non-refuge lands and no significant threat to public health or safety). Prior to 2005, it was believed that no habitat capable of supporting prescribed burning existed on the refuge. Most natural fires, if discovered, burned out before suppression efforts would begin. However, after periods of above average rainfall fuel loads capable of carrying fire can develop. Human Activity (e.g., smuggling and interdiction) provides potential ignition sources. Because of this, a fire management plan will be developed for the refuge in the future. Methods of fire management used in designated wilderness will meet MRA.

1.13.2.3 Trespass Livestock

Trespass and feral animals are not permitted on refuge lands (50 CFR 26.21 b). The Service aggressively removes all trespass livestock. Methods of removal are determined on a case-by-case basis subject to MRA in wilderness. The refuge will attempt to work with the Mexican and U.S. ranchers to prevent or curtail trespass incidents. Any necessary fencing will be designed to allow free movement of pronghorn.

1.13.2.4 Pets

No unconfined domestic animal may enter or roam at large upon any national wildlife refuge (50 CFR 26.21 b). The refuge requires all pets to be leashed and under the control of the owner at all times.

1.13.2.5 Firearms

Refuge regulations (50 CFR 27:42) permit possession, use, and transport of firearms on refuges only for the purpose of participating in authorized public hunting programs. Firearms must be unloaded and cased when transported on refuge roads.

1.13.2.6 Commercial Uses

There were several questions about policy regarding commercial use of the refuge. The only commercial uses currently occurring on the refuge are tour groups and hunting guides. Policy regarding commercial use can be found in Commercial and Appropriate Uses 630 FW3 and FW5. These uses must be determined to be appropriate refuge uses and compatible with refuge purpose(s) as outlined in Appropriate Uses 603 FW1 and Compatibility 603 FW2. Valid mineral claims in existence when the refuge was created are to be administered according to 603 FW1. All commercial uses require a special use permit issued by the refuge manager and include the above determinations.

1.13.2.7 Congressional Intent in the Arizona Desert Wilderness Act of 1990

Members of the Yuma Valley Rod and Gun Club and the Arizona Desert Bighorn Sheep Society have questioned whether or not congressional intent in the enactment of this law permitted vehicular use to maintain water developments. The solicitor for the Southwest Region of the Service provided the refuge with a verbal opinion that under the Wilderness Act of 1964 the refuge has authority to manage for wildlife, and to use a vehicle in instances where it is determined to be the minimum tool needed to accomplish necessary management, but that there are no special provisions in the Arizona Desert Wilderness Act of 1990 exempting the refuge from making the MRA.

The refuge must take the opportunity to review its management practices and their effectiveness in meeting refuge purpose(s), mission, goals and objectives in the CCP process.

1.13.3 Issue to be Determined Pending Adoption of Wilderness Policy Revisions: Wheeled Game Carriers

The Wilderness Act prohibits the use of mechanical transport except as necessary to meet minimum requirements for administration. Although other agencies (NPS, FS, and BLM) all defined this term in their policies, the Service did not further define mechanical transport in the Refuge Manual under 6RM8 Wilderness Area Management (1986). In general terms, the use of mechanical transport for recreation cannot be allowed by MRA. However, if the refuge manager determines that the use of wheeled game carriers is needed to effectively administer a hunt, facilitate data collection, or meet specific management objectives; then mechanical transport may be authorized if found to be the minimum tool necessary. Until Service policy clarifies the issue, use of wheeled game carriers on refuge wilderness will be at the discretion of the refuge manager, subject to compliance with the Wilderness Act of 1964.

1.13.4 Issues Beyond the Scope of this Plan

1.13.4.1 Remove Wilderness Designation

Only Congress has the ability to establish or remove wilderness designation.

1.13.4.2 Turn the Refuge over to the State

Only Congress has the ability to remove lands from the National Wildlife Refuge System. While there are examples of cooperative management of visitor services by the State on a few refuges, there have been no instances where a refuge has been dissolved or transferred to a state agency.

1.13.4.3 Sonoran Desert National Park Proposal

A proposal to form the Sonoran Desert National Park has been developed by a private organization. The proposal is a citizen proposal and does not originate from the Department of Interior or National Park Service. This proposal is not to be confused with the recommended name change from OPCNM to the Sonoran Desert National Park that was proposed in the OPCNM 1997 General Management Plan, or the recent creation of the Sonoran Desert Monument on BLM lands northeast of the refuge. Congressmen Morris Udall first proposed the formation of a park comprised of OPCNM, Cabeza Prieta Game Range, and BLM lands in 1965. Only Congress can change the designation of a National Wildlife Refuge.

While this alternative is beyond the scope of this plan, many of the ideas suggested by the citizen group will be similar to those found in alternatives presented in Chapter 2. Separate management plans developed by the BMGR, OPCNM, and Cabeza Prieta NWR do not preclude these agencies from developing a comprehensive regional plan which could take the form of multi-agency cooperation under one of several existing teams such as the Barry M. Goldwater Executive Committee.

1.13.4.4 Additional Acquisitions

Comments were received asking that the refuge acquire additional lands for resource protection, specifically the Tinajas Altas to the west, and rangelands on the east which are part of the BLM's Lower Gila Resource Area. The refuge is completely surrounded by federal lands or Mexico except at headquarters in town. This option would require transferring BLM lands to the FWS.

Although several proposals in the past have included adding Tinajas Altas to the refuge, legislation has so far precluded the addition. Most recently, Congress authorized the BMGR to manage the natural resources on the west side, including Tinajas Altas, and required the completion of an EIS within two years. The BLM has identified certain lands it would like to divest to other federal agencies, but did not identify the lands on the refuge's east boundary. The refuge has not identified lands other than 12 hectares (30 acres) adjacent to refuge headquarters for acquisitions. The refuge seeks to work cooperatively with the BLM to achieve resource protection on neighboring lands.

1.14 EXISTING PARTNERSHIPS, COORDINATION AND COOPERATION

1.14.1 Interagency Cooperation

1.14.1.1 Arizona Game and Fish Department (AGFD)

A requirement to cooperate and coordinate with State wildlife management agencies is clearly stated in laws governing the National Wildlife Refuge System (National Wildlife System Administrative Act, of 1966, as amended; Fish and Wildlife Act of 1956, as amended). While ultimate authority to manage wildlife resources on refuge lands rests with the Service,⁶ state wildlife agencies have authority to manage wildlife

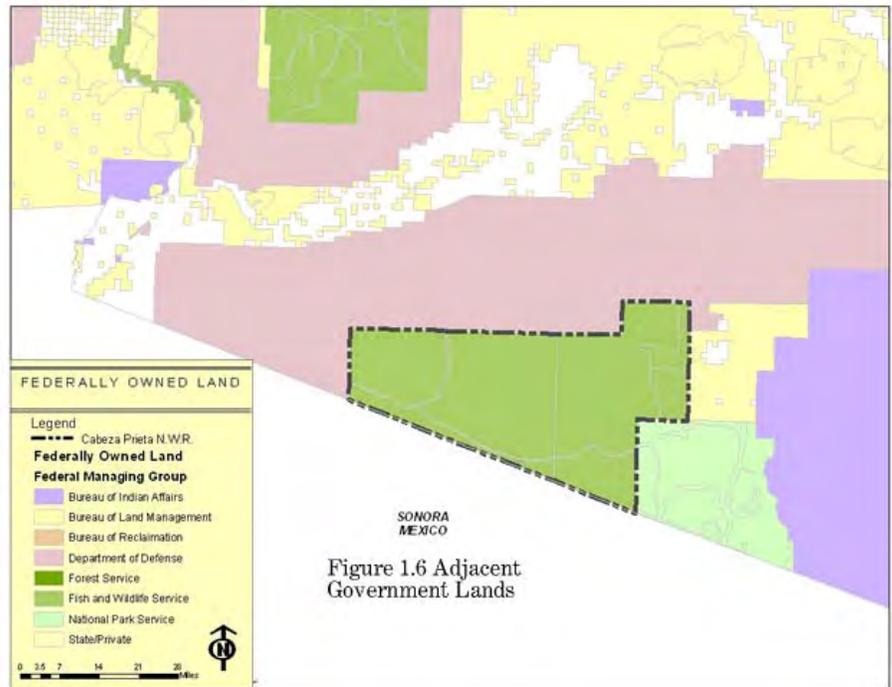
⁶In 1976 the Supreme Court, in *Kleppe v. New Mexico*, recognized the Constitution's provision of Federal authority to regulate wildlife on Federal lands. These powers are paramount to those of the States and, to the extent that Congress uses them to

resources unless there is a conflict with a defined federal interest. In the spirit of cooperative federalism, state wildlife managers are invited to participate in the refuge comprehensive conservation planning process.

The AGFD has been a full partner assisting the refuge in aerial surveys, managing the desert bighorn sheep hunt, and wildlife surveys, and has served as a member of the Sonoran Pronghorn Recovery Team. Additionally, the Refuge Improvement Act of 1997 requires refuges to consult with adjoining Federal, State, local, and private landowners and affected State conservation agencies in the development and revision of CCPs. AGFD administers the annual desert bighorn sheep hunt on the refuge, and AGFD staff members have participated in the CCP process as members of the planning team. Ultimate decisions regarding refuge management rest with Service.

1.14.1.2 Barry M. Goldwater Range Executive Council (BEC)

The BEC was formed August 1997 to provide a forum to enhance management of natural and cultural resources on the BMGR by teaming various state and federal agencies into a collaborative management council. The BEC addressed resource management issues and conflicts arising from land uses on the BMGR or affected by the BMGR with the intention of resolving those issues and conflict. The BEC met approximately six times a year, with subcommittees such as the Pronghorn Recovery Team meeting as required. Membership was limited to agencies having direct responsibility for lands or resources on or directly affected by military or other activities on the Range. The committee developed a unified permit system for public access to the entire area under federal administration instead of separate permit systems.



conserve wildlife, such action may pre-empt State authority. Such decisions have provided a firm basis upon which the Congress and the courts have established the role of the Federal Government as a full partner with the state in the conservation and management of wildlife and the habitats upon it depends. More recently (1999), the Supreme Court decided in favor of the Service in *Wyoming v. United States*, where the state contended that it had the right to manage wildlife on Federal lands.

1.14.1.3 The Intergovernmental Executive Committee

The 1999 MLWA mandated the formation of an Intergovernmental Executive Committee (IEC) solely for the purpose of exchanging views, information, and advice relating to the management of the natural and cultural resources of the BMGR. The IEC is established by the memorandum of agreement between the secretaries of the Air Force, Navy and Department of the Interior and is comprised of selected representatives from interested federal agencies, as well as at least one elected officer (or other authorized representative) from state government and at least one elected officer or other authorized representative from each local and tribal government.

The IEC convenes three times each year and meetings are advertised to solicit public participation. Meeting locations rotate to maximize opportunity for interested public and local jurisdictional participation. The IEC provides a forum for public groups and private citizens to express their views regarding the management process.

1.14.1.4 Organ Pipe Cactus National Monument

This unit of the National Park System abuts the refuge to the south and east and contains many habitats similar to those on the refuge, although the monument's climate is generally somewhat more mesic (wetter) than that of the refuge. Wide-ranging wildlife species, such as the Sonoran pronghorn, may range between the refuge and OPCNM. The refuge and the monument cooperate with AGFD on Sonoran pronghorn monitoring and share other resource data. The refuge interacts with the monument on several committees, including the IEC and International Sonoran Desert Alliance.

1.14.1.5 Border Law Enforcement

The National MOU established in 2006 specifies appropriate border law enforcement operations on the National Wildlife Refuges. Although the Arizona Wilderness Act provides for continued operations within wilderness, the agencies cooperate to ensure operations do not unnecessarily impact wilderness resources.

The refuge is covered by both the Tucson and Yuma CBP-BP Sectors operating out of Why and Welton stations. The majority of CBP-BP use on the refuge occurs along El Camino del Diablo by the Yuma sector (Welton), which operates "Camp Grip," a temporary command station located in refuge non-wilderness and staffed round the clock. Camp Grip deters illegal travel through a permanent law enforcement presence in the refuge backcountry and facilitates rapid response when illegal cross border travelers are detected. The majority of the Why station's activity occurs on neighboring OPCNM. Daily helicopter patrol occurs along El Camino del Diablo and most vehicle use occurs in response to sensor or rescue activity. Welton provides monthly statistics to refuge management regarding illegal activities occurring on the refuge. Refuge Law Enforcement staff frequently engages in joint operations with DHS Law Enforcement staff.

An increase in CBP-BP coverage at the Ports of Entry and adjacent urban areas along the entire U.S./Mexico border has resulted in additional crossings occurring at more remote locations such as the refuge. In response to great increases in illegal trafficking in remote southwestern locations, the CBP-BP implemented the Arizona Border Control Initiative in 2004. This initiative increases the numbers of border law enforcement agents stationed on and around the refuge and relaxes motor vehicle use constraints previously observed. DEA conduct border operations as well, but has less contact with refuge staff.

1.14.1.6 Bureau of Land Management (BLM)

The refuge participates with the BLM Yuma and Phoenix field offices on regional committees such as the BEC, International Sonoran Desert Alliance, and the Borderlands Management Task Force, and conducts joint law enforcement activities.

1.14.1.7 Tohono O'odham Nation

The refuge participates in a variety of cooperative projects with the Nation including the International Sonoran Desert Alliance, and BEC described elsewhere in this section. Additionally, refuge staff provides technical assistance to Tohono O'odham Nation biologists in developing their natural resource program, assisted in setting up a GIS program, coordinates archeological resource issues, and discusses cultural interpretation development with the Nation.

1.14.1.8 Arizona Interagency Desert Tortoise Team (AIDTT)

The refuge is an important member of the AIDTT due to the large block of tortoise habitat it manages in the southwestern portion of the species' range. The refuge is involved in developing the State Conservation Agreement for the Tortoise.

1.15 NON-GOVERNMENT COOPERATION

1.15.1 International Sonoran Desert Alliance (ISDA)

The ISDA is a community based alliance of individuals, businesses, and organizations of the border region of the western Sonoran Desert area which includes the Cabeza Prieta NWR, OPCNM, Tohono O'odham Nation, the BMGR, the BLM, the Pinacate Biosphere Reserve and the Upper Gulf of California Biosphere Reserve. The organization promotes cooperation between communities, non-governmental organizations, and government agencies in the U.S. and Mexico to resolve resource conflicts, promote community development, and collaborative research activities.

The organization sponsors international border forums each year, has developed a tri-cultural environmental education program called Juntos, and is working to develop a brochure and regional plan for a sustainable economic development strategy.

1.15.2 Cabeza Prieta Natural History Association

The Natural History Association's mission is to promote the scientific, historic, educational, and interpretive activities of the U.S. Fish & Wildlife Service at Cabeza Prieta NWR. They sponsor a winter lecture series and guided tours to Childs Mountain twice a month January through April. The group also coordinates the annual Christmas Bird Count and provides volunteer assistance for a variety of maintenance projects. The group operates sales of books related to the Sonoran Desert, Cabeza Prieta and Sonoran Desert themed tee shirts, mugs, caps and other memorabilia at the refuge visitor center. Proceeds from sales are divided between the Association and the refuge to support visitor services activities and environmental interpretation.

2.0 MANAGEMENT ALTERNATIVES

2.1 ELEMENTS COMMON TO ALL ALTERNATIVES

Certain elements of endangered and threatened species recovery, wilderness stewardship, and cultural resources management are common to all action alternatives (Alternatives 2 through 5). Some of the alternatives include additional actions beyond those of the common elements. In all such cases the additional actions are described under the appropriate resource area for the individual alternative.

2.1.1 Federal Endangered and Threatened Species

Each of the alternatives will implement the following recovery actions and conservation activities for two federally endangered species documented to occur on the refuge, the Sonoran pronghorn and the lesser long-nosed bat. One other federally listed species, Pierson's milkvetch, may occur on the refuge, but has not been documented.

2.1.1.1 Sonoran Pronghorn

The refuge is a leader in the overall Sonoran pronghorn recovery effort. The refuge biologist is the recovery coordinator, and refuge staff is represented in all recovery team meetings. The refuge biologist is often elected as the recovery team leader. The refuge will continue to implement Sonoran Pronghorn Recovery Plan actions. The *Recovery Criteria and Estimates of Time for Recovery Actions for the Sonoran Pronghorn, a Supplement and Amendment to the 1998 Final Revised Sonoran Pronghorn Recovery Plan* established eight recovery efforts that should initially result in down-listing the species to federal threatened status (an estimated 300 adult Sonoran pronghorn in one U.S. population and a second separate population established in the U.S.). The recovery efforts should contribute to the eventual recovery of the species and its removal from endangered or threatened status (USFWS 2002). The amendment further states:

In the near-term, recovery efforts should focus on: 1) improving habitat for fawn survival and recruitment through the establishment and evaluation of forage enhancement plots on the BMGR (USAF 2000); 2) initiating a quantitative evaluation of pronghorn use and reliance on sources of free water (temporary and permanent); 3) reducing predation through the selective removal of coyotes from specific areas and at times of the year when adult female pronghorn are most susceptible to predation (the need for coyote control will vary from year-to-year based on environmental conditions); 4) evaluating potential transplant locations, establishing relocation methodology and protocols, developing interagency agreements (including with Mexico as required), acquiring funding, and initiating reestablishment projects; 5) increasing frequency and expanding scope of aerial monitoring in Mexico to improve comparability with U. S. surveys; 6) investigating potential pronghorn disease vectors; 7) reducing disturbance at critical times of the year; and 8) investigating and reducing movement barriers. The Service will annually review implementation of the Recovery Plan to determine when revisions are appropriate, including the appropriateness of establishing delisting criteria (USFWS 2002).



Helicopter crew releasing a radio collared pronghorn

USFWS Photo

The refuge's management actions for Sonoran pronghorn currently address all of the eight recovery actions listed above with the exception of numbers 3) reducing predation through coyote control, 5) increasing monitoring in Mexico, and 6) investigating potential disease vectors.

2.1.1.1.1 Population Monitoring

The refuge and AGFD conduct range wide population surveys of the U.S. Sonoran pronghorn sub-population every two years, using a group sighting model. The monitoring protocol sets a target of keeping radio collars on approximately 10 percent of the population. In the summer and fall of 2002 all remaining individuals with operating collars died. Additional capture and collar operations are undertaken when permits are obtained and weather conditions allow safe capture and collaring. During the winter of 2005 two Sonoran pronghorn were captured and collared. These are the only collared individuals currently within the U.S. population. The refuge and AGFD have developed protocols for capture and collar operations to prevent capture myopathy related mortality (that is, post-capture death of animals related to shock and stress of capture and handling; in the past capture myopathy resulted in high levels of mortality after collaring operations) to pronghorn.

AGFD also conducts weekly aerial radio tacking of collared pronghorn with visual reconnaissance for uncollared individuals. Whenever possible, mortalities are investigated and forensic investigations conducted promptly. AGFD and the refuge maintain a database of all Sonoran pronghorn sightings.

A summary of population data from the period 1992 through 2004 is presented in Table 2.1.

Date	Pronghorn seen on transects	Total number of pronghorn seen	Population estimate	95 % Confidence interval
Dec. 1992	99	121	179	145-234
Mar. 1994	100	109	282	205-489
Dec. 1996	71	95	130	114-154
Dec. 1998	74	98	142	125-167
Dec. 2000	67	69	99	69-392
Dec. 2002	18	18	21	18-35
Dec. 2004	39	39	58	40-175

2.1.1.1.2 Developed Waters

Five types of water developments are found on the refuge: buried reservoirs with collection points and drinking troughs, runoff tanks (modified tinajas), charcos, wells with drinking troughs, and storage tanks with drinking troughs. Buried reservoirs are typically constructed of one or more 1,780-liter (470-gallon) pipes connected to water collection points in natural drainage courses and wildlife drinking troughs. Buried tanks are covered with native soil and have very little visual impact on the surroundings. Runoff tanks mimic natural tinajas and are the next most natural looking structures. They are created by either blasting holes in rock or building small dams in mountain washes. A few hold water throughout the season. Charcos are dugout ponds also locally called repressos. An area is bulldozed and lined to hold water. The charcos dry up during the driest time of year. Fiberglass tanks and drinkers were added to charcos and other sites to augment water in dry months. These structures include a water reservoir of some type connected to a drinker, or trough regulated by a float valve, and require hauling water once or twice each year. Most of the wells are located outside of wilderness. They were developed for livestock when grazing was permitted and now feed drinkers for wildlife. Most are



Jose Juan Charco with water

USFWS Photo



Papago Well and water storage tank

USFWS Photo

located in pronghorn habitat, but levels of use by pronghorn are poorly understood, although refuge photography by motion triggered cameras verifies use of several developed waters by Sonoran pronghorn..

There are 22 developed waters on the refuge in Sonoran pronghorn habitat. See Table 2.2 for a listing of these water, their general type, location relative to the refuge wilderness, and type of activity related to managing the water.

A determination to haul water is based upon observation of water levels by AGFD personnel during weekly aerial reconnaissance, observations by refuge staff conducting field

Name	Type	Wilderness	Current Activity
Adobe	Well, tank & trough	No	Monitoring , maintenance, some water hauling
Adobe House	Well, tank & trough	No	Recently redeveloped, monitoring & maintenance
Antelope	Improved water	Yes	Monitoring, maintenance, emergency water hauling only
Bassarisc*	Improved water	Yes	Monitoring, maintenance, emergency water hauling only
Charlie Bell*	Well, tank & trough	Yes	Monitoring & maintenance
Chico Shunie	Well, tank & trough	No	Not functioning
Jacks	Well, tank & trough	Yes	Monitoring & maintenance, hauling, redevelopment proposed
Jose Juan	Charco, tank & trough	Yes	Monitoring, maintenance, water hauling
Little Tule	Well, tank & trough	No	Monitoring, maintenance, hauling, redevelopment proposed
Lower	Well, irrigation	No	Recently redeveloped
Papago	Well, tank & trough	No	Monitoring, maintenance & hauling
Redtail	Charco, tank & trough	Yes	Monitoring, maintenance & hauling
Tiller	Well, tank & trough	No	Monitoring & maintenance
9 emergency waters	Improved waters, some have limited capacity	Yes	Monitoring, maintenance & hauling enlargement and improvements proposed.

* These waters are used bighorn sheep as well as Sonoran pronghorn. In the case of Bassarisc, only very infrequent use by Sonoran pronghorn is known to occur

work near the waters, and best judgment of refuge staff considering precipitation and temperature. The refuge attempts to prevent developed waters from going dry during the hot summer season, while also avoiding unnecessarily frequent water hauling trips. Water is hauled in a 5,675 liter (1,500 gallon) capacity heavy duty truck. Typically nine to eighteen water hauling trips are made in each year. Refuge staff prepares a Minimum Requirements Analysis (MRA) (see Section 2.1.3.1 below for a discussion of MRA) prior to any hauling and records miles driven in wilderness.

In the spring of 2003, the refuge, with assistance from its partners, installed an improved water collection and storage system at Antelope Tank. The new system uses an underground storage tank of approximately 46,500 liters (11,000 gallons), multiple water collection points in washes, and a small drinking trough. This system has low visual impact, high water collection efficiency, and low evaporation potential and requires little maintenance. The system's design is expected to significantly lower required water hauling and scheduled maintenance, as compared to the parabolic tank it replaces. Experience since this improvement's installation suggests that water hauling will only be necessary in times of prolonged, extreme drought. In over two and one-half years since its installation, including a period of prolonged drought in the fall and winter of 2005 and 2006, no hauling of supplemental water has been required (Coffeen, pers. com. 2006).



Volunteer work crew installing buried reservoir system at Antelope Tank USFWS Photo

Refuge staff and volunteers installed an improved water storage and collection system of similar design to that used at Antelope Tank, as well as a drinking trough in Sonoran pronghorn habitat, at Bassarisc Tank in early 2004. The new buried tanks at Bassarisc Tank have a capacity of 37,360 liters (9,870 gallons) and are connected to multiple water collection points in natural drainages. This improved water Bassarisc Tank is not anticipated to require supplemental water other than during periods of prolonged, extreme drought.

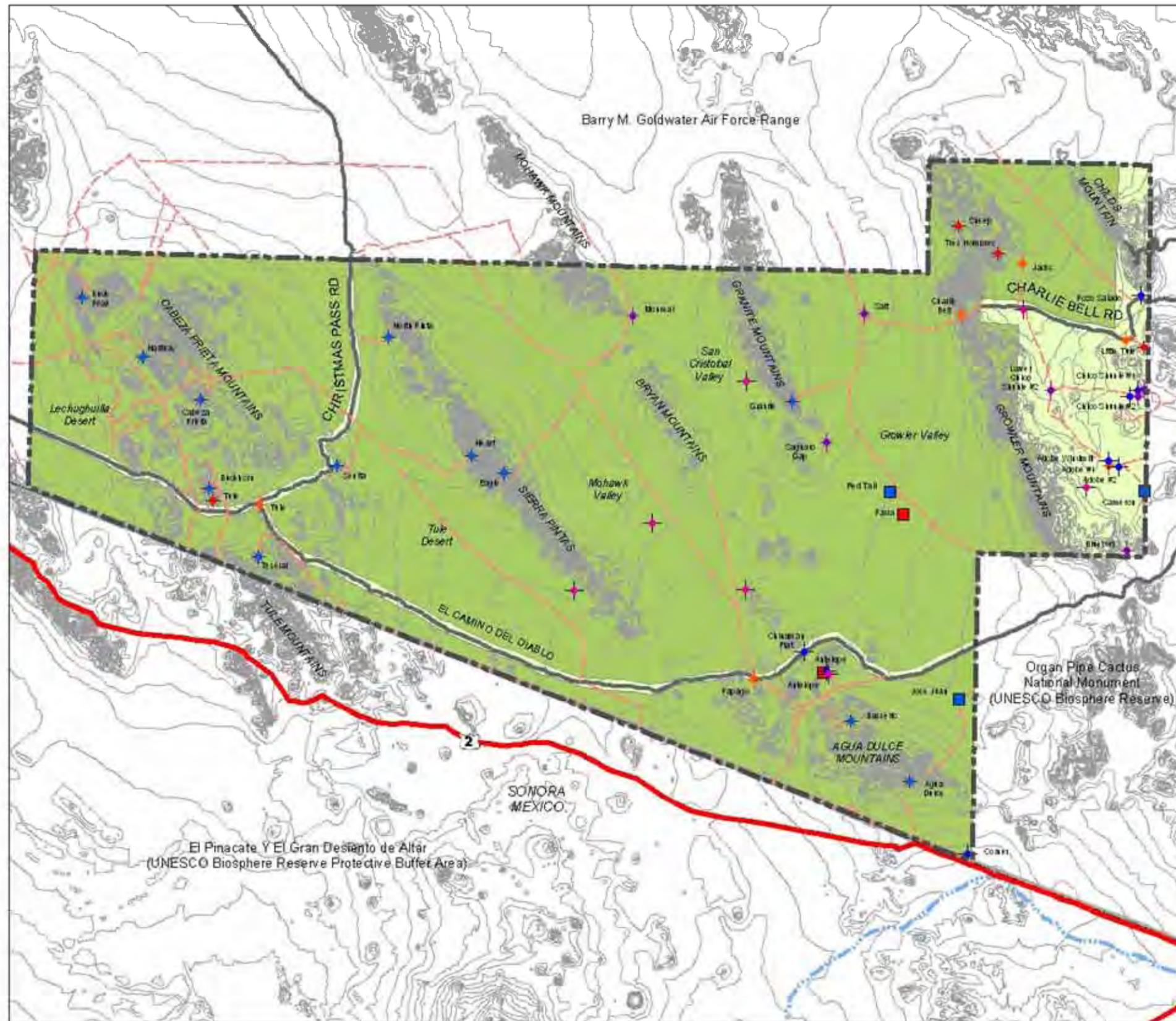
During the summers of 2001 and 2002, the refuge conducted water source monitoring and experimental placement of temporary developed waters in Sonoran pronghorn habitat. Temporary waters were placed south of Charlie Bell Road in Daniels Arroyo, and at two locations on the bajada of the Agua Dulce Mountains. This experiment verified that Sonoran pronghorn would use new sources of water in previously unwatered areas and also provided quantitative data on pronghorn use of temporary waters, as targeted by the second recovery effort.

In response to the results of the temporary waters experiment, the refuge has developed 10 emergency waters in Sonoran pronghorn habitat since 2003. These waters are similar to the improvements for Bassarisc and Antelope Tanks described above, except that they are of smaller capacity, ranging from 1,780 liters (470 gallons) to 3,560 liters (940 gallons). These ten emergency waters are located in wilderness (including one located on OPCNM). Figure 2.1 shows the locations of refuge developed waters.

2.1.1.1.3 Captive Breeding/Translocation

The refuge biologist, in consultation with AGFD biologists, prepared a white paper overview of Sonoran pronghorn reestablishment standards for the Canada/ Mexico/U.S. Trilateral Committee for Wildlife and Ecosystem Conservation and Management (Morgart *et al.*, 2002). This paper summarizes potential alternatives of translocation and/ or captive breeding of Sonoran pronghorn to increase the viability of existing subpopulations in the U.S. and Mexico, or establish a new subpopulation in either country in the interest of species recovery. The paper concludes: "Re-establishment of Sonoran pronghorn into suitable habitat in the Sonoran Desert of southwest Arizona and northwest Sonora, Mexico, is a necessary action in order to affect a meaningful recovery of the subspecies." (Morgart *et al.* 2002).

Figure 2.1 Developed Waters



Legend

- Cabeza Prieta N.W.R.
- Wilderness
- Non-Wilderness
- Public Roads
- Administrative Trails
- US/Mexico Border
- Highway
- Rio Sonoyta
- Active Well
- Active Tinaja / Tank
- Inactive Tinaja / Tank
- Inactive Well
- Capped Well
- Active Charco
- Inactive Charco
- Waters for Sonoran Proghoms

Sources: USFWS, 2003



**CABEZA PRIETA
NATIONAL WILDLIFE REFUGE**

COMPREHENSIVE CONSERVATION PLAN

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH & WILDLIFE SERVICE

In the winter of 2003, the refuge developed a semi-captive breeding facility south of Charlie Bell Road. The facility occupies approximately 260 hectares (640 acres) enclosed by a fence adequate to contain Sonoran pronghorn and exclude predators. A source of drinking water for pronghorn and several irrigated areas (irrigation simulates rainfall during a wetter than average year) supply sustenance for the pronghorn inside the enclosure. After the fence was installed, predators were aggressively removed from the enclosure. During the winter of 2004-2005 refuge and AGFD staff captured Sonoran pronghorn in Mexico and on the refuge to stock the semi-captive breeding facility. One animal captured during the 2005 operation was observed eating alfalfa hay used as bedding material. During the winter of 2005-2006 refuge staff provided Sonoran pronghorn in the semi-captive breeding facility alfalfa hay as an experimental food supplement. The animals accepted alfalfa as fodder. In the spring of 2006 there were 18 adult Sonoran pronghorn in the facility, 12 does, 2 breeding bucks and 4 yearling bucks that are considered surplus animals and will be released into the refuge when weather conditions are favorable. By providing ample food and water resources in an environment of reduced predation, the semi-captive breeding facility is anticipated to stimulate rapid regrowth of the refuge Sonoran pronghorn population (Coffeen, pers. comm.).

2.1.1.1.4 Area Closures

Recent biological opinions issued by the Service to the managers of adjacent public lands required the closure of Sonoran pronghorn habitat to public recreational access on lands administered by the BMGR and OPCNM during the fawning season (March 15 through July 15). The refuge, although not included in the mandatory closure, voluntarily closed public access to approximately the eastern three-quarters of its area, roughly from 8 kilometers (5 miles) east of Tule Well to the refuge eastern boundary, since 2002. Similar annual closures are likely until drought conditions ease and/or the U.S. Sonoran pronghorn subpopulation is considered stable. All action alternatives will include closure of this area during the fawning season until Sonoran pronghorn numbers have increased substantially.

2.1.1.1.5 Supplemental Feeding and Forage Enhancements

During the summer and fall of 2002, greater than normal mortality of radio-collared Sonoran pronghorns was observed on the refuge. During the December 2002 biennial Sonoran pronghorn survey conducted by AGFD and the Service, only 18 animals were observed. The 95 percent confidence interval estimate of the population size was 18 to 35 and the population estimate was 21. This is the lowest estimate ever observed. Such low population size is likely due to extreme drought resulting in poor forage conditions and high mortality (J. Morgart, USFWS, pers. comm.).

As an emergency response, the refuge provided mineral licks and supplemental feed, both pellets of a composition used to feed American pronghorn at zoos and grass hay, at sites of known pronghorn use. These measures were considered experimental, short-term efforts to address an acute need. No evidence was collected that Sonoran pronghorn recognized the feed pellets or hay as potential food sources. One remote camera recorded a single incidence of an individual pronghorn examining feed pellets, but none have been recorded eating the pellets. It appears that wild Sonoran pronghorn, unfamiliar with supplied feed, will not accept it. Sonoran pronghorns in the semi-captive breeding facility have accepted alfalfa hay as a supplemental fodder, and it is also being considered as a supplemental forage at the forage enhancement plots during extreme drought periods.

The Sonoran Pronghorn Recovery Team has proposed to develop forage enhancement areas on the refuge, BLM lands, and others in the BMGR to provide sources of green fodder to Sonoran pronghorn during times of drought stress on vegetation. Forage enhancements are areas of approximately 10 hectares (25 acres), selected on sites having greater than average vegetative cover in areas of documented frequent pronghorn presence. Approximately 2.4 hectares (6 acres) within the enhancement is then rigged for sprinkler irrigation. The site is irrigated during low rainfall years to mimic natural rainfall during a slightly wetter than average year. No

supplemental seeds are planted, as the ground should have adequate seed resources and off-site seed sources may be contaminated with exotic species. Currently six forage enhancement areas for Sonoran pronghorn exist on or near the refuge. One forage enhancement was developed in the semi-captive breeding enclosure to provide supplemental food sources for the animals contained within the enclosure. There are five additional forage enhancements in Sonoran pronghorn habitat, two within the BMGR to the north of the refuge, and three in Childs Valley on the refuge. The three refuge forage enhancement plots are all located in non-wilderness and are supplied with water from Tiller Well, Adobe House Well and Lower Well. If the Sonoran Pronghorn Recovery Team recommends development of additional forage enhancements on the refuge, the refuge will develop them, upon obtaining all necessary approvals.

2.1.1.1.6 Fencing

The refuge, with assistance from volunteer organizations, is in the process of removing barriers to pronghorn movement. Existing boundary fence separating refuge lands from adjacent lands subject to grazing is being modified to be cattle proof but pronghorn passable (lowest strand not barbed and at least 46 centimeters [18 inches] above grade). Subject to the BLM's current Biological Opinion for five livestock grazing allotments in the vicinity of Ajo, Arizona, fences between the refuge and BLM lands to the east will be laid down between May 1 and August 31 of each year to facilitate Sonoran pronghorn passage. Grazing has been abandoned on one allotment, resulting in complete removal of fencing from the Little Ajo Mountains. Fencing within the refuge and fencing between the refuge and OPCNM has been taken down, and the fencing materials removed by volunteers, refuge staff and OPCNM staff, subject to MRA.

2.1.1.2 Lesser Long-nosed Bat Conservation

The federally endangered lesser long-nosed bat's maternity roost known to exist on the refuge will continue to be afforded legal protection by virtue of the Refuge's protected status and limited access. Despite this level of legal protection, however, the roost has been subject to frequent unauthorized use by migrants and smugglers. In the early spring of 2004, the refuge installed a steel fence ranging from 2.5 to 3 meters (8 to 10 feet) high around the roost entrance to discourage human entry. The fence is constructed of 2.5-centimeter (1-inch) vertical pipes welded to cross pipes at 13-centimeter (5-inch) intervals. The tops of the vertical pipes are cut at an angle to produce a sharp point and the top 30 centimeters (12



Fence around entrance to lesser long-nosed bat maternity roost
Photo by Curtis McCasland

inches) of the pipe is bent outwards. The sharp tops and outward bend should make climbing over the fence difficult. This fence provided an immediate positive effect to bats that were displaced by human interference. After observing no bat use of the cave in the summer of 2003, refuge biologists documented use by more than 2000 bats in 2004, and a return to pre-disturbance levels in 2005. Refuge staff periodically monitors the entrance to the roost to document damage caused by unauthorized human use and assess bat use. Refuge law enforcement personnel conduct periodic surveillance of the roost to check for persons using the entrance as a campsite, storage area or shelter. Refuge biologists will continue to survey for additional, unknown roost sites on the refuge. The refuge will continue to keep the location of the roost unpublished. Survey and surveillance activities are conducted on foot in wilderness.

2.1.1.3 Pierson's Milkvetch Surveys

The federally threatened Pierson's milkvetch occurs on Marine Corps (USMC) lands to the west, but has not been documented on the refuge. The Pinta Sands, in the south central area of the refuge, provide potential habitat for Pierson's milkvetch. Refuge staff will continue to conduct periodic surveys for this threatened plant in suitable habitat.

2.1.1.4 Desert Pupfish Refugium

Action Item 11 of Objective 3 of the *Gila/Salt/Verde Ecosystem Plan* (USFWS 1994) calls for investigating the feasibility of establishing secondary populations of desert pupfish on refuge lands. This endangered fish is not known to have ever occurred on the refuge, but is a component of the Sonoran Desert biota. During the summer of 2004 the refuge developed a refugium on the visitor center site. Refuge staff will continue to monitor the refugium population and provide interpretive services for refuge visitors.

2.1.2 Species of Conservation of Concern

2.1.2.1 Cactus Ferruginous Pygmy-owl Monitoring

The refuge continues to take an interest in the formerly federally endangered cactus ferruginous pygmy-owl. Although only two records of the owl exist on the refuge, there is potential habitat on the refuge. Refuge staff will continue to monitor the presence and number (if present) of owls.

2.1.2.2 Desert Bighorn Sheep Population Monitoring

The refuge and AGFD conduct helicopter surveys to monitor sheep populations every three years. These surveys began in 1986. Population estimates are extrapolated from survey results using a correction factor for group size, sex and age structure, and percent of habitat surveyed to determine a population estimate from the number of sheep observed (see Table 2.3 for a summary of survey estimates). The refuge maintains a database of population statistics, including group size, sex and age structure, and percent of habitat surveyed.

Date	Population Estimate	95 Percent Confidence Interval
1993	480	334-958
1996	408	285-801
1999	381	271-718
2002	323	228 -621
2005	348	248-663

2.1.3 Wilderness Stewardship

The Arizona Desert Wilderness Act of 1990 designated 325,133 hectares (803,418 acres) of the 348,035-hectare (860,010-acre) refuge, or 93 percent of the refuge area, as Federal Wilderness. This wilderness is administered in compliance with the Wilderness Act of 1964, with the exception that the Arizona Desert Wilderness Act of 1990 included provisions to allow some generally prohibited uses in order to facilitate border law enforcement and military training activities. Refuge management and operations will strive to protect the character of the designated wilderness, so that it meets the definition found in the Wilderness Act of 1964:

A wilderness, in contrast with those areas where man and his works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological or other features of scientific, educational, scenic or historical value. (Sec. 2 (c)).

2.1.3.1 Minimum Requirements Analysis

The Wilderness Act of 1964 lists uses that are generally prohibited within designated wilderness unless the use is necessary to meet the minimum requirements for administration of the area as wilderness. These generally prohibited uses are: any temporary road, use of motor vehicles, motorized equipment or motor boats, landing of aircraft, any other form of mechanical transport or any structure or installation (Sec. 4 (c)). Any refuge management activity proposing one or more of the generally prohibited uses within the refuge wilderness will be subject to MRA to determine appropriateness, on either a programmatic or case-by-case basis. In addition to such uses, which are generally prohibited, but may be allowed as the minimum requirement to administer the area as wilderness, the Wilderness Act of 1964 also prohibits two uses in wilderness unconditionally. Commercial enterprises and permanent roads are prohibited in wilderness, unless specifically provided for in the Act or subsequent wilderness establishment legislation (Sec. 4 (c)).

The MRA is a two-step process. First, the proposed use must be demonstrated to be necessary for administration of the area as wilderness. Second, the means of accomplishing the proposed use must be analyzed and alternatives investigated to determine that the necessary use is being executed in a manner that minimizes impacts to wilderness character, both long- and short-term. Only when both of these conditions have been satisfied can the use be considered "necessary to meet the minimum requirements for the administration of the area" and be allowed within wilderness.

Although the intensities of management activity and means of wilderness access will vary among the alternatives, only activities determined necessary to administer the refuge as a wilderness or those specifically exempted under the Arizona Desert Wilderness Act, such as border enforcement, will be allowed within designated wilderness. Activities necessary to administer the area as a wilderness include wildlife management practices determined necessary to foster or maintain appropriate densities of native wildlife.

2.1.3.2 Border Law Enforcement

The Arizona Desert Wilderness Act of 1990 specifically states that designation of wilderness lands within the refuge will not preclude or otherwise affect continued border operations by the Immigration and Naturalization Service, the Drug Enforcement Administration (DEA) or the United States Customs Service, in accordance with interagency agreements (Title III, Sec. 301 (g)). Earlier interagency agreements between federal border law enforcement agencies and the Service limited routine patrol vehicle use to public roads; and allowed use of refuge administrative trails only to investigate sensor activity, engage in pursuit activity, and search and rescue operations; and limit off-road travel to emergency situations. The national MOU enacted in March of 2006 among DHS and bureaus of the Departments of Agriculture and the Interior that manage lands authorizes use of vehicles for border law enforcement activities on administrative trails closed to the general public. Such use on the refuge is consistent with the Arizona Desert Wilderness Act of 1990, as the density of illegal travelers and the size of the refuge renders use of administrative trails necessary effect border law enforcement.

In recent years undocumented alien (UDA) traffic in and around the refuge has increased significantly, apparently in response to increased law enforcement in urban areas. In the response to this increase, the CBP-BP is implementing the Arizona Border Control Initiative. This effort will increase the number of border law enforcement personnel and equipment along the international boundary in Arizona and may result in some relaxation of vehicle use restrictions on border law enforcement personnel in wilderness areas.

The refuge presents training and orientation sessions for CBP-BP and DEA agents to increase their awareness of appropriate operations in wilderness, and is assisting CBP-BP in preparation of a training video that provides guidelines on low impact wilderness travel techniques.

Refuge law enforcement staff participates in the Border Anti-Narcotics Network (BANN), a combined effort among local and federal law enforcement agencies (Pima County Sheriff's Office, CBP, Immigration and Naturalization Service, DEA, BLM, NPS and Military) to combat narcotics trafficking. Refuge staff also participates with CBP-BP in apprehending undocumented aliens on the refuge. The refuge and CBP-BP deploy and monitor a network of remotely operated sensors to detect vehicles and pedestrians moving in proximity to the border. This remote sensing includes magnetometers, automated cameras and motion detectors.

The refuge maintains bilingual (English-Spanish) warning signs along the border. These signs warn that crossing the desert is dangerous due to hazards of heat and dry conditions. In addition to bilingual written warnings, the signs include easily understood icons depicting the dangers of heat and desiccation. The signs are often stolen or removed by unknown individuals (permitted refuge visitors are not allowed on the border) and refuge staff cannot keep up with replacement.

DHS is currently developing plans for a border vehicle barrier. Other solutions, including a human- and vehicle-proof fence along the entire U.S./Mexico border are being considered in U. S. Congress. Prior to the Department of Homeland Security's proposal to develop a border vehicle barrier, the refuge had proposed developing a similar structure. Upon review, the Office of Management and Budget (OMB) determined that the potential cost of a vehicle barrier would be too high to be borne by the National Wildlife Refuge System. Furthermore, OMB stated that it was not the job of the Department of the Interior to secure an international border. The exact location and design of the Department of Homeland Security's vehicle barrier has not yet been determined. The barrier would require regular patrols to detect efforts to circumvent the barrier such as placement of vehicle ramps over the barrier. All environmental and NEPA clearances for construction and operation of the vehicle barrier will be obtained by the U.S. Department of Homeland Security when actual construction is proposed. The refuge and the Service will review and comment upon any structures proposed to be constructed along the border in the vicinity of the refuge.

2.1.3.3 Wilderness Impact Monitoring

In 1999, the refuge initiated a program of annually surveying 25 designated monitoring areas for impacts to wilderness. The monitoring areas are 9.1 meters by 10.7 meters (30 feet by 35 feet) in area and are located along all public use roads and along 10 administrative trails. Each area was evaluated for percent bare soil, percent slope, trail depth, evidence of vehicle use beyond the limits of the road or administrative trail, washouts, vegetation cover, vegetation damage, root exposure, cleanliness, and evidence of wildlife. Control plots are also established nearby to monitor natural conditions as compared to changes occurring due to vehicle and other road/administrative trail impacts. In addition, a campsite monitoring program has been initiated to record the number, size, location, and condition of campsites on the refuge. Owing to reduced staff levels and funding, as well as increased demands brought on by border problems, the refuge has been unable to consistently monitor these impacts in recent years.

2.1.4 Cultural Resources Management

All management activities on the refuge will be in compliance with Section 106 of the National Historic Preservation Act. Prior to any projects requiring earth moving, an archaeological review will be completed to ensure that cultural resources are not affected. Unauthorized excavation or disturbance of cultural or historical artifacts is prohibited. The location of known cultural artifacts on the refuge is not published or otherwise publicly disclosed. The only interpretation of cultural artifacts at the refuge occurs at the visitor center. The *Cultural Resources Overview and Assessment, Cabeza Prieta National Wildlife Refuge*, prepared under contract to the Service in 2001, contains information on prehistoric cultures that occupied or traveled through the lands that became the refuge, and records known cultural resources. The refuge also hosts annual surveys by Archaeological Site Stewards, a group of volunteers recognized by the State of Arizona for their archaeological training. The locations of all archaeological sites identified are recorded by the refuge, but are not made public to avoid attracting pot hunters.



Water jar
USFWS Photo

2.1.5 Research

2.1.5.1 Biological Research

As a result of serious budget cuts in Fiscal Year 2006 and further cuts proposed for FY 2007, the refuge is not funding any biological research other than research related to Sonoran pronghorn recovery.

2.1.5.1.1 Sonoran Pronghorn

The refuge implements research goals of the Sonoran pronghorn recovery effort, and also invites research by other pronghorn experts. The refuge cooperates with outside researchers investigating Sonoran pronghorn/water relationships, and the effect of developed waters on other wildlife populations, including predators and non-native species.

A University of Arizona research project investigating the behavior of Sonoran pronghorn in the breeding enclosure was initiated in 2004. In 2006, funds to complete the last year of the study were cut because of a midterm budget cut and only limited data collection was funded by University of Arizona.

The refuge, in cooperation with AGFD and funded by USAF, conducted studies of Sonoran pronghorn's responses to nighttime aerial training missions over the refuge and BMGR, using mule deer as a surrogate species.

2.1.5.1.2 Desert Bighorn Sheep

A University of Arizona research project investigating desert bighorn sheep water preference was initiated in 2001. This study uses radio collars with global positioning system satellite uplink capability to establish a baseline of sheep movements in the Sierra Pintas and then monitor response when sheep access to the three primary water sources in that range (North Pinta Tank, Heart Tank and Eagle Tank) is experimentally denied (i.e., the waters will be fenced to exclude any use by sheep). The 5-year study should be of sufficient length to capture responses to some of the climatic variation typical of the Sonoran Desert. In 2006, funds to complete the last year of this PhD research study were cut and only limited data were collected the last year.

2.1.5.1.3 Other Species

Refuge staff and resources are available as feasible to researchers investigating any of the threatened or endangered species known or believed to occur on the refuge.

The refuge encourages academic research on its reptiles and amphibians. The University of Arizona is developing a recommended survey protocol for reptiles and amphibians. The refuge plans to adopt this protocol.

The refuge will invite academic and other researchers to conduct rodent monitoring on the refuge.

2.1.5.1.4 Ecological Integrity

The refuge supports any academic or other research investigating ecosystem integrity of the Sonoran Desert, both in the U.S. and Mexico.

2.1.6.1.5 Exotic and Invasive Species

The refuge and the Service Regional Office staff seek methods to control and/or prevent infestations of exotic or invasive species. The refuge will support academic research regarding control of such species on the refuge.

2.1.5.2 Wilderness

The refuge analyzes the data gathered in all wilderness monitoring efforts, both current and proposed. This data analysis is aimed at identifying the type and magnitude of impacts to wilderness character caused by refuge management activities, illegal cross border traffic, border law enforcement and military activities. See the individual alternative descriptions for the details regarding ongoing or proposed wilderness monitoring. The refuge also welcomes wilderness research proposals by academic and other researchers.

2.1.5.3 Visitor Services

The refuge will analyze visitor survey data collected in 2002 to identify trends in preferred visitor experiences, factors that adversely affect the visitor experience, and other trends.

2.1.5.4 Cultural Resources

The refuge will continue to consult with the Tohono O'odham Nation, the Hia-Ced O'odham and Yuman/Patayan nations, when considering requests by academic and other researchers to conduct archeological surveys of the refuge. Archaeological Site Stewards will continue to consult with the refuge and conduct period site investigations for cultural resources.

2.2 ALTERNATIVE 1: NO ACTION ALTERNATIVE (CURRENT MANAGEMENT)

This alternative describes the current management activities at the refuge. These programs and activities would continue if none of the action alternatives (Alternatives 2 through 5) were adopted. Management activities are focused on recovery of the endangered Sonoran pronghorn, maintaining the populations of desert bighorn sheep, monitoring nongame wildlife species, monitoring and controlling invasive species, protecting wilderness character, and providing visitors with quality wildlife-dependent recreational experiences that are compatible with the refuge purposes.

2.2.1 Goal: Wildlife and Habitat Management

Protect, maintain, enhance, and/or restore the diversity and abundance of wildlife species and ecological communities of the Sonoran Desert represented at Cabeza Prieta NWR.

2.2.1.1 Endangered and Threatened Species

2.2.1.1.1 Sonoran Pronghorn

2.2.1.1.1.1 Population Monitoring

No change from that described above in Section 2.1.1.1.1, Elements Common to all Alternatives.

2.2.1.1.1.2 Developed Waters

No change from that described above in Section 2.1.1.1.2, Elements Common to all Alternatives.

2.2.1.1.1.3 Captive Breeding/Translocation

No change from that described above in Section 2.1.1.1.3, Elements Common to all Alternatives.

2.2.1.1.1.4 Area Closures

No change from that described above in Section 2.1.1.1.4, Elements Common to all Alternatives.

2.2.1.1.1.5 Supplemental Feeding and Forage Enhancements

No change from that described above in Section 2.1.1.1.5, Elements Common to all Alternatives.

2.2.1.1.1.6 Fencing

No change from that described above in Section 2.1.1.1.6, Elements Common to all Alternatives.

2.2.1.1.1.7 Predator Management

None.

2.2.1.1.1.8 Habitat Restoration Research

Other than research on use of developed waters and supplemental food sources by Sonoran pronghorn, none is ongoing.

2.2.1.1.2 Lesser Long-nosed Bat Conservation

No change from that described above in Section 2.1.1.2, Elements Common to all Alternatives.

2.2.1.1.3 Pierson's Milkvetch Surveys

No change from that described above in Section 2.1.1.4, Elements Common to all Alternatives.

2.2.1.1.4 Desert Pupfish Refugium

No change from that described above in Section 2.1.1.5, Elements Common to all Alternatives.

2.2.1.2 Desert Bighorn Sheep

Conservation of the desert bighorn sheep was central to the purpose of creation of Cabeza Prieta NWR. Sheep occupy all of the mountain ranges within the refuge.

2.2.1.2.1 Developed Waters

There are currently 15 developed waters located within desert bighorn sheep habitat on the refuge (see map, figure 2.2). Two of these, Charlie Bell Well and Bassarisc Tank, also serve Sonoran pronghorn. The refuge periodically hauls supplemental water to Buck Peak, Halfway, Tuseral, Bassarisc, North Pinta, Granite, Heart and Eagle Tanks, all located within the wilderness, as well as the Childs Mountain Parabolic Tank, in non-wilderness. Refuge staff hauls waters to these tanks once or twice annually during normal years, with more hauling during drought years. Hauling to North Pinta, Heart and Eagle Tanks ceased for the duration of the experiment described above in Section 2.1.5.1.2. As in the case for the pronghorn waters, a determination to haul water is based upon observation of water levels by AGFD personnel during weekly aerial reconnaissance, observations by refuge staff conducting field work near the waters, and best judgment of refuge staff considering precipitation and temperature. The refuge attempts to prevent developed waters from going dry during the hot summer season, while also avoiding unnecessarily frequent water hauling trips. Water is normally hauled in a 5,675 liter (1,500 gallon) capacity heavy duty truck, although a helicopter was used to haul water to Heart and Eagle Tanks during the unusually dry summer of 2002. The refuge has installed measures to limit evaporation at the waters, consistent with minimum requirement analyses for waters in wilderness. The most commonly used measures are simple shade structures and mats that float on the water surface. The refuge has relied upon the results of a literature search conducted by AGFD, as well as established wildlife management practices, as a basis for the developed waters program in desert bighorn sheep habitat.

2.2.1.2.2 Forage Enhancements

None.

2.2.1.2.3 Population Goal

The refuge has never established a numerical goal for the population of desert bighorn sheep, but rather manages for a healthy, breeding population of unstated size. Although comparing population estimates from earlier times with recent estimates can be misleading due to differing population survey protocols having been used, recent population estimates for the refuge (348 in 2005) are considerably higher than those of the middle of the twentieth century (50 to 100 in 1939) when the population was heavily exploited.

2.2.1.2.4 Predator Management

None.

2.2.1.3 Desert Ecosystem Integrity Monitoring

2.2.1.3.1 Cactus Ferruginous Pygmy-owl

The refuge will continue to survey for the presence of Cactus Ferruginous Pygmy-owl, as described above in Section 2.1.2.1, Elements common to All Alternatives.

2.2.1.3.2 Migratory Birds

The refuge staff monitors Le Conte's thrasher nests for reproductive success, renesting attempts and nest site characteristics. Le Conte's thrasher is listed by the Arizona Partners in Flight program as an indicator of Sonoran Desert health. All monitoring for Le Conte's thrasher in wilderness is conducted on foot from vehicles using the non-wilderness public access corridors.

2.2.1.3.3 Reptiles and Amphibians

The refuge will continue to survey abundance, distribution and breeding potential of amphibians, especially in developed waters.

2.2.1.3.4 Raptors and Ravens

No monitoring currently occurs.

2.2.1.3.5 Game Animals

There is no formal monitoring or management program for game species other than desert bighorn sheep.

2.2.1.3.6 Long-Term Monitoring

The refuge formerly operated eight meteorological instruments that recorded precipitation, temperature, and humidity. This equipment has become nonfunctional and cannot be used until funds are acquired for its repair. The refuge also established vegetation transects in 2002 for repeat monitoring to detect changes in the refuge plant community.

2.2.1.3.7 Exotic/Invasive Species

The *Checklist of the Plants of Cabeza Prieta National Wildlife Refuge, Arizona* lists 32 non-native plant species that occur on the refuge (Felger 1998). This list is presented in Appendix E. Three non-native species: fountain grass, buffelgrass and Sahara mustard, have become established at infestation levels on the refuge. These species have the potential to out-compete native species for resources and reduce the density of native flora on the refuge. Sahara mustard is of particular concern as it appears to be infesting the Pinta Sands area, which has supported a native sand dune endemic community considered to be an important food source for Sonoran pronghorn. In consultation with the regional Exotic/Invasive Species Coordinator, the refuge has modeled likely locations of occurrence for each species. Refuge staff has been trained to recognize these species and document any occurrences encountered during fieldwork. The refuge controls small infestations of fountain grass and buffelgrass by hand pulling to prevent the spread of infestation.

Trespass livestock present a variety of potential problems to native wildlife on the refuge, including the spread of disease, competition for forage resources and exclusion of native wildlife from water sources. There are two sources of trespass cattle, a private grazing lease on BLM land to the east of the refuge and occasional cross

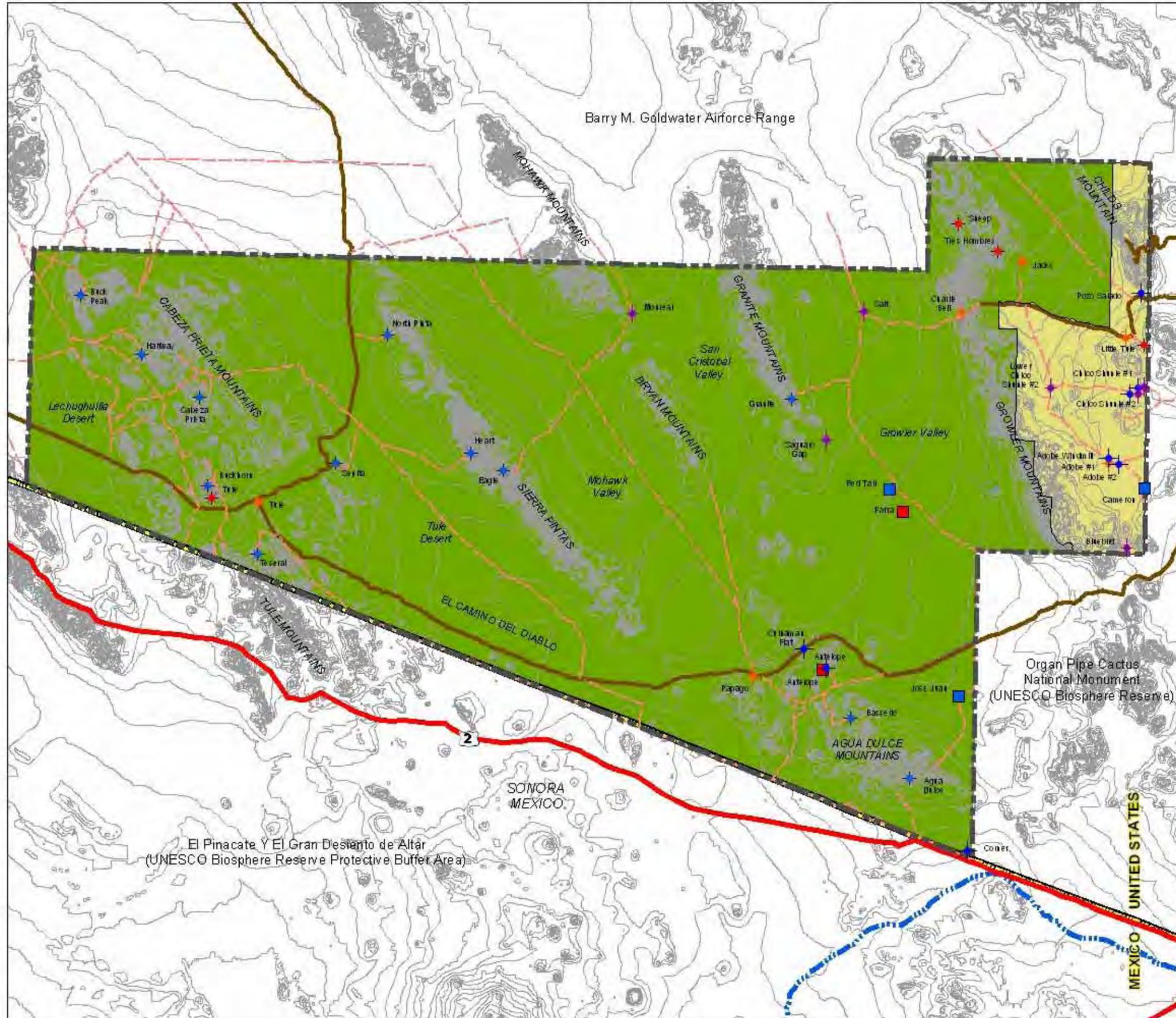
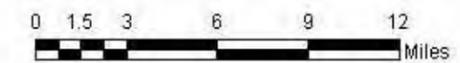


Figure 2.2 Developed Waters

Legend

- Cabeza Prieta N.W.R.
- Wilderness
- Non-Wilderness
- Public Roads
- Administrative Trails
- US/Mexico Border
- Highway
- Rio Sonoyta
- Active Well
- Active Tinaja / Tank
- Inactive Tinaja / Tank
- Inactive Well
- Capped Well
- Active Charco
- Inactive Charco

Sources: USFWS, 2006



**CABEZA PRIETA
NATIONAL WILDLIFE REFUGE**

COMPREHENSIVE CONSERVATION PLAN

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH & WILDLIFE SERVICE

border trespass from Mexico. Domestic goats from Mexico occasionally cross onto the refuge. Goats are particularly problematic as bot fly hosts. While bot flies are not a troublesome parasite to goats, bot fly larvae cause chronic sinusitis in wild desert bighorn sheep, a debilitating and frequently lethal condition. When livestock are encountered on the refuge, staff attempts to identify and contact the owner to facilitate removal. If the owner cannot be identified, trespass livestock are humanely removed.

2.2.2 Goal: Wilderness Stewardship

Protect and conserve refuge wilderness employing strategies of wildlife and plant conservation that will maintain and restore the wilderness character of Cabeza Prieta NWR.

2.2.2.1 Minimum Requirements Analysis

When management actions requiring use of vehicles, mechanized transport, or motorized equipment is proposed in wilderness, the refuge prepares a minimum requirements analysis for the proposed action.

2.2.2.2 Abandoned Vehicles Removal

When abandoned vehicles are found in the refuge wilderness they are removed as soon as possible. Normally, refuge staff tows the vehicles to the nearest non-wilderness road, typically El Camino del Diablo, using a refuge vehicle. Whenever feasible, the vehicle is towed along its entry track, thus avoiding new impacts to wilderness. Once removed to a road outside of wilderness, the vehicle is hauled off of the refuge by a commercial towing company. Vehicles abandoned on refuge non-wilderness are also removed as soon as possible, taking care to limit damage to vegetation and the soil surface.

2.2.2.3 Military Debris Removal

The only active military debris removal on the refuge is military removal of unexploded ordnance as it is found.

2.2.2.4 Administrative Trails

Approximately 234 kilometers (145 miles) of designated administrative trails occur within the wilderness portion of the refuge (see map, figure 2.3). These are unimproved or very lightly improved vehicle trackways established prior to wilderness designation in 1990. While these administrative trails remain, they are closed to all uses other than refuge management access, subject to MRA, and border law enforcement as provided in the Arizona Desert Wilderness Act of 1990. The *Final Programmatic Environmental Assessment for the Future Management of Cabeza Prieta National Wildlife Refuge and Draft Comprehensive Conservation Plan*, published in September of 1998, identified 224 kilometers (139 miles) of discernable vehicle trackways not part of the administrative trails system. These trails were slated for closure. Although the 1998 plan has not been implemented, these non-designated trails have not been considered part of the Administrative Trails system. The refuge has rehabilitated, and will continue to rehabilitate, such unofficial trails or other vehicle tracks in wilderness. Each year, refuge volunteers do a limited amount of rehabilitation to reclaim unauthorized trails in wilderness. Trail rehabilitation is accomplished using hand tools and natural materials from the immediate area or live native plants taken from alongside the public access roads. These plants would normally be damaged by vehicle traffic, so transplanting accomplishes the goal of protecting these plants as well as providing needed transplant specimens. Volunteers hike to all the sites. In areas where unauthorized trails lead deep into the wilderness, only approximately the first 400 meters (1/4 mile) of the road is reclaimed to conceal the trail and discourage its use. The refuge has documented approximately 400 kilometers (250 miles) of illegal roads and trails created by drug and illegal migrant smugglers and the law enforcement actions necessary to deter and

interdict the smugglers and illegal migrants and conduct life saving search and rescue operations. Refuge staff does not engage in rehabilitation efforts on these roads and trails because of the unpredictable use by smugglers and illegal migrants and law enforcement agents engaged in hot pursuit or search and rescue operations.

2.2.2.5 Wilderness Impact Monitoring

No change from the program described above in Section 2.1.3.3 under Elements Common to All Alternatives.

2.2.2.6 Border Law Enforcement

The Refuge coordinates with border law enforcement agencies as described above in Section 2.1.3.2, Elements Common to All Alternatives, Wilderness Stewardship.

2.2.2.7 Licensing Uses of the Childs Mountain Communications Site

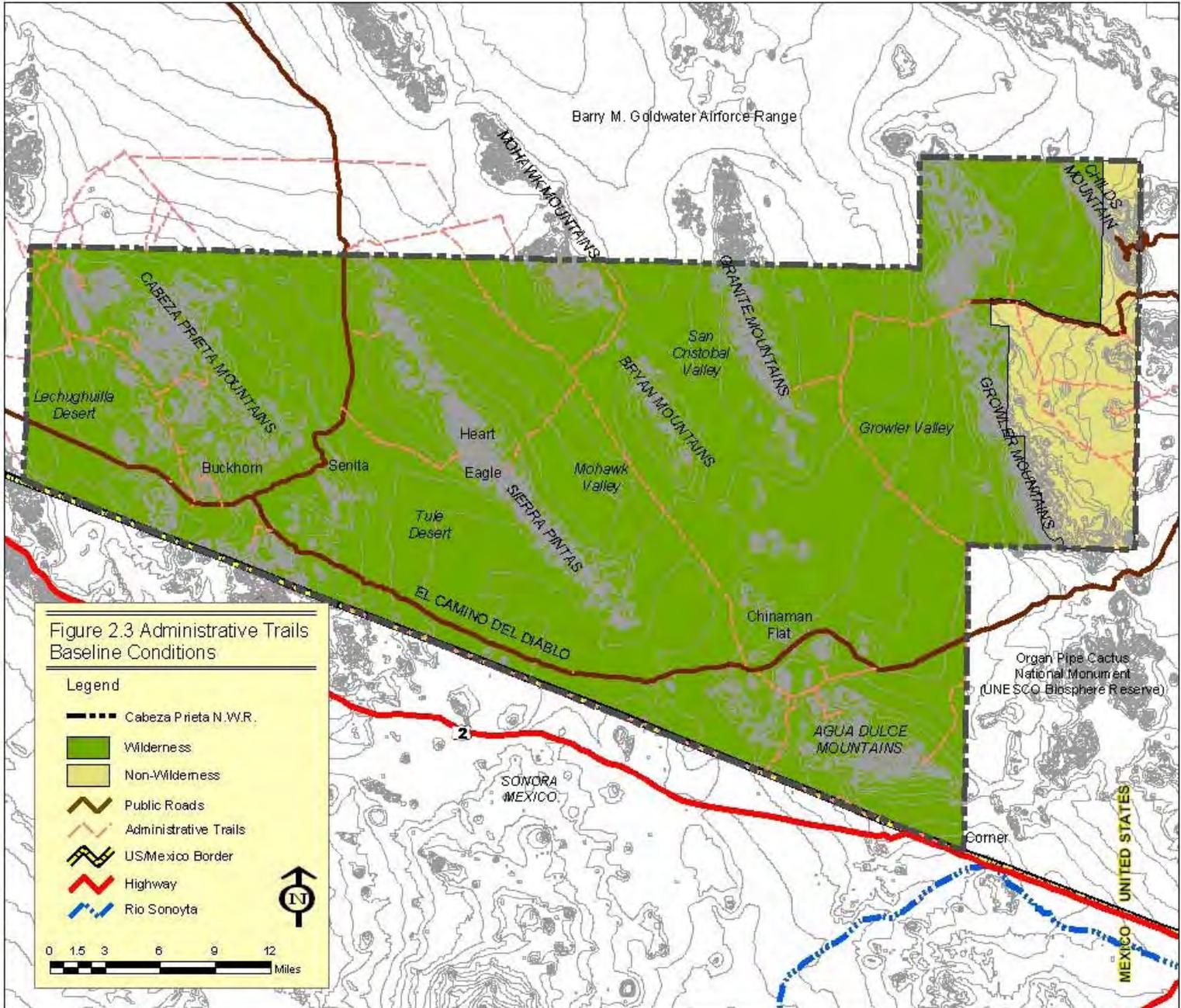
The Refuge allows use of a small area on the summit of Childs Mountain for government and private communications equipment by special use permit. Although located outside of the designated wilderness, this site is considered a wilderness issue, as the facilities are visible from the eastern portion of the refuge wilderness and several comments regarding their impact on wilderness character have been received. The refuge considers requests for new equipment sites on a “no-net increase of development foot print” basis. Uses that can be accommodated on existing towers or foundations are considered, those that would require new structures are not, unless determined necessary for public safety and protection.

2.2.3 Goal: Visitor Services

Provide visitors with compatible, high quality wildlife-dependent recreational and educational experiences designed to foster better appreciation, understanding and protection of the plant, animal and wilderness resources of Cabeza Prieta NWR.

2.2.3.1 Managing Visitor Access

Access to the refuge, other than the visitor center, is by permit only. The refuge, the BMGR and BLM issue joint public access permits. Permits are available at several locations, including the refuge office and visitor center in Ajo, Luke Air Force Base in Phoenix, Marine Corps Air Station in Yuma, Gila Bend Auxiliary Air Base south of Gila Bend and the Bureau of Land Management Office in Phoenix. In accordance with their permit materials, visitors must contact the Auxiliary Air Base by telephone prior to entry and upon exit of BMGR. Effective July 1, 2006, visitors to the refuge are required to contact a refuge phone-in number prior to entering the refuge and leave a recorded message with the following information to assist the Fish and Wildlife Service in managing the refuge: permit number for each person in the party, date of entry, destination, length of visit and number of vehicles in the party. There is no requirement to contact the call in upon leaving the refuge. This information is used by the refuge to track numbers of visitors and routes of travel in the refuge. The permit clarifies that leaving this message does not assure search and rescue should the visitors encounter an emergency, but is for informational use only by the Service and the refuge. The current refuge access permit also serves as a military hold harmless agreement, in the case of injury caused by military activities or debris. Each recipient of an access permit also receives an informational packet outlining the rules and regulations for the BMGR and the Refuge. The refuge visitor center is staffed during normal business hours on weekdays year round.



El Camino del Diablo and Christmas Pass Road are restricted to four-wheel-drive, high clearance vehicles only. Charlie Bell Road is restricted to high clearance vehicles only (two-wheel-drive permitted). Vehicle travel is restricted to the existing roadway, with pull-off and parking allowed in the center 30 meters (100 feet) of the 60-meter (200-foot) non-wilderness travel corridors along El Camino del Diablo and Christmas Pass Road. Only registered, street-legal vehicles are permitted on the refuge. Motor vehicles and mechanical transport are prohibited in designated wilderness. Pack and saddle stock are allowed only by special use permit (restrictions of the special use permit for pack and saddle stock include: a maximum of four horses, burros or mules per party; travel only on the administrative trails, dry washes and along the base of the mountain ranges; no grazing on the refuge or use of refuge water holes, tinajas, tanks, etc., to water stock; feed pellets or processed and pelletized feed only while on the refuge and for three days prior to entry; long-term stock camps (more than 2 nights) are permitted only in designated areas: Daniel's Arroyo, Lower Well, Agua Dulce, O'Neil Hills, Christmas Pass, Coyote Wash and Tule Tank (1.6 kilometer [1 mile] east of Tule Well); all surface disturbance at campsites must be restored; and all trash and animal waste must be removed from base camps). All visitors to wilderness receive orientation information on leave-no-trace wilderness use techniques.

2.2.3.2 Administering Hunt Program

2.2.3.2.1 Desert Bighorn Sheep

The refuge currently permits a limited desert bighorn sheep hunt, administered in cooperation with AGFD and allowed under a refuge special use permit (restrictions of the special use permit for hunting include those listed above for saddle and pack stock, as sheep hunters are the primary stock users on the refuge; the special use permit also allows detailed tracking of hunting on the refuge). The tag limit for bighorn has ranged between one and seven permits per year.

2.2.3.2.2 Mule Deer

None currently offered.

2.2.3.2.3 Small Game

None currently offered.

2.2.3.2.4 Predators

None currently offered.

2.2.3.3 Implementation of Leave-No-Trace Program

Leave-No-Trace (LNT) is a set of back-country travel and camping skills aimed at greatly reducing the overall impacts of outdoor recreation. The refuge provides all permitted back-country users an information packet including LNT information and detailing the generally prohibited uses of wilderness enumerated in the Wilderness Act of 1964. The refuge makes LNT information available to visitors and annually reviews LNT handouts for accuracy.

2.2.3.4 Provision of Environmental Education

Educational programs are presented to both public and private schools in the U.S. and Mexico at all grade-levels from Kindergarten to 12th grade. The refuge also responds to requests from local schools for natural history and other environmental education presentations.

2.2.3.5 Interpretation of Environmental Resources

The refuge visitor center includes a small visitor orientation area with several interpretive displays and a video, as well as an associated short interpretive trail. The refuge is currently attempting to acquire a 12-hectare (30-acre) parcel adjacent to the visitor center for development of a longer trail with more examples of Sonoran Desert resources.

The refuge has developed a watchable wildlife site on Childs Mountain with a short trail, shade structures and interpretive panels. Access to this site is for pre-arranged group tours only. The Cabeza Prieta Natural History Association provides group tours. The refuge will continue to work with the Cabeza Prieta Natural History Association to make interpretive tours available.

The refuge provides interpretation of the Sonoran Desert resources each February at the Sonoran Shindig. This is an annual celebration of the Sonoran Desert cosponsored by the refuge and the Ajo Chamber of Commerce. The Shindig includes cultural activities and displays interpreting the flora and fauna of the refuge. The refuge also hosts open houses during National Wildlife Refuge Week each October.

2.2.3.6 Managing Visitor Camping

Camping is considered necessary to support hunting, wildlife observation and photography, given the remoteness of the refuge, the difficulty of access to much of the refuge and the nocturnal or twilight activity of many desert wildlife species. The refuge offers both back-country and vehicle accessible camping. The following rules have been established to protect refuge resources and maintain wilderness character. Camping is prohibited within 400 meters (1/4 mile) of any wildlife water; fires are restricted to charcoal and camp stoves; and the maximum length of stay is 14 consecutive days. There are three developed, vehicle accessible, primitive camping areas with minimal amenities at Papago Well, Tule Well and Christmas Pass.

2.2.3.7 Pack and Saddle Stock Restrictions

While virtually all use of pack and saddle stock on the refuge has been by desert bighorn sheep hunters, any refuge visitor may use stock, subject to a special use permit, described above in Section 2.2.3.1. Control of pack and saddle stock, through the requirement of a special use permit, is appropriate. Pack and saddle stock cause much greater impacts on campsites and trails than do hikers (Spidlie *et al.*, 2000). There are five designated stock camps along the refuge public access roads.

2.2.4 Goal: Cultural Resources Management

Protect, maintain and interpret cultural and historic resources on Cabeza Prieta NWR, in cooperation with Tribal governments and the State of Arizona to benefit present and future generations.

2.2.4.1 General Provisions

This goal is addressed as described above in Section 2.1.4 under Elements Common to All Alternatives.

2.2.4.2 On-Site Interpretation

No on-site interpretation of cultural resources is provided.

2.2.4.3 Site Stabilization/Patrols

Other than checking the condition of known cultural resource sites while in their vicinity during other refuge management activities, no site stabilization or site patrols occur.

2.2.4.4 Inventory

No active inventory of cultural resources occurs on the refuge.

2.2.4.5 Training

Staff training does not focus on specific cultural resources conservation methods.

2.2.5 Staffing

The refuge currently employs thirteen full time staff, as summarized in: Table 2.4 The personnel costs of refuge operations and the effect of this employment on the local and regional economies are summarized below in Section 4.6.1.1.

Position	Number	Grade Level
Project Leader	1	GS-14
Deputy Project Leader	1	GS-13
Wildlife Biologist	1	GS-12,
Outdoor Recreation/ Outreach Specialist	1	GS-11
Law Enforcement (Supervisory)	1	GS-11
Law Enforcement	4	GS-9
Budget Administrator	1	GS-7
Maintenance Mechanic	1	WG-10
Maintenance Worker	1	WG-8
Office Assistant	1	GS-6

2.3 ALTERNATIVE 2: MINIMUM INTERVENTION

This alternative features an approach to refuge management that minimizes active intervention on ecological processes, particularly within the refuge wilderness areas. Other than management activities required for Sonoran pronghorn or other endangered species recovery, the refuge will not haul water in wilderness; develop new, or redevelop existing, wildlife waters; or otherwise attempt to support wildlife populations greater than those that refuge natural resources and precipitation support in the context of existing decimating factors. These factors include changes in native vegetation due to past over-grazing by domestic livestock, introduction of exotic plants and animal species, fragmentation of the habitats of wide ranging species and introduction of diseases from domestic livestock. Desert bighorn sheep hunting and use of pack and saddle stock would not be allowed under this alternative.

2.3.1 Goal: Wildlife and Habitat Management

Protect, maintain, enhance and/or restore the diversity and abundance of wildlife species and ecological communities of the Sonoran Desert represented at Cabeza Prieta NWR.

2.3.1.1 Endangered and Threatened Species

In addition to the measures described in Section 2.1.1 above, Elements Common to All Alternatives, the following measures will be implemented.

2.3.1.1.1 Sonoran Pronghorn

2.3.1.1.1.1 Population Monitoring

When weather and population conditions permit radio collaring Sonoran pronghorn, any collaring operations will proceed only in non-wilderness areas.

2.3.1.1.1.2 Developed Waters

The refuge will investigate the feasibility of obtaining photovoltaic powered water level sensors with remote transmission capability or other devices for remote water level monitoring. Should such devices be available they will be installed at each of the developed waters serving Sonoran pronghorn in wilderness, subject to MRA for waters in wilderness. Trips for hauling water will be made only when these sensors indicate that less than one week's supply of water remains. This would reduce the number of water hauling trips made to the minimum necessary to keep the developed waters from going dry. If no such devices are available, refuge management will continue to determine when to haul supplemental water as described above in Section 2.1.1.1.2.

2.3.1.1.1.3 Captive Breeding/Translocation

No change from that described above in Section 2.1.1.1.3, Elements Common to all Alternatives.

2.3.1.1.1.4 Area Closures

No change from that described above in Section 2.1.1.1.4, Elements Common to all Alternatives.

2.3.1.1.1.5 Supplemental Feeding and Forage Enhancements

Any additional supplemental feeding program or forage enhancements developed for Sonoran pronghorn beyond those described above in Section 2.1.1.1.5 will be located in non-wilderness areas.

2.3.1.1.1.6 Fencing

No change from that described above in Section 2.1.1.1.6, Elements Common to all Alternatives.

2.3.1.1.1.7 Predator Management

None.

2.3.1.1.1.8 Habitat Restoration Research

None is proposed.

2.3.1.1.2 Lesser Long-nosed Bat Conservation

No change is proposed from that described above in Section 2.1.1.2, Elements Common to all Alternatives.

2.3.1.1.3 Pierson's Milkvetch Surveys

No change is proposed from that described above in Section 2.1.1.4, Elements Common to all Alternatives.

2.3.1.1.4 Desert Pupfish Refugium

No change is proposed from that described above in Section 2.1.1.5, Elements Common to all Alternatives.

2.3.1.2 Desert Bighorn Sheep

Conservation of the desert bighorn sheep was central to the purpose of creation of Cabeza Prieta NWR. Sheep occupy all of the mountain ranges within the refuge.

2.3.1.2.1 Developed Waters

There are currently 15 developed waters located within desert bighorn sheep habitat on the refuge. The refuge will cease hauling supplemental water to any desert bighorn sheep developed water located in wilderness other than Charlie Bell Well and Bassarisc Tank, which are also used by Sonoran pronghorn. This will mean cessation of hauling to Buck Peak, Halfway, Tuseral, Buckhorn, North Pinta, Senita, Granite, Heart and Eagle Tanks. The refuge will continue to haul water to the Childs Mountain Parabolic Tank, in non-wilderness.

The refuge will initiate a phased removal of structural improvements to developed waters in wilderness, subject to MRA. This will entail removing small dams at the Cabeza Prieta Tanks and Heart Tank, both natural tinajas with low dams (less than 0.5 meter [1.6 foot] high) that were installed to increase water storage volume; removing sediment capturing dams above Buck Horn and Senita Tanks; removing an artificial catchment below the Agua Dulce spring; removing several shade covers; and discontinuing all scheduled maintenance of developed waters. Buckhorn Tank and Senita Tank, both adits, or short drilled depressions in rock, will not be filled, but will likely become filled with sediment in a few seasons due to the removal of sediment catching dams above the adits.

Those developed waters on or near illegal migrant pathways will receive special consideration. When hauling is ceased refuge staff will work with CBP-BP to establish emergency rescue beacons at these sites. MRAs will be completed for the rescue beacons.

The refuge will monitor the desert bighorn sheep population for any short term response to cessation of water hauling and removal of water development structures by monthly aerial surveys using visual search for bighorns in the vicinity of waters, as well as monitoring radio collared sheep for movement and mortality.

2.3.1.2.2 Forage Enhancements

None are proposed.

2.3.1.2.3 Population Goal

This alternative sets a refuge population goal for desert bighorn sheep of 100 to 200. This is a population goal aimed at addressing concerns that the current policy of supplying supplemental water to populations is artificially supporting unnaturally high numbers of sheep. Although this number is well below estimates of pre-contact sheep numbers in the area that became the refuge, it is believed to represent a realistic goal, given the continued existence of introduced diseases, habitat degradation by past grazing and habitat fragmentation beyond the limits of the refuge that restrict the population's long-term movement in response to weather patterns and climatic trends.

2.3.1.2.4 Predator Management

None is proposed.

2.3.1.3 Desert Ecosystem Integrity Monitoring

2.3.1.3.1 Cactus Ferruginous Pygmy-owl

The refuge will continue to survey for the presence of Cactus Ferruginous Pygmy-owl, as described above in Section 2.1.2.1, Elements common to All Alternatives.

2.3.1.3.2 Migratory Birds

Refuge staff will continue to monitor Le Conte's thrasher nests for reproductive success, renesting attempts and nest site characteristics.

2.3.1.3.3 Reptiles and Amphibians

The refuge will continue to survey abundance, distribution and breeding potential of amphibians.

2.3.1.3.4 Raptors and Ravens

No program for monitoring raptors and ravens proposed.

2.3.1.3.5 Game Animals

No monitoring or management program for game species on the refuge other than desert bighorn sheep is proposed.

2.3.1.3.6 Long-term Monitoring

The refuge will continue to monitor vegetation transects established in 2002 to detect changes in the refuge plant community.

2.3.1.3.7 Exotic/Invasive Species

Refuge staff will continue to record the location of exotic species infestations. Staff will continue to hand pull fountain grass where new infestations occur and remove trespass cattle, goats and burros. Should effective new methods of controlling exotic/invasive species be developed, they will be implemented on the refuge, pending a determination of suitability.

2.3.2 Goal: Wilderness Stewardship

Protect and conserve refuge wilderness employing strategies of wildlife and plant conservation that will maintain and restore the wilderness character of Cabeza Prieta NWR.

2.3.2.1 Minimum Requirements Analysis

The refuge will prepare a minimum requirements analysis whenever management actions requiring use of vehicles, mechanized transport, or motorized equipment are proposed in wilderness.

2.3.2.2 Abandoned Vehicles Removal

Abandoned vehicles will continue to be removed as they are found in the refuge wilderness. Refuge staff will tow the vehicle to the nearest non-wilderness road, typically El Camino del Diablo, using a refuge vehicle. Whenever feasible, the vehicle will be towed along its entry track, thus avoiding new impacts to wilderness. Once removed to a road outside of wilderness, the vehicle will be hauled off of the refuge by a commercial towing company. Vehicles abandoned on refuge non-wilderness will also be removed as soon as is feasible, taking care to limit damage to vegetation and the soil surface.

2.3.2.3 Military Debris Removal

Active military debris removal by the refuge will continue to include notification to the military of unexploded ordnance as it is found.

2.3.2.4 Administrative Trails

The refuge will close administrative trails in the wilderness other than the Welton Trail, the Mohawk Valley Trail, the Growler Valley Trail, Jack's Well Trail, the segment of the Agua Dulce Trail leading from El Camino del Diablo to Jose Juan Charco and the wilderness portion of Charlie Bell Road (see figure 2.4) to management vehicular use. This configuration will provide a minimum administrative trail network of access for general management activities such as abandoned vehicle removal throughout the refuge wilderness and allow vehicular water hauling to Jack's Well, Charlie Bell Well, and Jose Juan Charco as necessary for Sonoran pronghorn recovery activities.

These restrictions will end refuge management vehicular use of approximately 97 kilometers (60 miles) of administrative trails previously so used. The trails will be closed to management vehicular use, but will remain available to border law enforcement use under the provisions of the Arizona Desert Wilderness Act of 1990. Management vehicular use of the administrative trails not closed will continue to require an MRA. If future changes in management regime result permanent cessation of all water hauling, all the

administrative trails will be closed to refuge management use.

2.3.2.5 Wilderness Impact Monitoring

In addition to continuation of the ongoing wilderness impact monitoring described above in Section 2.1.3.3 under Elements Common to All Alternatives, the refuge will work with the Regional Office remote sensing staff to design an aerial photography program to monitor impacts of trail development by undocumented aliens or narcotics traffickers crossing the refuge. Photography flown in 1994 by the Department of Commerce's Borderlands Project can serve as a baseline for comparison. Refuge field staff will identify areas known to be impacted by illegal traffic. This information will be used to identify areas of the refuge to be flown and photographed on a biennial basis.

Refuge staff will maintain a database of all observed adverse impacts to wilderness, whether caused by refuge management, border law enforcement, visitor use or illegal activities. These data and those from wilderness impact monitoring will support the wilderness research described above in Section 2.1.5.2.

2.3.2.6 Border Law Enforcement

The Refuge will continue to coordinate with border law enforcement agencies described above in Section 2.1.3.2, Elements Common to All Alternatives, Wilderness Stewardship.

2.3.2.7 Licensing Uses at the Childs Mountain Communications Site

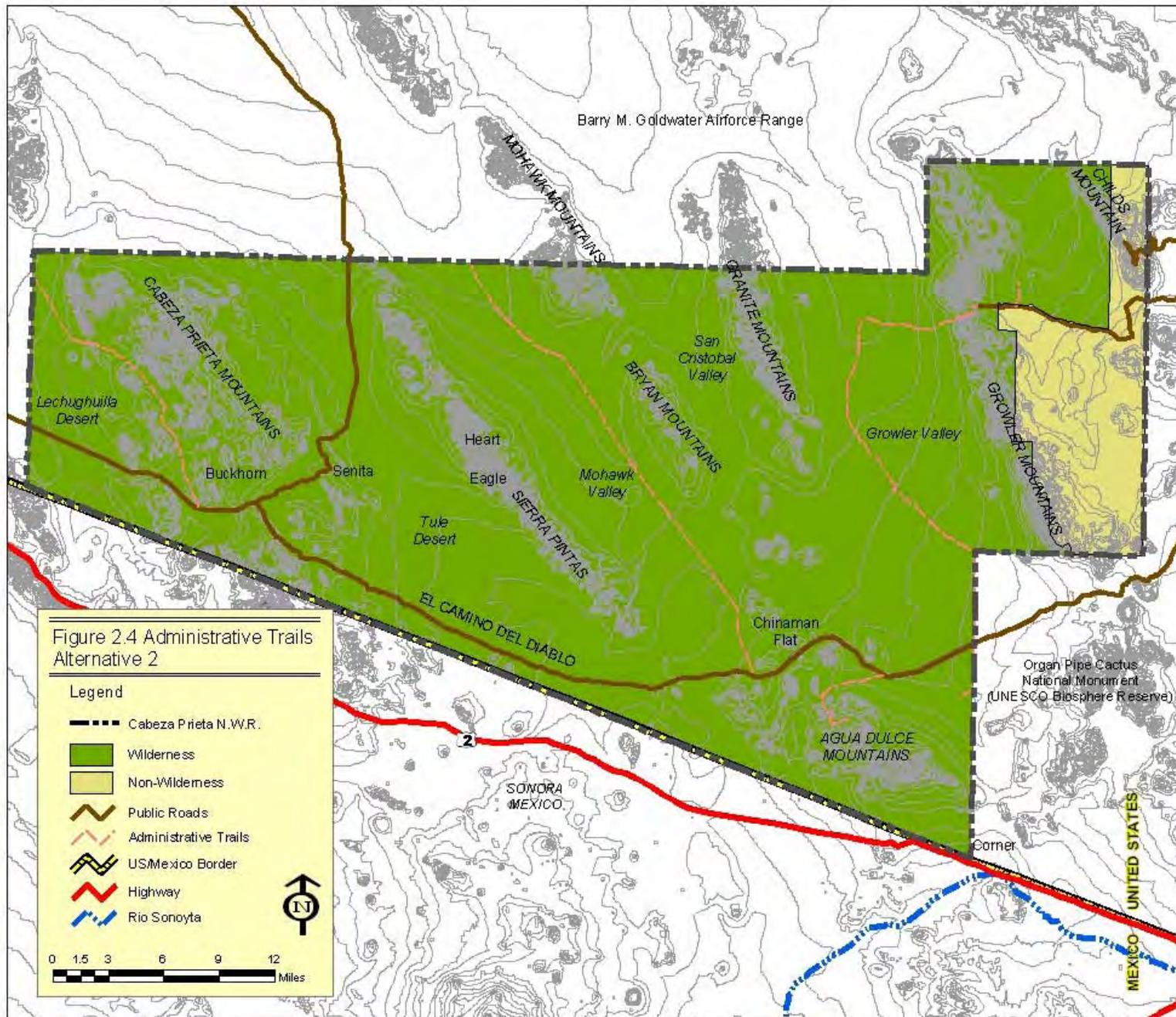
The refuge will work with the FAA, the military and commercial lessees of the Childs Mountain site to assure that all facilities are removed from the site upon the termination of the existing memorandum of understanding between the Service, the military and the FAA. The refuge will work with the military to identify any obsolete buildings or other structures on the site and have them removed.

2.3.3 Goal: Visitor Services

Provide visitors with compatible, high quality wildlife-dependent recreational and educational experiences designed to foster better appreciation, understanding and protection of the plant, animal and wilderness resources of Cabeza Prieta NWR.

2.3.3.1 Managing Visitor Access

Access to the refuge, other than the Visitor Center, is by permit only. The refuge, BMGR and BLM will continue to issue joint public access permits. Permits will be available at several locations, including the refuge office and visitor center in Ajo, Luke Air Force Base in Phoenix, Marine Corps Air Station Yuma in Yuma, Gila Bend Air Force Auxiliary Field south of Gila Bend and the Bureau of Land Management Office in Phoenix. In accordance with their permit materials, visitors must contact the Auxiliary Air Base by telephone prior to entry and upon exit of BMGR. Visitors to the refuge are required to contact a refuge phone-in number prior to entering the refuge and leave a recorded message with the following information to assist the Fish and Wildlife Service in managing the refuge: permit number for each person in the party, date of entry, destination, length of visit and number of vehicles in the party. There is no requirement to contact the call in upon leaving the refuge. This information is used by the refuge to track numbers of visitors and routes of travel in the refuge. The permit clarifies that leaving this message does not assure search and rescue should the visitors encounter an emergency, but is for informational use only by the refuge. The refuge access permit will continue to serve as a military hold harmless agreement, in case



of injury caused by military activities or debris. Each recipient of an access permit will also receive an informational packet outlining the rules and regulations for the BMGR and the Refuge.

Only registered, street-legal vehicles will be permitted on the refuge. El Camino del Diablo and Christmas Pass Road will remain restricted to four-wheel-drive, high clearance vehicles only, and Charlie Bell Road to high clearance vehicles only (two-wheel-drive permitted). Vehicle travel remains restricted to the established roadway, with pull-off and parking allowed in the center 30 meters (100 feet) of the 60-meter (200-foot) non-wilderness travel corridors along el Camino del Diablo and Christmas Pass Road. Use of motor vehicles and other forms of mechanical transport remains prohibited in designated wilderness.

Pack and Saddle stock will no longer be permitted in the refuge.

2.3.3.2 Administering Hunt Program

2.3.3.2.1 Desert Bighorn Sheep

No hunting will be allowed in the refuge.

2.3.3.2.2 Mule Deer

No hunting will be allowed in the refuge.

2.3.3.2.3 Small Game

No hunting will be allowed in the refuge.

2.3.3.2.4 Predators

No hunting will be allowed in the refuge.

2.3.3.3 Implementation of Leave-No-Trace Program

Leave-No-Trace (LNT) is a set of back county travel and camping skills aimed at greatly reducing the overall impacts of outdoor recreation. The refuge provides all permitted back-country users an information packet including LNT information and detailing the generally prohibited uses of wilderness enumerated in the Wilderness Act of 1964. The refuge will continue to make LNT information available to visitors and annually review LNT handouts for accuracy. The leader of any group requiring a special use permit for refuge access will be required to have received LNT training.

2.3.3.4 Provision of Environmental Education

The refuge will continue to respond to requests from local schools for natural history and other environmental education presentations.

2.3.3.5 Interpretation of Natural Resources

The refuge visitor center includes a small visitor orientation area with several interpretive displays and video, as well as an associated short interpretive trail.

Access to the watchable wildlife site on Childs Mountain site will remain restricted to pre-arranged group tours only. The refuge will continue to work with the Cabeza Prieta Natural History Association to make interpretive tours available.

The refuge will continue to provide interpretation of the Sonoran Desert resources each February at the Sonoran Shindig. This annual celebration of the Sonoran Desert is cosponsored by the refuge and the Ajo Chamber of Commerce. The Shindig includes cultural activities and displays interpreting the flora and fauna of the refuge. The refuge will also host open houses during National Wildlife Refuge Week each October. The visitor center will remain open seven days a week during the winter season (October through April), in order to maximize contact with refuge visitors and maximize transmission of the resource protection message.

2.3.3.6 Managing Visitor Camping

Camping is considered necessary to support wildlife observation and photography, given the remoteness of the refuge, the difficulty of access to much of the refuge and the nocturnal or twilight activity of many desert wildlife species. The refuge will continue to offer both back-country and vehicle accessible camping. The following rules will be enforced to protect refuge resources and maintain wilderness character: camping is prohibited within 400 meters (1/4 mile) of any wildlife water; fires are restricted to charcoal and camp stoves; the maximum length of stay is seven consecutive days; and parties of more than eight campers will require a special use permit (Monz *et al.* 2000 provide a discussion of the reasons to limit party size in wilderness). One developed, vehicle accessible, primitive camping area with minimal amenities will be retained at Tule Well.

2.3.3.7 Pack and Saddle Stock Restrictions

No pack or saddle stock will be allowed on the refuge

2.3.4 Goal: Cultural Resources Management

Protect, maintain and interpret cultural and historic resources on Cabeza Prieta NWR, in cooperation with Tribal governments and the State of Arizona to benefit present and future generations.

2.3.4.1 General Provisions

This goal is addressed as described above in Section 2.1.4 under Elements Common to All Alternatives.

2.3.4.2 On-Site Interpretation

No on-site interpretation of cultural resources is proposed.

2.3.4.3 Site Stabilization/Patrols

Other than continuing to check the condition of known cultural resource sites when refuge staff are in their vicinity during other refuge management activities, no site stabilization or site patrols is proposed.

2.3.4.4 Inventory

No active inventory of cultural resources on the refuge is proposed.

2.3.4.5 Training

Staff training will not focus on specific cultural resources conservation methods.

2.3.5 Staffing

In order to implement this management alternative, the refuge will need to add one full time position beyond that of the no-action scenario. This position will assist in keeping the visitor center open seven days a week during the winter season. The required staffing level is summarized in Table 2.5. The cost of implementing this staffing level, and its impacts on the local and regional economy are summarized below in Section 4.6.1.1.

Position	Number	Grade Level
Project Leader	1	GS-14
Deputy Project Leader	1	GS-13
Wildlife Biologist	1	GS-12,
Outdoor Recreation/ Outreach Specialist	1	GS-11
Law Enforcement (Supervisory)	1	GS-11
Law Enforcement	4	GS-9
Budget Administrator	1	GS-7
Maintenance Mechanic	1	WG-10
Maintenance Worker	1	WG-8
Office Assistant	1	GS-6
Office Assistant	1	GS-5

2.4 ALTERNATIVE 3: RESTRAINED INTERVENTION

This alternative emphasizes preserving the refuge's wilderness character. It focuses on restoring the natural conditions and self-sustaining ecosystem processes that will support healthy populations of native species. This alternative assumes that permanent, artificial structures and installations, no matter how well camouflaged, are inappropriate in wilderness. This alternative will support wildlife populations primarily with naturally occurring precipitation; supplemental water will be provided to developed waters as an infrequent measure during periods of extreme drought, rather than as a response to summertime desert conditions. While not embracing aggressive manipulation of habitats and processes, this alternative recommends some habitat manipulation to restore endangered species and would take additional steps, if necessary, to protect them. By restoring degraded portions of the habitat (e.g. by establishing wildlife corridors in non-wilderness) the wilderness itself can maintain its wildness and be free from man's control. This alternative also favors increased habitat management outside of wilderness and working aggressively with adjacent landowners and other partners to reduce active management in the wilderness.

2.4.1 Goal: Wildlife and Habitat Management

Protect, maintain, enhance and/or restore the diversity and abundance of wildlife species and ecological communities of the Sonoran Desert represented at Cabeza Prieta NWR.

2.4.1.1 Endangered and Threatened Species

The refuge will continue to participate in recovery of endangered and threatened species as described above in Section 2.1.1 under Elements Common to All Alternatives, with the following additions.

2.4.1.1.1 Sonoran Pronghorn

2.4.1.1.1.1 Population Monitoring

No change is proposed from that described above in Section 2.1.1.1.1, under Elements Common to all Alternatives.

2.4.1.1.1.2 Developed Waters

The refuge will investigate the feasibility of obtaining photovoltaic powered water level sensors with remote transmission capability or other devices for remote water level monitoring. Should such devices be available they will be installed at each of the developed waters serving Sonoran pronghorn in wilderness, subject to MRA for waters in wilderness. Trips for hauling water will be made only when these sensors indicate that less than one week's supply of water remains. This would reduce the number of water hauling trips made to the minimum necessary to keep the developed waters from going dry. If no such devices are available, refuge management will continue to determine when to haul supplemental water as described in Section 2.1.1.1.2 above. Water will be hauled to Jose Juan and Redtail Charcos only during periods of severe drought (a value of negative three or lower on the Palmer Drought Index – a measure of drought severity that considers rainfall and heat). During radio telemetry studies of Sonoran pronghorn conducted by refuge staff, the area surrounding these waters showed very low density of pronghorn. This led some to conclude that the charcos are poorly located for use by Sonoran pronghorn under normal conditions.

Refuge staff will annually collect water samples from all developed waters. Samples will be analyzed for pathogens and their potential to adversely affect the health of Sonoran pronghorn.

The refuge will place greater emphasis on working with the Air Force, Marine Corps and BLM to have developed waters established in Sonoran pronghorn habitat adjacent to the refuge wilderness. As the Sonoran Pronghorn Recovery Plan states, "moving great distances in search of ephemeral resources" is crucial to the pronghorn

survival and that “Expanding present used range east of highway 85 and north of Interstate 8 might prove to be the most effective recovery effort”, these efforts are appropriate.

2.4.1.1.3 Captive Breeding/Translocation

No change is proposed from that described above in Section 2.1.1.1.3, Elements Common to all Alternatives.

2.4.1.1.4 Area Closures

No change is proposed from that described above in Section 2.1.1.1.4, Elements Common to all Alternatives.

2.4.1.1.5 Supplemental Feeding and Forage Enhancements

No change is proposed from that described above in Section 2.1.1.1.5, Elements Common to all Alternatives.

2.4.1.1.6 Fencing

The refuge will work with its partners to develop wildlife corridors to the east across Arizona Highway 85 and north across the BMRG. The refuge will work with BLM to eliminate grazing on adjacent lands and then remove fences.

2.4.1.1.7 Predator Management

The refuge will implement studies, including radio collaring, to investigate use of developed waters, size of home range and breeding success of coyote on the refuge. These studies will also include review of data on predation on Sonoran pronghorn collected on BMGR and OPCNM. Selective removal of coyotes will be implemented when the Sonoran pronghorn population is below 100 animals and winter and spring precipitation is 50 percent or less of average.

2.4.1.1.8 Habitat Restoration Research

The refuge will invite partners to develop large-scale experimental desert restoration sites in refuge non-wilderness. If successful restoration techniques are developed, they will be implemented to restore degraded sites on the refuge. Degraded sites most important to pronghorn survival will be identified as the highest priority sites for applying desert wilderness restoration work.

2.3.1.1.2 Lesser Long-nosed Bat Conservation

No change is proposed from that described above in Section 2.1.1.2, Elements Common to all Alternatives.

2.4.1.1.3 Pierson’s Milkvetch Surveys

No change is proposed from that described above in Section 2.1.1.4, Elements Common to all Alternatives.

2.4.1.1.4 Desert Pupfish Refugium

No change is proposed from that described above in Section 2.1.1.5, Elements Common to all Alternatives.

2.4.1.2 Desert Bighorn Sheep

Conservation of the desert bighorn sheep was central to the purpose of creation of Cabeza Prieta NWR. Sheep occupy all of the mountain ranges within the refuge.

2.4.1.2.1 Developed Waters

There are currently 15 developed waters located within desert bighorn sheep habitat on the refuge. The refuge will reduce the frequency of hauling supplemental water to any developed water located in wilderness other than Bassarisc Tank and Charlie Bell Well, which are also used by Sonoran pronghorn. Water will be hauled to Buck Peak, Halfway, Tuseral, Bassarisc, North Pinta, Granite, Heart and Eagle Tanks only during periods of severe drought (Palmer Drought Index value of negative three or less). The refuge will continue to haul water to the Childs Mountain Parabolic Tank, in non-wilderness.

The refuge will initiate a phased removal of structural improvements to developed waters in wilderness, subject to MRA. This will entail removing small dams at the Cabeza Prieta Tanks and Heart Tank, both natural tinajas with low dams (less than 0.5 meter [1.6 foot] high) that were installed to increase water storage volume but may have unintended effects on water quality and overall hydrology; removing an artificial catchment below the Agua Dulce spring; removing any shade covers; and discontinuing scheduled maintenance of developed waters. Buckhorn Tank and Senita Tank, both adits, or short drilled depressions in rock, will not be filled, but will likely become filled with sediment over time in the absence of scheduled maintenance.

The refuge will survey non-wilderness desert bighorn sheep habitat (the eastern portions of the Growler Mountains and Childs Mountain) for potential sites of new developed waters. New waters will be developed in suitable, non-wilderness sites.

The refuge will monitor the desert bighorn sheep population for any short term response to reduction of water hauling and removal of water development structures by monthly aerial surveys using visual search for bighorns in the vicinity of waters, as well as monitoring radio collared sheep for movement and mortality.

2.4.1.2.2 Forage Enhancements

None is proposed.

2.4.1.2.3 Population Goal

This alternative sets a refuge population goal for desert bighorn sheep of 250 to 350. This range has been extrapolated by computing the average density of sheep per acre in southwestern Arizona mountain ranges similar to those in the refuge (approximately two sheep per acre). A correction factor of one half was applied to account for the fact that the mountain ranges in question include maintained developed waters. The resulting value of one sheep per acre was multiplied by the refuge's 290 square miles of desert bighorn sheep habitat. The range is considerably lower than the population range that was likely supported by resources in the area of the refuge prior to the introduction of disease by domestic stock, the fragmentation of habitats by modern land management practices and the degradation of native habitats from grazing by domestic stock decimated native desert bighorn sheep populations.

2.4.1.2.4 Predator Management

Within two years the refuge will implement studies, including radio collaring, to investigate use of developed waters, size of home range, breeding success, movements of mountain lion within the refuge and mountain lion movement relative to desert bighorn sheep movement. These studies will also include review of data on predation on desert bighorn sheep collected on BMGR and OPCNM.

2.4.1.3 Desert Ecosystem Integrity Monitoring

2.4.1.3.1 Cactus Ferruginous Pygmy-owl

No change is proposed from that described above in Section 2.1.2.1, Elements Common to all Alternatives.

2.4.1.3.2 Migratory Birds

Refuge staff will continue to monitor Le Conte's thrasher nests for reproductive success, re-nesting attempts and nest site characteristics.

2.4.1.3.2 Reptiles and Amphibians

The refuge will continue to survey abundance, distribution and breeding potential of amphibians.

2.4.1.3.4 Raptors and Ravens

No monitoring of raptors and ravens is proposed.

2.4.1.3.5 Game Animals

No monitoring or management program for any game animal other than desert bighorn sheep is proposed.

2.4.1.3.6 Long-term Monitoring

The refuge will continue to monitor vegetation transects established in 2002 to detect changes in the refuge plant community. Additionally, the refuge and the Regional Office remote sensing scientist will implement a change detection analysis program, using aerial photography sampling (i.e., photography will be taken of a random sample of the refuge, as full photographic coverage of the refuge would be too large to effectively analyze). Analysis of photography taken every two years and comparison of photography from different years and archival photography will allow identification of changes in vegetation community composition and density. The data generated by this monitoring project will be tracked to identify existing sources of change and evaluate their causes and importance.

2.4.1.3.7 Exotic/Invasive Species Control

The *Checklist of the Plants of Cabeza Prieta National Wildlife Refuge, Arizona* lists 32 non-native plant species that occur on the refuge (Felger 1998). This list is presented in Appendix E. Three non-native species, fountain grass, buffelgrass and Sahara mustard, have become established at infestation levels on the refuge. These species have the potential to out-compete native species for resources and reduce the density of native flora on the refuge. Sahara mustard is of particular concern as it appears to be infesting the Pinta Sands area, which has supported a native sand dune endemic community considered to be an important food source for Sonoran pronghorn. Refuge staff will continue to be trained to recognize these species and will continue to document any occurrences encountered during fieldwork. The refuge will continue to remove newly discovered occurrences of fountain grass by hand pulling to limit its spread and eliminate new small infestations where feasible. To prevent new infestations to the greatest degree feasible, refuge staff will visually inspect refuge vehicles, clothing and equipment for seeds or other plant propagules prior to entering the refuge.

The refuge will establish a native plant nursery in non-wilderness for revegetation efforts.

Trespass livestock present a variety of potential problems to native wildlife on the refuge, including the

spread of disease, competition for forage resources and exclusion of native wildlife from water sources. There are two sources of trespass cattle, a private grazing lease on BLM land to the east of the refuge and occasional cross border trespass from Mexico. Domestic goats from Mexico occasionally cross onto the refuge. Goats are particularly problematic as bot fly hosts. While bot flies are not a troublesome parasite to goats, bot fly larvae cause chronic sinusitis in wild desert bighorn sheep, a debilitating and frequently lethal condition. When livestock are encountered on the refuge, staff will attempt to identify and contact the owner to facilitate removal. If the owner cannot be identified, trespass livestock will be humanely removed.

2.4.2 Goal: Wilderness Stewardship

Protect and conserve refuge wilderness employing strategies of wildlife and plant conservation that will maintain and restore the wilderness character of Cabeza Prieta NWR.

2.4.2.1 Minimum Requirements Analysis

The refuge will streamline the MRA process described above in 2.1.3.1 under Elements Common to All Alternatives, Wilderness Stewardship, by establishing programmatic MRAs for all predictable, recurring activities, such as water hauling, wildlife surveys, removal of abandoned vehicles and water sample collection, which require generally prohibited uses of wilderness. These programmatic MRAs will not relieve the refuge of the requirement to conduct activity-specific MRAs in each case of water hauling, vehicle removal or other activities. The process of preparing activity-specific MRAs will be simplified by the existence of programmatic MRAs, in that staff will focus on the unique aspects of each type of activity (e.g., location of vehicle to be removed, season and recent weather for water hauling).

2.4.2.2 Abandoned Vehicle Removal

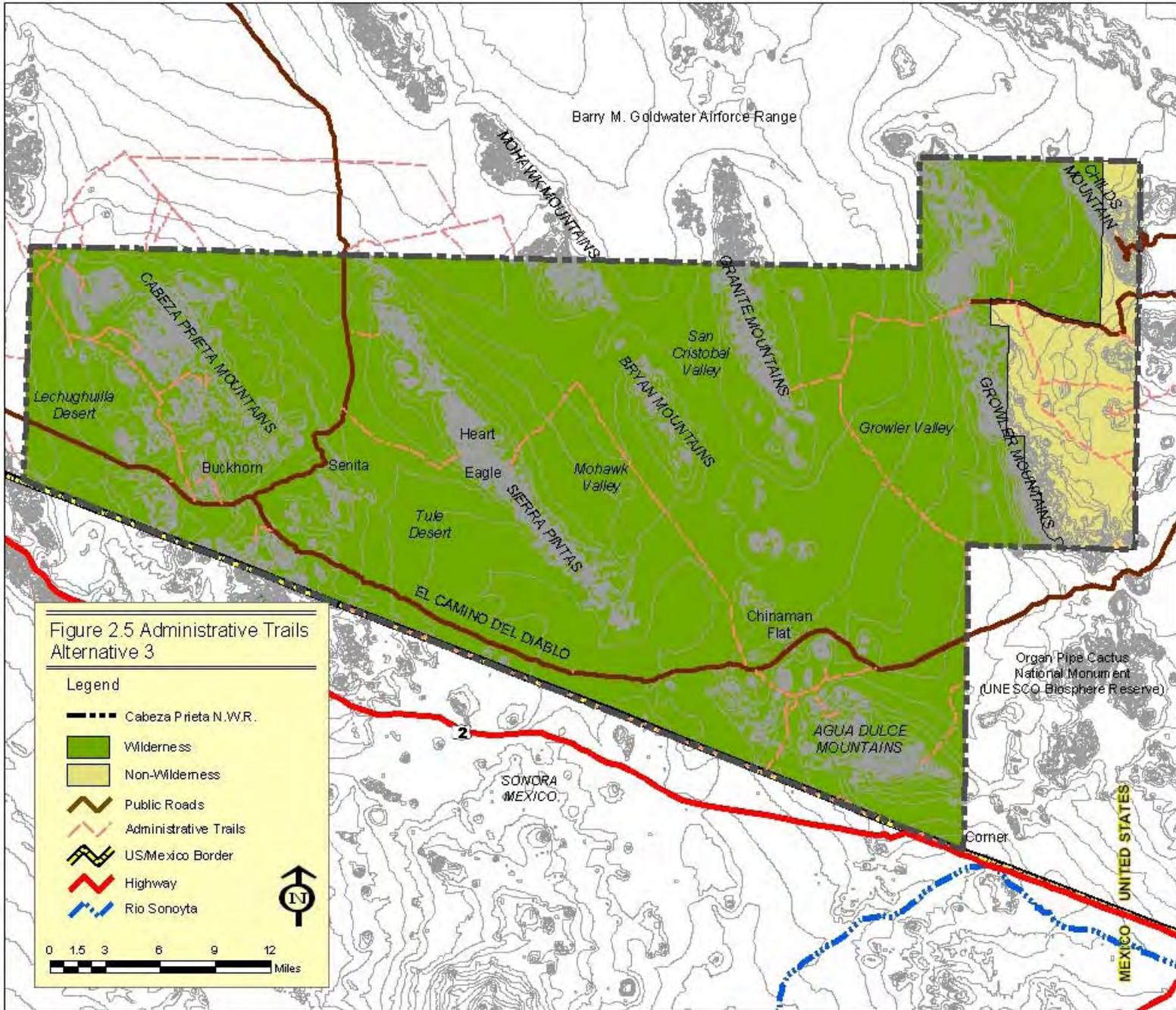
Abandoned vehicles will continue to be removed as they are found in the refuge wilderness, subject to an MRA. In the case of vehicles abandoned in wilderness, refuge staff will tow the vehicle to the nearest non-wilderness road, typically El Camino del Diablo, using a refuge vehicle. Whenever feasible, the vehicle will be towed along its entry track, thus avoiding new impacts to wilderness. Once removed to a road outside of wilderness, the vehicle will be hauled off of the refuge by a commercial towing company. The refuge will also reexamine the feasibility entering a memorandum of agreement with adjacent military commands to make heavy-lift military helicopters available for removing abandoned vehicles from refuge wilderness. Vehicles abandoned on refuge non-wilderness will also be removed as soon as is feasible, taking care to limit damage to vegetation and the soil surface (the refuge examined this technique in 2002 but no military airlift commands were willing to assume the risks involved in removing vehicles at that time).

2.4.2.3 Military Debris Removal

Active military debris removal by the refuge will continue to include notification to the military of unexploded ordnance as it is found. The refuge will actively coordinate with the military and volunteers to remove tow darts and tow cable from the refuge, using appropriate means in wilderness to accomplish removal. Refuge staff will develop standards to prioritize tow darts for removal.

2.4.2.4 Administrative Trails

The refuge will close Monreal Well Trail, Tractor Trail and the Mohawk Trail north of Eagle Tank Trail in the wilderness to management vehicular use (see figure 2.5). These restrictions will end refuge management



vehicular use of approximately 32 kilometers (20 miles) of administrative trails previously so used. The trails are closed to management vehicular use, but will remain available to border law enforcement use under the provisions of the Arizona Desert Wilderness Act of 1990. Management vehicular use of the administrative trails not closed will continue to require an MRA.

Refuge staff will coordinate with CBP-BP staff to identify which of the Administrative Trails closed to management vehicular use are not needed for border law enforcement patrols. The refuge will rehabilitate the first 400 meters (1/4 mile) of these trails to discourage their use.

If future changes in management regime result permanent cessation of all water hauling, all the administrative trails will be closed to refuge management use.

2.4.2.5 Wilderness Impact Monitoring

In addition to continuation of the ongoing wilderness impact monitoring described above in 2.1.3.3 under Elements Common to All Alternatives, Wilderness Stewardship, the refuge will work with the Regional Office remote sensing staff to design an aerial photography program to monitor impacts of trail development by undocumented aliens or narcotics traffickers crossing the refuge. Photography flown in 1994 by the Department of Commerce's Borderlands Project can serve as a baseline for comparison. Refuge field staff will identify areas known to be impacted by illegal traffic. This information will be used to identify areas of the refuge to be flown and photographed on a biennial basis.

The refuge will develop standard protocols for monitoring aspects of wilderness character such as solitude, naturalness, etc. and will develop a monitoring program, but without adequate funding and staffing it will be difficult to conduct this program.

Refuge staff will maintain a database of all observed adverse impacts to wilderness, whether caused by refuge management, illegal activities, border law enforcement or visitor use. These data and those generated by wilderness impact monitoring will support the wilderness research described above in Section. 2.1.5.2.

2.4.2.6 Border Law Enforcement

The refuge will continue to provide orientation and wilderness training for border law enforcement personnel.

2.4.2.7 Licensing Uses of the Childs Mountain Communications Site

The refuge will work with the Federal Aviation Administration (FAA), the military and commercial lessees of the Childs Mountain site to assure that all facilities are removed from the site upon the termination of the existing memorandum of understanding between the Service, the military and the FAA. The refuge will work with the military to identify any obsolete buildings or other structures on the site and have them removed.

2.4.3 Goal: Visitor Services

Provide visitors with compatible, high quality wildlife-dependent recreational and educational experiences designed to foster better appreciation, understanding and protection of the plant, animal and wilderness resources of Cabeza Prieta NWR.

2.4.3.1 Managing Visitor Access

Access to the refuge, other than the Visitor Center, is by permit only. The refuge, the BMGR and BLM will continue to issue joint public access permits. Permits will be available at several locations, including the refuge office and visitor center in Ajo, Luke Air Force Base in Phoenix, Marine Corps Air Station Yuma, Gila Bend Auxiliary Air Base in Gila Bend, and the Bureau of Land Management office in Phoenix. Visitors must contact the Auxiliary Air Base by telephone prior to entry and upon exit of permitted BMGR. Visitors to the refuge are required to contact a refuge phone-in number prior to entering the refuge and leave a recorded message with the following information to assist the Fish and Wildlife Service in managing the refuge: permit number for each person in the party, date of entry, destination, length of visit and number of vehicles in the party. There is no requirement to contact the call in upon leaving the refuge. This information is used by the refuge to track numbers of visitors and routes of travel in the refuge. The permit clarifies that leaving this message does not assure search and rescue should the visitors encounter an emergency, but is for informational use only by the refuge. The refuge access permit will continue to serve as a hold harmless agreement protecting the military from any liability if refuge visitors are harmed by military activities or debris. Each recipient of an access permit will also receive an informational packet outlining the rules and regulations for the BMGR and the refuge. The refuge will coordinate with the military and BLM to ensure that every visitor to the refuge receives Leave No Trace travel and camping information.

El Camino del Diablo and Christmas Pass Road will remain restricted to four-wheel-drive, high clearance vehicles only, and Charlie Bell Road to high clearance vehicles only (two-wheel-drive permitted). Vehicles remain restricted to the established roadway, with pull-off and parking limited to the center 30 meters (100 feet) of the 60-meter (200-foot) non-wilderness corridors.

2.4.3.2 Administering Hunt Program

2.4.3.2.1 Desert Bighorn Sheep

The refuge will continue to offer a limited desert bighorn sheep hunt, administered in cooperation with AGFD and allowed under a refuge special use permit. No hunt will be offered during years in which water was hauled due to severe drought.

2.4.3.2.2 Mule Deer

No hunting will be allowed on the refuge.

2.4.3.2.3 Small Game

No hunting will be allowed on the refuge.

2.4.3.2.4 Predators

Non hunting will be allowed on the refuge.

2.4.3.3 Implementing Leave-No-Trace Program

Leave-No-Trace (LNT) is a set of backcountry travel and camping skills aimed at greatly reducing the overall impacts of outdoor recreation. The refuge will continue to provide all permitted backcountry users an information packet including LNT information and detailing the generally prohibited uses of wilderness enumerated in the Wilderness Act of 1964. The refuge will continue to make LNT information available to

visitors and annually review LNT handouts for accuracy. All visitor contact refuge employees and interested volunteers will be provided annual opportunities to receive LNT training.

2.4.3.4 Provision of Environmental Education

The refuge will continue to respond to requests from local schools for natural history and other environmental education presentations and associated instructional materials for use by staff and educators. The refuge will also develop a Sonoran Desert ecosystem-specific environmental education program for use by staff in schools and other venues. This program will include a discussion of wilderness values.

2.4.3.5 Interpretation of Natural Resources

The refuge will develop a new general refuge video for visitor orientation. The refuge will also acquire the Wilderness Awareness video produced by the Carhart Center for visitor orientation. The refuge will upgrade existing interpretative materials and programs at the refuge visitor center. All such materials and programs will include discussion of the effects of modern human land uses on Sonoran Desert wildlife.

The refuge will develop public information, including interpretive pamphlets available at the visitor center, regarding the beneficial attributes of bats, such as plant pollination.

The refuge will continue to provide interpretation of the Sonoran Desert resources each February at the Sonoran Shindig. This is an annual celebration of the Sonoran Desert is cosponsored by the refuge and the Ajo Chamber of Commerce. The Shindig includes cultural activities and displays interpreting the flora and fauna of the refuge. The refuge will also host open houses during National Wildlife Refuge Week each October.

The refuge will develop additional interpretive signage and overlooks in non-wilderness areas. Pending a determination that Sonoran pronghorn populations have stabilized and that such use would not jeopardize the subspecies, the refuge will pursue cooperation of the BLM on developing a road loop in the non-wilderness portion of the Childs Valley.

2.4.3.6 Managing Visitor Camping

Camping is considered necessary to support hunting, wildlife observation and photography, given the remoteness of the refuge, the difficulty of access to much of the refuge and the nocturnal or twilight activity of many desert wildlife species. The refuge will continue to offer both back-country and vehicle accessible camping. The following rules will be enforced to protect refuge resources and maintain wilderness character: camping is prohibited within 400 meters (1/4 mile) of any wildlife water; fires are restricted to charcoal and camp stoves; the maximum length of stay is seven consecutive days; and parties of more than eight campers will require a special use permit (Monz *et al.*, 2000, provide a discussion of the reasons to limit party size in wilderness). One developed, vehicle accessible primitive camping area with minimal amenities will be retained at Tule Well.

2.4.3.7 Pack and Saddle Stock Restrictions

Pack and saddle stock use by visitors will continued to be allowed subject to a special use permit, described above in Section 2.2.3.1.

2.4.4 Goal: Cultural Resources Management

Protect, maintain and interpret cultural and historic resources on Cabeza Prieta NWR, in cooperation with Tribal governments and the State of Arizona to benefit present and future generations

2.4.4.1 General Provisions

This goal is addressed as described above in Section 2.1.4 under Elements Common to All Alternatives.

2.4.4.2 On-Site Interpretation

No on-site interpretation of cultural resources is proposed.

2.4.4.3 Site Stabilization/Patrols

Other than continuing to check the condition of known cultural resource sites when refuge staff is in their vicinity during other refuge management activities, no site stabilization or site patrols are proposed.

2.4.4.4 Inventory

No active inventory of cultural resources on the refuge is proposed.

2.4.4.5 Training

No staff training focused on protection of cultural resources is proposed.

2.4.5 Staffing

In order to implement this management alternative, the refuge will need to add two full time positions beyond the level of the no-action scenario. These positions, one wildlife biologist and one maintenance worker, reflect increased wildlife monitoring efforts. The required staffing level is summarized in Table 2.6. The cost of implementing this staffing level, and its impacts on the local and regional economy are summarized below in Section 4.6.1.1.

Position	Number	Grade Level
Project Leader	1	GS-14
Deputy Project Leader	1	GS-13
Wildlife Biologist	2	GS-12, GS-11
Outdoor Recreation/ Outreach Specialist	1	GS-11
Law Enforcement (Supervisory)	1	GS-11
Law Enforcement	4	GS-9
Maintenance Mechanic	1	WG-10
Maintenance Worker	2	WG-8
Budget Administrator	1	GS-7
Office Assistant	1	GS-6

2.5 **ALTERNATIVE 4 (PREFERRED ALTERNATIVE): ACTIVE MANAGEMENT**

This alternative emphasizes maintaining the refuge's wildlife populations through the continued provision of developed waters. Assumptions central to this alternative's approach include the following. Habitat fragmentation and human development around perennial sources of water have restricted access to alternate sources of water and forage previously used by wide-ranging resident wildlife during times of drought stress on the refuge. Habitat degradation by past overgrazing impacts the quality of forage and increases the density of woody shrubs. Many diseases introduced by domestic livestock persist in refuge wildlife populations. In view of these assumptions, provision of developed waters to refuge wildlife is considered essential to maintaining natural population densities of large, wide-ranging species such as desert bighorn sheep and Sonoran pronghorn. In the context of providing reliable waters for wildlife, the refuge will continue to investigate and implement measures to reduce and eventually eliminate the need to haul water in wilderness. This Alternative is most similar to the No Action Scenario, but offers a more active approach to the achieving the refuge's purposes, goals and objectives.

2.5.1 Goal: Wildlife and Habitat Management

Protect, maintain, enhance and/or restore the diversity and abundance of wildlife species and ecological communities of the Sonoran Desert represented at Cabeza Prieta NWR.

2.5.1.1 Endangered and Threatened Species

The refuge will continue to participate in recovery of endangered and threatened species as described above in Section 2.1.1 under Elements Common to All Alternatives, with the following additions.

2.5.1.1.1 Sonoran Pronghorn

2.5.1.1.1.1 Population Monitoring

No change is proposed from that described above in Section 2.1.1.1.1, under Elements Common to all Alternatives.

2.5.1.1.1.2 Developed Waters

Any new developed waters for Sonoran pronghorn that the Sonoran pronghorn recovery team determines to be necessary will be constructed at sites determined by consultation between the refuge and the recovery team.

The refuge will investigate the feasibility of obtaining photovoltaic powered water level sensors with remote transmission capability or other devices for remote water level monitoring. Should such devices be available, and prove effective, they will be installed at each of the developed waters serving Sonoran pronghorn in wilderness, subject to MRA for waters in wilderness. Trips for hauling water will be made only when these sensors indicate that the water remaining would not last until the next seasonal rainy period. This should reduce the number of water hauling trips made to the minimum necessary to keep the developed waters from going dry.

The refuge will implement a program of upgrading existing developed waters in wilderness. The upgrades will increase their water collection efficiency and capacity while decreasing evaporation, visual intrusiveness and maintenance requirements. These improvements should greatly reduce or eliminate the need for hauling supplemental water. The improved waters will include enhanced visual clues of water level, to facilitate accurate determination of the volume of water remaining in each by AGFD staff conducting

weekly aerial reconnaissance of the refuge.

Within three years of the adoption of this CCP the refuge will conduct a comprehensive survey of the pronghorn habitat to identify suitable locations for developing additional pronghorn waters.

Refuge staff will annually collect water samples from all developed water for analysis and detection of potential pathogens and their potential affect on the health of Sonoran pronghorn.

2.5.1.1.1.3 Captive Breeding/Translocation

No change is proposed from that described above in Section 2.1.1.1.3, Elements Common to all Alternatives.

2.5.1.1.1.4 Area Closures

No change is proposed from that described above in Section 2.1.1.1.4, Elements Common to all Alternatives.

2.5.1.1.1.5 Supplemental Feeding and Forage Enhancements

In addition to the forage enhancement plots described above in Section 2.1.1, Elements Common to All Alternatives, the refuge will locate suitable sites for additional forage enhancement areas. Selected sites will be characterized by better than average vegetative cover in areas of documented frequent pronghorn presence.

2.5.1.1.1.6 Fencing

The refuge will work with its partners to develop wildlife corridors to the east across Arizona Highway 85 and north across the BMRG. The refuge will work with BLM to eliminate grazing on adjacent lands and then remove fences.

2.5.1.1.1.7 Predator Management

The refuge will implement studies, including radio collaring, to investigate use of developed waters, size of home range and breeding success of coyote on the refuge. These studies will also include review of data on predation on Sonoran pronghorn collected on BMGR and OPCNM. Predator management may be a necessary component of Sonoran pronghorn recovery.

2.5.1.1.1.8 Habitat Restoration Research

Other than research on use of developed waters and supplemental food sources by Sonoran pronghorn, none is proposed.

2.5.1.1.2 Lesser Long-nosed Bat Conservation

In addition to the protection afforded by the lesser long-nosed bat's maternity roost's remote location and fence around the roost entrance described above in Section 2.1.1.2, under this alternative refuge staff will install a gate over the entrance to the roost if there is any evidence that unauthorized individuals are circumventing the fence and gaining access to the roost. The gate would be locked open during the bat's breeding and rearing season, as juvenile lesser long-nosed bats are poor fliers and are unable to pass through any grate that will prohibit human entry. The gate would contain grates passable by adult lesser-long nosed bat so that any bats that arrive early in the spring while the gate would still be closed can access the roost. When bats are absent during the winter the gate would be locked closed to discourage human use.

The gate should be considered be a “second line of defense” to further deter any habitual users of the roost entrance who devise a method of climbing over or otherwise circumventing the fence. Refuge staff will continue to periodically monitor the roost entrance to document damage caused by human use and assess bat use of the roost. Refuge law enforcement personnel will continue periodic surveillance of the roost entrance to apprehend unauthorized users. Refuge staff will continue to survey for additional, unknown roost sites on the refuge. The refuge will continue to keep the location of the roost unpublished.

2.5.1.1.3 Pierson’s Milkvetch Surveys

No change is proposed from that described above in Section 2.1.1.4, Elements Common to all Alternatives.

2.5.1.1.4 Desert Pupfish Refugium

No change is proposed from that described above in Section 2.1.1.5, Elements Common to all Alternatives.

2.5.1.2 Desert Bighorn Sheep

Conservation of the desert bighorn sheep was central to the purpose of creation of Cabeza Prieta NWR. Sheep occupy all of the mountain ranges within the refuge.

2.5.1.2.1 Developed Waters

The refuge will implement a program of upgrading existing developed waters in wilderness. The upgrades will increase their water collection efficiency and capacity while decreasing evaporation, visual intrusiveness and maintenance requirements. These improvements should greatly reduce or eliminate the need for hauling supplemental water. The improved waters will be designed with enhanced visual clues to water level, so that Service and AGFD personnel conducting monitoring flights over the refuge can more easily and accurately determine water levels. The improved waters will also be designed to facilitate water drops from helicopters, should that option be desirable. Refuge staff will continue to periodically haul supplemental water to Buck Peak, Halfway, Tuseral, Senita, Bassarisc, North Pinta, Granite, Eagle and Heart Tanks, all located within the wilderness, as well as the Childs Mountain Parabolic Tank, in non-wilderness, on an as-needed basis.

Should the results of the University of Arizona study of sheep water relationship and other research indicate that additional waters would benefit the refuge sheep population, additional waters may be proposed for development. Should any new developed waters be proposed for desert bighorn sheep, the refuge would conduct a detailed habitat evaluation prior to developing the water and closely monitor response of desert bighorn sheep populations to the new developed water. All appropriate environmental compliance for new waters will be obtained should new waters be proposed. Similarly, should study and research results suggest that any currently operating waters are non-beneficial to sheep, the refuge will consider removing such waters. Prior to removal the refuge would experimentally close wildlife access to the water and monitor for adverse impacts to wildlife.

2.5.1.2.2 Forage Enhancement

None is proposed.

2.5.1.2.3 Population Goal

This alternative sets a refuge population goal for desert bighorn sheep of 500 to 700. This population goal was developed through compiling desert bighorn sheep densities, in sheep per square mile, on other ranges

nearby, averaging the densities and applying a target density lower than the average to the refuge sheep habitat area. The resulting population goal is considered quite conservative, based on the best biological judgment of refuge and AGFD staff. It should be noted that the habitats used for comparison in establishing the population goal all contain developed waters, as provision of developed water is central to AGFD's management of desert bighorn sheep. Nearby occupied sheep habitation OPCNM with limited or no developed water was surveyed once for sheep (Henry 1995). This survey found a desert bighorn sheep density of 1.7 animals per square mile of habitat on the Monument, or slightly lower than the 2.0 animals used for the refuge population goal. Henry's estimate is of limited value, however, as it represents only a single year's data with no repetition. Additionally, OPCNM, is considerably wetter than most of the refuge desert bighorn sheep habitat and includes some natural perennial waters, making comparisons between the two areas questionable.

2.5.1.2.4 Predator Management

The refuge will implement studies, including radio collaring, to investigate use of developed waters, size of home range, breeding success, movements of mountain lion on the refuge and mountain lion movement relative to desert bighorn sheep movement. These studies will also include review of data on predation on desert bighorn sheep collected on BMGR and OPCNM.

2.5.1.3 Desert Ecosystem Integrity Monitoring

2.5.1.3.1 Cactus Ferruginous Pygmy-owl Monitoring

The refuge will develop a monitoring protocol to survey potential habitat for the presence of cactus ferruginous Pygmy-owls, and gather natural history information, juvenile dispersal, home breeding range, and habitat use information for the species.

2.5.1.3.2 Migratory Birds

Refuge staff will continue to monitor Le Conte's thrasher nests for reproductive success, renesting attempts and nest site characteristics. The refuge will initiate research on other bird species listed as Birds of Conservation Concern by the Service's Office of Migratory Bird Management, or as indicators of Sonoran Desert health by the Arizona Partners in Flight program. New research will include point counts for loggerhead shrike, Bell's vireo, gray vireo, crissal thrasher, yellow warbler, black-chinned sparrow and sage sparrow; and determination of the age/size class of saguaros used by nesting by Gila woodpecker and glided flicker.

2.5.1.3.3 Reptiles and Amphibians

When standard protocols for reptile surveys have been developed, the refuge will initiate surveys for Gila monster, desert tortoise, chuckwalla, canyon spotted whiptail and rosy boa. Refuge surveys for desert tortoise will be coordinated with the AIDTT to ensure consistency among agencies. The refuge will survey for the presence of flat-tailed horned lizard, an Arizona Special Status Species that has been documented to occur on Marine Corps lands to the west of the refuge. The refuge will continue to survey abundance, distribution and breeding potential of amphibians, especially in developed waters.

2.5.1.3.4 Raptors and Ravens

The refuge will establish and implement protocols for inventory and monitoring of golden eagle, prairie falcon and raven.

2.5.1.3.5 Game Animals

The refuge will implement a population survey program for mule deer to establish accurate estimates of refuge populations.

2.5.1.3.6 Long-term Monitoring

The refuge will continue to monitor vegetation transects established in 2002 to detect changes in the refuge plant community. Additionally, the refuge and the Regional Office remote sensing scientist will implement a change detection analysis program, using aerial photography sampling (i.e., photography will be taken of a random sample of the refuge, as full photographic coverage of the refuge would be too large to effectively analyze). Analysis of photography taken every two years and comparison of photography from different years and archival photography will allow identification of changes in vegetation community composition and density. The data generated by this monitoring project will be tracked to identify existing sources of change, evaluate their causes and importance and suggest management remedies.

2.5.1.3.7 Exotic/Invasive Species

The *Checklist of the Plants of Cabeza Prieta National Wildlife Refuge, Arizona* lists 32 non-native plant species that occur on the refuge (Felger 1998). This list is presented in Appendix E. Three non-native species, fountain grass, buffelgrass and Sahara mustard, have become established at infestation levels on the refuge. These species have the potential to out-compete native species for resources and reduce the density of native flora on the refuge. Sahara mustard is of particular concern as it appears to be infesting the Pinta Sands area, which has supported a native sand dune endemic community considered to be an important food source for Sonoran pronghorn. Refuge staff will continue to be trained to recognize these species and will continue to document any occurrences encountered during field work. The refuge will continue to remove newly discovered occurrences of fountain grass by hand pulling to limit its spread and eliminate new small infestations where feasible. To prevent new infestations to the greatest degree feasible, refuge staff will visually inspect vehicles, clothing and equipment for seeds or other plant propagules prior to entering the refuge. The refuge will attempt to work with the Mexican government to identify means of controlling the spread of exotic plants along Mexican Highway 2.

Trespass livestock present a variety of potential problems to native wildlife on the refuge, including the spread of disease, introduction of invasive plant species competition for forage resources and exclusion of native wildlife from water sources. There are two sources of trespass cattle, a private grazing lease on BLM land to the east of the refuge and occasional cross border trespass from Mexico. Domestic goats from Mexico occasionally cross onto the refuge. Goats are particularly problematic as bot fly hosts. While bot flies are not a troublesome parasite to goats, bot fly larvae cause chronic sinusitis in wild desert bighorn sheep, a debilitating and frequently lethal condition. When livestock are encountered on the refuge, staff will attempt to identify and contact the owner to facilitate removal. If the owner cannot be identified, trespass livestock will be humanely removed. Areas where livestock trespass occurred will be monitored for invasive or exotic plant species.

2.5.2 Goal: Wilderness Stewardship

Protect and conserve refuge wilderness employing strategies of wildlife and plant conservation that will maintain and restore the wilderness character of Cabeza Prieta NWR.

2.5.2.1 Minimum Requirements Analysis

The refuge will streamline the MRA process described above in Section 2.1.3.1 under Elements Common to

All Alternatives, Wilderness Stewardship, by establishing programmatic MRAs for all predictable, recurring activities, such as water hauling, wildlife surveys, removal of abandoned vehicles and water sample collection, which require generally prohibited uses of wilderness. These programmatic MRAs will not relieve the refuge of the requirement to conduct activity-specific MRAs in each case of water hauling, vehicle removal or other activities. The process of preparing activity-specific MRAs will be simplified by the existence of programmatic MRAs, in that staff will focus on the unique aspects of each type of activity (e.g., location of vehicle to be removed, season and recent weather for water hauling). Programmatic MRAs for management activities proposed under this alternative are found at Appendix F.

2.5.2.2 Abandoned Vehicles Removal

Abandoned vehicles will continue to be removed as they are found on the refuge wilderness, subject to an MRA. In the case of vehicles abandoned in wilderness, refuge staff will tow the vehicle to the nearest non-wilderness road, typically El Camino del Diablo, using a refuge vehicle. Whenever feasible, the vehicle will be towed along its entry track, thus avoiding new impacts to wilderness. Once removed to a road outside of wilderness, the vehicle will be hauled off of the refuge by a commercial towing company. The refuge will also examine the feasibility entering a memorandum of agreement with adjacent military commands to make heavy-lift military helicopters available for removing abandoned vehicles from refuge wilderness (the refuge examined this technique in 2002 but no military airlift commands were willing to assume the risks involved in removing vehicles at that time). Vehicles abandoned on refuge non-wilderness will also be removed as soon as is feasible, taking care to limit damage to vegetation and the soil surface.

2.5.2.3 Military Debris Removal

Active military debris removal by the refuge will continue to include notification to the military of unexploded ordnance as it is found. The refuge will actively coordinate with the military and volunteers to remove tow darts and tow cable from the refuge, using appropriate means in wilderness to accomplish removal.

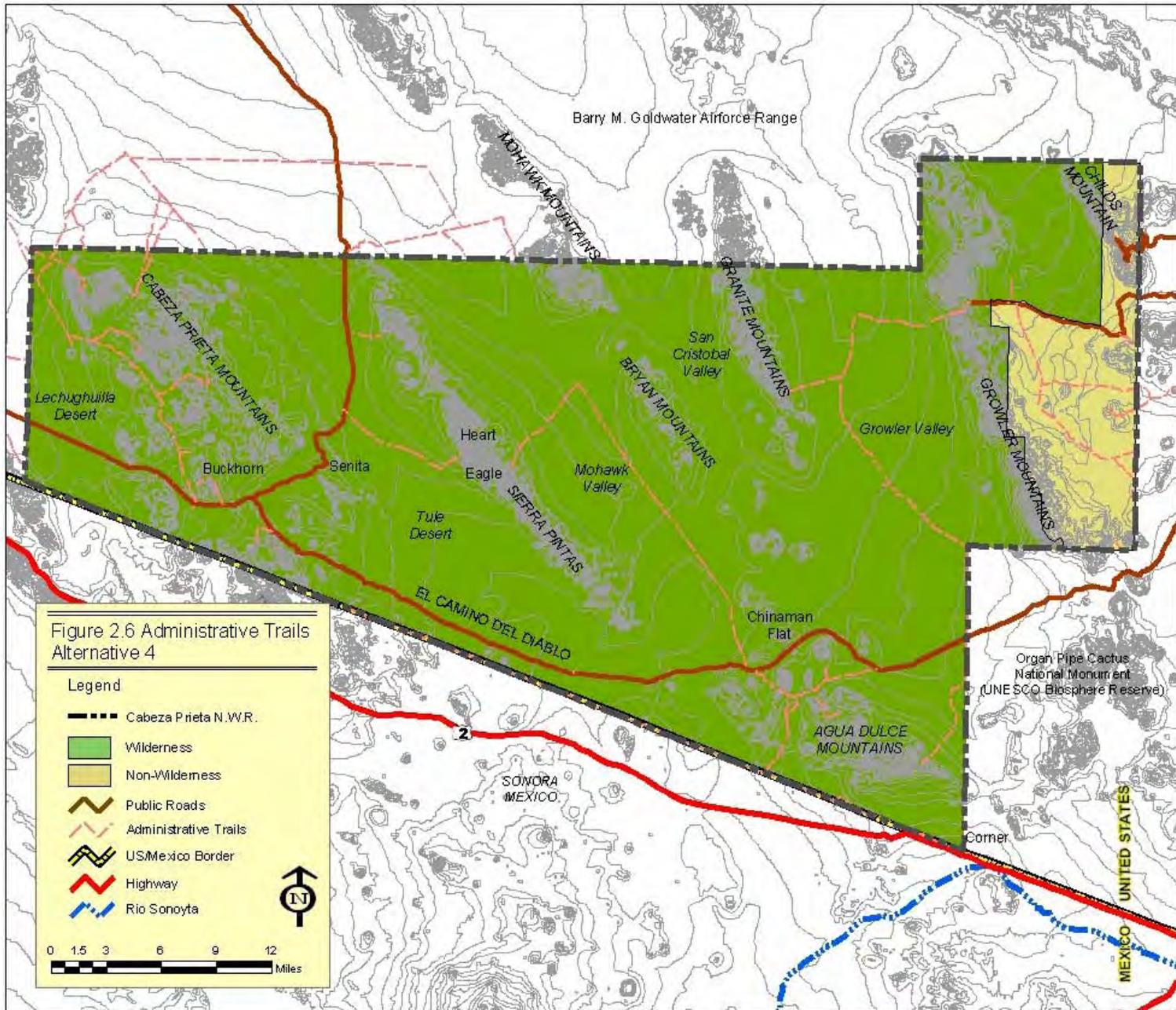
2.5.2.4 Administrative Trails

The refuge will close Monreal Well Trail, Tractor Trail and the Mohawk Trail north of Eagle Tank Trail in the wilderness to management vehicular use (see figure 2.6). These restrictions will end refuge management vehicular use of approximately 32 kilometers (20 miles) of administrative trails previously so used. The trails are closed to management vehicular use, but will remain available to border law enforcement use under the provisions of the Arizona Desert Wilderness Act of 1990. Management use of the administrative trails not closed will continue to require an MRA. Refuge back-country visitors will be encouraged to hike on administrative trails in order to concentrate user impacts on already affected areas.

If future changes in management regime result permanent cessation of all water hauling, all the administrative trails will be closed to refuge management use.

2.5.2.5 Wilderness Impact Monitoring

In addition to continuation of the ongoing wilderness impact monitoring described above in Section 2.1.3.3 under Elements Common to All Alternatives, Wilderness Stewardship, the refuge will work with the Regional Office remote sensing staff to design an aerial photography program to monitor impacts of trail development by undocumented aliens or narcotics traffickers crossing the refuge. Photography flown in 1994 by the Department of Commerce's Borderlands Project can serve as a baseline for comparison. Refuge field staff will identify areas known to be impacted by illegal traffic. This information will be used to identify areas of the refuge to be flown and photographed on a biennial basis.



Refuge staff will maintain a database of all observed adverse impacts to wilderness, whether caused by refuge management, illegal activities, border law enforcement or visitor use. This and data generated by wilderness impact monitoring will support the research described above in Section 2.1.5.2.

2.5.2.6 Border Law Enforcement

The Refuge will continue to coordinate with border law enforcement agencies described above in Section 2.1.3.2, Elements Common to All Alternatives, Wilderness Stewardship.

2.5.2.7 Licensing Uses of the Childs Mountain Communications Site

The Refuge will continue to allow currently permitted uses of the Childs Mountain site, and will renew permits as deemed necessary for human safety and efficient law enforcement. The refuge will maintain a current inventory of all permitted uses and prevent any increase of the development footprint. The refuge will work with the military to identify any obsolete buildings or other structures on the site and have them removed. At the end of the current use agreement, the refuge will work with the FAA and military to renew the agreement or have the facilities removed, if no longer needed for health, safety and national security.

2.5.3 Goal: Visitor Services Management

Provide visitors with compatible, high quality wildlife-dependent recreational and educational experiences designed to foster better appreciation, understanding and protection of the plant, animal and wilderness resources of Cabeza Prieta NWR.

2.5.3.1 Managing Visitor Access

Access to the refuge, other than the Visitor Center, is by permit only. The refuge, the BMGR and BLM will continue to issue joint public access permits. Permits will be available at several locations, including the refuge office and visitor center in Ajo, Luke Air Force Base in Phoenix, Marine Corps Air Station in Yuma, Gila Bend Air Force Auxiliary Field south of Gila Bend and the Bureau of Land Management Office in Phoenix. Upon obtaining the permit, visitors must contact the Auxiliary Air Base by telephone prior to entry and upon exit of BMGR. Visitors to the refuge are required to contact a refuge phone-in number prior to entering the refuge and leave a recorded message with the following information to assist the Fish and Wildlife Service in managing the refuge: permit number for each person in the party, date of entry, destination, length of visit and number of vehicles in the party. There is no requirement to contact the call in upon leaving the refuge. This information is used by the refuge to track numbers of visitors and routes of travel in the refuge. The permit clarifies that leaving this message does not assure search and rescue should the visitors encounter an emergency, but is for informational use only by the refuge. The refuge access permit will continue to serve as a hold harmless agreement protecting the military from any liability if refuge visitors are harmed by military activities or debris. Each recipient of an access permit will also receive an informational packet outlining the rules and regulations for the BMGR and the Refuge. The refuge will coordinate with the military and BLM to ensure that every visitor to the refuge receives Leave No Trace travel and camping information.

El Camino del Diablo and Christmas Pass Road will remain restricted to four-wheel-drive, high clearance vehicles only; Charlie Bell Road will remain restricted to high clearance vehicles only (two-wheel-drive permitted). Vehicle travel will remain restricted to the established roadway, with pull-off and parking allowed in the center 30 meters (100 feet) of the 60 meter (200 foot) non-wilderness travel corridors along el Camino del Diablo and Christmas Pass Road. Only registered, street-legal vehicles will be permitted on the refuge. Motor vehicles and mechanical transport will remain prohibited in designated wilderness. Parties of more than four vehicles traveling together will require a special use permit. Street-legal, registered ATVs and motorcycles will also be allowed on the refuge non-wilderness access roads. Street-legal, registered

ATVs and motorcycles operating on the refuge non-wilderness access roads will be required to be fitted with a mast displaying an orange flag at least 2.4 meters (8 feet) off the ground. The flag's area must equal or exceed 0.5 square meter (80 square inches).

Refuge roads will be closed from March 15 to July 15 each year for Sonoran Pronghorn fawning protection. The beginning date may be moved to March 1st in a severe drought or April 15 during heavy precipitation years with excellent habitat conditions.

Pack and saddle stock will be allowed only by special use permit. Restrictions of the special use permit for pack and saddle stock will include: a maximum of four horses, burros or mules per party; travel only on the administrative trails, dry washes and along the base of the mountain ranges; no grazing on the refuge or use of refuge water holes, tinajas, tanks, etc. to water stock; feed pellets or processed and pelletized feed only while on the refuge and for three days prior to entry; long-term stock camps (more than 2 nights) are permitted only in designated areas: Daniel's Arroyo, Lower Well, Agua Dulce, O'Neil Hills, Christmas Pass, Coyote Wash and Tule Tank (1.6 kilometer [1 mile] east of Tule Well); all surface disturbance at campsites must be restored; and all trash and animal waste must be removed from base camps. All visitors to wilderness will receive orientation information on leave no trace wilderness use techniques

2.5.3.2 Administering Hunt Program

2.5.3.2.1 Desert Bighorn Sheep

The refuge will continue to offer a limited desert bighorn sheep hunt, administered in cooperation with AGFD and allowed under a refuge special use permit (restrictions of the special use permit for hunting include those listed above for saddle and pack stock, as sheep hunters are the primary stock users on the refuge; the special use permit also allows detailed tracking of hunting on the refuge). The tag limit for bighorn has ranged between one and eight permits per year.

2.5.3.2.2 Mule Deer

Should the results of the game animal population surveys indicate that the refuge population mule deer is sufficient to support hunting, and such as hunt is compatible with refuge purposes, the refuge will implement a mule deer hunt. This hunt will be administered by AGFD, subject to Arizona hunting regulations, and will only be implemented upon a determination that the U.S. subpopulation of Sonoran pronghorn has stabilized and would not be jeopardized by such a hunt. Numbers of permits issued for mule deer on the refuge hunt units will be determined using the results of the population survey and considering refuge management goals. Should the refuge implement a mule deer hunt, accommodations for hunters with disabilities will be developed in refuge non-wilderness.

2.5.3.2.3 Small Game

The refuge will consider implementing a small game hunt for quail, dove and rabbit. This hunt will be administered by AGFD, subject to Arizona hunting regulations. The hunt would commence only upon a determination that the U.S. subpopulation of Sonoran pronghorn has stabilized and would not be jeopardized by such a hunt, that the hunt is consistent with refuge management goals, and that the hunt is compatible with the refuge purpose.

2.5.3.2.4 Predators

If determined consistent with refuge management goals and compatible with the refuge purposes, public predator hunts for coyote, bobcat and mountain lion may be authorized on the refuge. These hunts would be administered by AGFD, subject to Arizona hunting regulations, and will only be implemented upon a

determination that the U.S. subpopulation of Sonoran pronghorn has stabilized and would not be jeopardized by such a hunt.

2.5.3.3 Implementing the Leave-No-Trace Program

Leave-No-Trace (LNT) is a set of back-country travel and camping skills aimed at greatly reducing the overall impacts of outdoor recreation. The refuge will continue to provide all permitted back-country users an information packet including LNT information and detailing the generally prohibited uses of wilderness enumerated in the Wilderness Act of 1964. The refuge will continue to make LNT information available to visitors and annually review LNT handouts for accuracy. Visitor contact refuge employees and interested volunteers will be provided annual opportunities to receive LNT training.

2.5.3.4 Provision of Environmental Education

The refuge will continue to respond to requests from local schools for natural history and other environmental education presentations. The refuge will also develop a Sonoran Desert ecosystem-specific environmental education program and associated instructional materials for use by staff in schools and other venues.

2.5.3.5 Interpretation of Environmental Resources

The refuge will develop a trail and overlook, compliant with the Americans with Disabilities Act (ADA), to provide viewing of the desert pupfish refugium. The overlook will be shaded for visitor comfort and will include interpretive materials describing the desert pupfish, its conservation status and the purpose of the refugium.

The refuge will expand the visitor center with additional exhibition, classroom and office space. The visitor center will be staffed seven days a week during the winter season when staffing levels permit. Refuge staff and contractors will develop a new general refuge video an interpretive pamphlet for the existing trail on the visitor site and additional interpretive displays for the visitor center. Refuge staff will lead guided interpretive walks and offer lectures and workshops on Sonoran Desert natural resources at the visitor center.

The refuge will develop additional interpretive signage and overlooks in non-wilderness areas. Pending a determination that Sonoran pronghorn populations have stabilized and that such use would not jeopardize the subspecies, the refuge will investigate the feasibility of developing a road loop in the non-wilderness portion of the Childs Valley in cooperation with BLM.

Should ongoing efforts to acquire a 12-hectare (30-acre) site adjacent to the current refuge visitor center site be successful, the refuge will develop an expanded interpreted trail on that site. The trail would include placarded examples of plant species typical of the refuge's various vegetation communities, and information about their habitat value, wildlife use and any traditional cultural uses of the plant or its seeds and fruits.

The refuge will develop public information, including pamphlets available at the refuge visitor center, regarding the beneficial attributes of bats, such as pollination.

The Childs Mountain Watchable Wildlife site will continue to be open only to guided tours due to safety constraints.

The refuge will continue to provide interpretation of the Sonoran Desert resources each February at the Sonoran Shindig. This is an annual celebration of the Sonoran Desert is cosponsored by the refuge and the Ajo Chamber of Commerce. The Shindig includes cultural activities and displays interpreting the flora and

fauna of the refuge. The refuge will also host open houses during National Wildlife Refuge Week each October.

2.5.3.6 Managing Visitor Camping

Camping is considered necessary to support hunting, wildlife observation and photography, given the remoteness of the refuge, the difficulty of access to much of the refuge and the nocturnal or twilight activity of many desert wildlife species. The refuge will continue to offer both back-country and vehicle accessible camping. The following rules will be enforced to protect refuge resources and maintain wilderness character: camping is prohibited within 400 meters (1/4 mile) of any wildlife water; along the non-wilderness access roads fires are restricted to charcoal and camp stoves, and wood that can be determined by a law enforcement officer to be of non-Sonoran Desert origin (e.g., construction materials, pine, etc.); the maximum length of stay is 14 consecutive days and parties of more than eight campers or four vehicles will require a special use permit (Monz *et al.* 2000, provide a discussion of the reasons to limit party size in wilderness). Three developed, vehicle accessible primitive camping areas with minimal amenities will be retained at Papago Well, Tule Well and Christmas Pass. In the refuge backcountry (i. e., areas away from the non-wilderness access roads, which are reached by backpacking) campers may collect dead and down wood for campfires.

2.5.3.7 Pack and Saddle Stock Restrictions

Continued control of pack and saddle stock, through the requirement of a special use permit, is appropriate due to the much greater impacts on campsites and trails caused by pack and saddle stock versus hikers (Spildie *et al.* 2000). Pack and saddle stock will be limited to horses, burros and mules. There are five designated stock camps along the refuge public access roads.

2.5.4 Goal: Cultural Resources Management

Protect, maintain and interpret cultural and historic resources on Cabeza Prieta NWR, in cooperation with Tribal governments and the State of Arizona to benefit present and future generations.

2.5.4.1 General Provisions

The general provisions for achieving this goal are addressed as described above in Section 2.1.4 under Elements Common to All Alternatives.

2.5.4.2 Onsite Interpretation

The refuge will develop panels interpreting the early history of Ajo with placards on the refuse heaps on the visitor center site.

2.5.4.3 Site Stabilization/Patrols

Refuge staff will periodically inspect known sites for damage and develop stabilization measures if needed. Refuge law enforcement staff will periodically patrol known sites to apprehend unauthorized individuals and discourage unauthorized entry.

2.5.4.4 Inventory

The refuge will not conduct any inventory of cultural resources.

2.5.4.5 Training

The refuge will provide training to border law enforcement staff regarding the sensitivity of refuge cultural resources and avoidance of damage to cultural resources during border law enforcement operations.

2.5.5 Staffing

In order to implement this management alternative, the refuge will need to add three full time positions beyond the level of the no-action scenario. These positions, one wildlife biologist (GS-11), one maintenance worker (WG-8), and one law enforcement officer, reflect increased wildlife monitoring and law enforcement efforts. The required staffing level summarized in Table 2.7. The cost of implementing this staffing level, and its impacts on the local and regional economy are summarized below in Section 4.6.1.1.

Position	Number	Grade Level
Project Leader	1	GS-14
Deputy Project Leader	1	GS-13
Refuge Operations Specialist	1	GS-11
Wildlife Biologist	2	GS-12, GS-11
Outdoor Recreation/ Outreach Specialist	1	GS-12
Law Enforcement (Supervisory)	1	GS-11
Law Enforcement	4	GS-9
Maintenance Worker	3	WG-10, WG-8
Budget Administrator	1	GS-7
Office Assistant	1	GS-6

2.6 ALTERNATIVE 5: MAXIMUM EFFORT

This alternative emphasizes active management aimed at increasing the size of the refuge desert bighorn sheep population and also enhancing the refuge visitor experience. An assumption basic to this alternative is that desert bighorn abundance was historically much greater in the region prior to habitat fragmentation, groundwater withdrawals, surface water diversion, over hunting and the introduction of diseases carried by domestic livestock. In view of this assumption, a population goal established for desert bighorn sheep reflects the densities observed in the better stocked existing habitats with developed water sources in the region today. This density is considered a component of refuge wilderness character.

2.6.1 Goal: Wildlife and Habitat Management

Protect, maintain, enhance and/or restore the diversity and abundance of wildlife species and ecological communities of the Sonoran Desert represented at Cabeza Prieta NWR.

2.6.1.1 Endangered and Threatened Species

The refuge will continue to participate in recovery of endangered and threatened species as described above in Section 2.1.1 under Elements Common to All Alternatives, with the following additions.

2.6.1.1.1 Sonoran Pronghorn

2.6.1.1.1.1 Population Monitoring

The frequency of the population surveys described above in Section 2.1.1.1.1 under Elements Common to All Alternatives, will be increased to yearly surveys.

2.6.1.1.1.2 Developed Waters

The refuge will investigate the feasibility of obtaining photovoltaic powered water level sensors with remote transmission capability or other devices for remote water level monitoring. Should such devices be available they will be installed at each of the developed waters serving Sonoran pronghorn in wilderness, subject to MRA for waters in wilderness. Trips for hauling water will be made only when these sensors indicate that less than one week's supply of water remains. This should reduce the number of water hauling trips made to the minimum necessary to keep the developed waters from going dry.

The refuge will implement a program of upgrading existing developed waters in wilderness. The upgrades will increase their water collection efficiency and capacity while decreasing evaporation, visual intrusiveness and maintenance requirements. These improvements should greatly reduce or eliminate the need for hauling supplemental water.

Within three years of the adoption of this CCP the refuge will conduct a comprehensive survey of the pronghorn habitat to identify suitable locations for developing additional pronghorn waters.

Refuge staff will annually collect water samples from all developed water for analysis and detection of potential pathogens and their potential affect on the health of Sonoran pronghorn.

2.6.1.1.1.3 Captive Breeding/Translocation

No change is proposed from that described above in Section 2.1.1.1.3, Elements Common to all Alternatives.

2.6.1.1.4 Area Closures

No change is proposed from that described above in Section 2.1.1.4, Elements Common to all Alternatives.

2.6.1.1.5 Supplemental Feeding and Forage Enhancement

In addition to the forage enhancement plots described above in Section 2.1.1, Elements Common to All Alternatives, the refuge will locate suitable sites for additional forage enhancement areas. Selected sites will be characterized by better than average vegetative cover in areas of documented frequent pronghorn presence.

2.6.1.1.6 Fencing

The refuge will work with its partners to develop wildlife corridors to the east across Arizona Highway 85 and north across the BMRG. The refuge will work with BLM to eliminate grazing on adjacent lands and then remove fences.

2.6.1.1.7 Predator Management

The refuge will implement studies, including radio collaring, to investigate use of developed waters, size of home range and breeding success of coyote on the refuge. These studies will also include review of data on predation on Sonoran pronghorn collected on BMGR and OPCNM. Selective removal of coyotes will be implemented when the Sonoran pronghorn population is below 100 animals and winter and spring precipitation is 50 percent or less of average.

2.6.1.1.8 Habitat Restoration Research

Other than research on use of developed waters and supplemental food sources by Sonoran pronghorn, none is proposed.

2.6.1.2 Lesser Long-nosed Bat Conservation

In addition to the protection afforded by the lesser long-nosed bat's maternity roost's remote location and fence around the roost entrance described above in Section 2.1.1.2, under this alternative refuge staff will install a gate over the entrance to the roost, if there is any evidence that unauthorized persons are circumventing the fence. The gate will be locked open during the bat's breeding and rearing season, as juvenile lesser long-nosed bats are poor fliers and are unable to pass through any grate that will prohibit human entry. The gate will contain grates passable by adult lesser-long nosed bat so that any bats that arrive early in the spring while the gate is still closed can access the roost. When bats are absent during the winter the gate will be locked closed to disrupt of human use. The gate should be considered be a "second line of defense" to further deter any habitual users of the roost entrance who devise a method of climbing over or otherwise circumventing the fence. Refuge staff will continue to periodically monitor the roost entrance to document damage caused by human use and assess bat use of the roost. Refuge law enforcement personnel will continue periodic surveillance of the roost entrance to apprehend unauthorized users. Refuge staff will continue to survey for additional, unknown roost sites on the refuge. The refuge will continue to keep the location of the roost unpublished.

2.6.1.3 Pierson's Milkvetch Surveys

No change is proposed from that described above in Section 2.1.1.4, Elements Common to all Alternatives.

2.6.1.1.4 Desert Pupfish Refugium

No change is proposed from that described above in Section 2.1.1.5, Elements Common to all Alternatives.

2.6.1.2 Desert Bighorn Sheep

Conservation of the desert bighorn sheep was central to the purpose of creation of Cabeza Prieta NWR. Sheep occupy all of the mountain ranges within the refuge.

2.6.1.2.1 Developed Waters

The refuge will implement a program of upgrading existing desert bighorn sheep developed waters in wilderness. The upgrades will increase their water collection efficiency and capacity while decreasing evaporation, visual intrusiveness and maintenance requirements. These improvements should greatly reduce or eliminate the need for hauling supplemental water. The improved waters will be designed with enhanced visual clues to water level, so that Service and AGFD personnel conducting monitoring flights over the refuge can more easily and accurately determine water levels.

Refuge staff will continue to periodically haul supplemental water to Buck Peak, Halfway, Tuseral, Bassarisc, North Pinta, Granite, Heart and Eagle Tanks, all located within the wilderness, as well as the Childs Mountain Parabolic Tank, in non-wilderness.

The refuge will investigate the feasibility of obtaining photovoltaic powered water level sensors with remote transmission capability or other devices for remote water level monitoring. Should such devices be available they will be installed at all waters retained. When these sensors indicate that water supplies insufficient to last until the next anticipated rainy season remain, supplemental water will be hauled to the developed water. These sensors should reduce the number of water hauling trips made to the minimum necessary to keep the waters from going dry.

Within one year of CCP adoption, the refuge will complete a comprehensive survey of desert bighorn sheep habitat to identify suitable sites for additional high collection and retention efficiency, low visual impact developed waters. Sites for new developed waters in the northern Granite Mountains and throughout the Growler Mountains are particularly desirable, as these ranges are considered under supplied with water for optimum desert bighorn sheep population increase on the refuge (Morgart 2002). Developed waters will be constructed subject to MRA, using both refuge staff and volunteer labor.

2.6.1.2.2 Forage Enhancements

During the refuge-wide survey of desert bighorn sheep habitat for potential developed water sites, the refuge will also search for valleys or canyons in the mountain ranges that would be suitable as forage enhancement areas. In wilderness potential forage enhancement sites would be achieved by subtly redirecting runoff from adjacent slopes to concentrate flows into the site and construction of small check dams along the valley bottom to capture runoff, increase water residence time, and increase infiltration. In non-wilderness areas forage enhancement may be achieved by irrigation of the valley or canyon using water from a well. Supplemental water in these sites will foster growth of grasses and forbs, and has the potential to greatly increase the area's carrying capacity for desert bighorn sheep (J. Hervert, AGFD, pers. comm.).

2.6.1.2.3 Population Goal

This alternative sets a refuge population goal for desert bighorn sheep of 900 to 1200. This goal is based upon comparison of sheep densities in the more densely stocked similar habitats off-refuge. It represents a sustainable population for the refuge, in the best professional judgment of refuge staff, given additional developed waters and forage enhancements. If 75 percent of this goal is not achieved within 15 years of plan adoption, the refuge will seek off-site stock for stocking of refuge mountain ranges.

2.6.1.2.4 Predator Management

Within two years of CCP adoption the refuge will implement studies, including radio collaring, to investigate use of developed waters, size of home range and breeding success of mountain lion on the refuge. Studies will also include review of data on predation on desert bighorn sheep collected on BMGR and OPCNM. If studies determine that predation is adversely affecting desert bighorn population numbers, the refuge will implement limited predator controls, including a public predator hunt coordinated by AGFD, consistent with MRA and Sonoran pronghorn conservation.

2.6.1.3 Desert Ecosystem Integrity Monitoring

2.6.1.3.1 Cactus Ferruginous Pygmy-owl Monitoring

The refuge will develop a monitoring protocol to survey potential habitat for the presence of cactus ferruginous Pygmy-owls, and gather natural history information, juvenile dispersal, home breeding range and habitat use information for the species.

2.6.1.3.2 Migratory Birds

Refuge staff will continue monitor Le Conte's thrasher nests for reproductive success, renesting attempts and nest site characteristics. Le Conte's thrasher is listed by the Arizona Partners in Flight program as an indicator of Sonoran Desert health. The refuge will initiate research on other bird species listed as Birds of Conservation Concern by the Service's Office of Migratory Bird Management, or as indicators of Sonoran Desert health by the Arizona Partners in Flight program. New research will include distribution and status surveys for elf owl, Gila woodpecker, gilded flicker, loggerhead shrike, Bell's vireo, gray vireo, crissal thrasher, black-chinned sparrow and sage sparrow; point counts for yellow warbler; determination of the age/size class of saguaros used by nesting Gila wood pecker and glided flicker; and study of habitat use by black-chinned sparrow, sage sparrow and Costa's hummingbird. and investigation of natural history, juvenile dispersal.

2.6.1.3.3 Reptiles and Amphibians

The refuge will develop standard protocols for reptile surveys and implement additional surveys, contracting with the University of Arizona for staff. When the protocols are in place, the refuge will initiate surveys for Gila monster, desert tortoise, chuckwalla, canyon spotted whiptail, flat tailed horned lizard and rosy boa. Refuge surveys for desert tortoise will be coordinated with the AIDTT to ensure consistency among agencies. The refuge will continue to survey abundance, distribution and breeding potential of amphibians, especially in developed waters.

2.6.1.3.4 Raptors and Ravens

The refuge will establish and implement protocols for inventory and monitoring of golden eagle, prairie falcon and raven.

2.6.1.3.5 Game Animal

The refuge will implement a population survey program for mule deer, quail, dove and rabbit to establish accurate estimates of refuge populations.

2.6.1.3.6 Long-term Monitoring

Within four years of CCP adoption, the refuge will complete a survey of critical desert resources, refuge-wide. Resources to be surveyed include natural water sources, invasive species infestations, areas of high forage value for desert bighorn sheep or Sonoran pronghorn and mineral licks used by wildlife. Refuge staff will document the locations of surveyed resources using global positioning system equipment to allow efficient, accurate mapping.

The refuge will continue to monitor vegetation transects established in 2002 to detect changes in the refuge plant community. Additionally, the refuge and the regional office will implement a change detection analysis, using aerial photography sampling (i.e., photography will be taken of a random sample of the refuge, as full photographic coverage of the refuge would be too large to effectively analyze). Analysis of photography taken each year and comparison of photography from different years and archival photography will allow identification of changes in vegetation community composition and density.

2.6.1.3.7 Exotic/Invasive Species

The *Checklist of the Plants of Cabeza Prieta National Wildlife Refuge, Arizona* lists 32 non-native plant species that occur on the refuge (Felger 1998). This list is presented in Appendix E. Three non-native species, fountain grass, buffelgrass and Sahara mustard, have become established at infestation levels on the refuge. These species have the potential to out-compete native species for resources and reduce the density of native flora on the refuge. Sahara mustard is of particular concern as it appears to be infesting the Pinta Sands area, which has supported a native grass community considered to be an important food source for Sonoran pronghorn. In consultation with the regional Exotic/Invasive Species Coordinator, the refuge has modeled likely locations of occurrence for each species. Refuge staff will continue to be trained to recognize these species and document any occurrences encountered during field work. Additionally, new infestations of exotic and invasive plants should be identified during the refuge-wide survey described in Section 2.6.1.3.6 above. The refuge will continue to actively manage fountain grass by hand pulling to limit its spread and eradicate small infestations where feasible. As new occurrences of exotic/invasive species are identified, refuge staff will eradicate by hand pulling, burning or chemical treatment, as appropriate, subject to MRA in wilderness.

Trespass livestock present a variety of potential problems to native wildlife on the refuge, including the spread of disease, competition for forage resources and exclusion of native wildlife from water sources. There are two sources of trespass cattle, a private grazing lease on BLM land to the east of the refuge and occasional cross border trespass from Mexico. Domestic goats from Mexico occasionally cross onto the refuge. Goats are particularly problematic as bot fly hosts. While bot flies are not a troublesome parasite to goats, bot fly larvae cause chronic sinusitis in wild desert bighorn sheep, a debilitating and frequently lethal condition. When livestock are encountered on the refuge, staff will attempt to identify and contact the owner to facilitate removal. If the owner cannot be identified, trespass livestock will be humanely removed.

2.6.2 Goal: Wilderness Stewardship

Protect and conserve refuge wilderness employing strategies of wildlife and plant conservation that will maintain and restore the wilderness character of Cabeza Prieta NWR.

2.6.2.1 Minimum Requirements Analysis

The refuge will streamline the MRA process described above in Section 2.1.3.1 under Elements Common to All Alternatives, Wilderness Stewardship, by establishing programmatic MRAs for all predictable, recurring activities, such as water hauling, wildlife surveys and water sample collection, which require generally prohibited uses of wilderness. The only case-by-case MRAs anticipated are those covering unpredictable, one-time or very intermittent activities requiring generally prohibited uses in wilderness.

2.6.2.2 Abandoned Vehicles Removal

Abandoned vehicles will continue to be removed as they are found in the refuge wilderness, subject to an MRA. Refuge staff will tow the vehicle to the nearest non-wilderness road, typically El Camino del Diablo, using a refuge vehicle. Whenever feasible, the vehicle will be towed along its entry track, thus avoiding new impacts to wilderness. Once removed to a road outside of wilderness, the vehicle will be hauled off of the refuge by a commercial towing company. The refuge will also examine the feasibility entering a memorandum of agreement with adjacent military commands to make heavy lift military helicopters available for removing abandoned vehicles from refuge wilderness (the refuge examined this technique in 2002 but no military airlift commands were willing to assume the risks involved in removing vehicles at that time). Vehicles abandoned on refuge non-wilderness will also be removed as soon as is feasible, taking care to limit damage to vegetation and the soil surface. All abandoned vehicles will be removed from refuge wilderness within 72 hours of their discovery.

2.6.2.3 Military Debris Removal

Military debris removal by the refuge will continue to include notification to the military of unexploded ordnance as it is found. The refuge will actively coordinate with the military and volunteers to remove tow darts and tow cable from the refuge, using appropriate means in wilderness to accomplish removal. The refuge will set a goal of removing at least 15 military tow darts each year.

2.6.2.4 Administrative Trails

The refuge will retain all administrative trails currently available for management vehicular use (as shown on figure 2.3). Vehicular access to the trails will be limited to border law enforcement under the provisions of the Arizona Desert Wilderness Act of 1990 and refuge management actions subject to MRA. Refuge back-country visitors will be encouraged to hike on administrative trails in order to concentrate user impacts on already affected areas.

If future changes in management regime result permanent cessation of all water hauling, all the administrative trails will be closed to refuge management use.

2.6.2.5 Wilderness Impact Monitoring

In addition to continuation of the ongoing wilderness impact monitoring described above in Section 2.1.3.3 under Elements Common to All Alternatives, Wilderness Stewardship, the refuge will work with the Regional Office remote sensing staff to design an aerial photography program to monitor impacts of trail development by undocumented aliens or narcotics traffickers crossing the refuge. Photography flown in 1994 by the Department of Commerce's Borderlands Project can serve as a baseline for comparison. Refuge field staff will identify areas known to be impacted by illegal traffic. This information will be used to identify areas of the refuge to be flown and photographed on a biennial basis.

Refuge staff will maintain a database of all observed adverse impacts to wilderness, whether caused by refuge management, illegal activities, border law enforcement or visitor use. These data and those

generated by wilderness impact monitoring will support the wilderness research described above in Section 2.1.5.2.

2.6.2.6 Border Law Enforcement

The Refuge will continue to coordinate with border law enforcement agencies described above in Section 2.1.3.2, Elements Common to All Alternatives, Wilderness Stewardship.

2.6.2.7 Licensing of Uses of the Childs Mountain Communications Site

The Refuge will continue to allow currently permitted uses of the Childs Mountain site and will renew permits as deemed necessary for human safety and efficient law enforcement. The refuge will maintain a current inventory of permitted uses and limit any increase of the development footprint that is not necessary in the interest of national security, local law enforcement or human health and safety. The refuge will work with the military to identify any obsolete buildings or other structures on the site and have them removed.

2.6.3 Goal: Visitor Services

Provide visitors with compatible, high quality wildlife-dependent recreational and educational experiences designed to foster better appreciation, understanding and protection of the plant, animal and wilderness resources of Cabeza Prieta NWR.

2.6.3.1 Managing Visitor Access

Access to the refuge, other than the Visitor Center, is by permit only. The refuge, pending cooperation with NPS and USMC, will develop a telephone or internet accessible refuge entry permit in addition to the permit currently issued at the visitor center. Concurrence from NPS and USMC is necessary for visitors planning a through trip on El Camino del Diablo, as access to the refuge is through OPCNM on the east and a portion of the BMGR administered by the USMC on the west. If established, this permit would provide full access to the refuge and transit-only access to National Park Service and USMC lands via El Camino del Diablo.

Vehicular access restrictions will continue to limit access to Christmas Pass Road and El Camino del Diablo to four-wheel-drive vehicles, ATVs and motorcycles licensed for roadway use and fitted with a mast displaying an orange flag at least 2.4 meters (8 feet) off the ground. The flag's area must equal or exceed 0.5 square meter (80 square inches). While vehicular travel will be limited to the actual roadway, the entire 60 meter (200 foot) width of the non-wilderness corridor will be open to pull-off and parking. Pending a determination that Sonoran pronghorn populations have stabilized and that such use would not jeopardize the subspecies, the refuge will investigate the feasibility of developing a road loop in the non-wilderness portion of the Childs Valley in cooperation with BLM. Both this road loop and Charlie Bell Road will be maintained to a standard allowing use of ordinary passenger cars at low speed.

2.6.3.2 Administering Hunt Program

2.6.3.2.1 Desert Bighorn Sheep

The refuge will continue to offer a limited desert bighorn sheep hunt, administered in cooperation with AGFD and allowed under a refuge special use permit.

2.6.3.2.2 Mule Deer

Should the results of the game animal population surveys indicate that the refuge deer population is sufficient to support hunting, the refuge will implement a mule deer hunt. This hunt will be administered by AGFD, subject to Arizona hunting regulations, and will only be implemented upon a determination that the U.S. subpopulation of Sonoran pronghorn has stabilized and would not be jeopardized by such hunts. Numbers of permits issued for mule deer on the refuge hunt units will be determined using the results of population surveys and refuge management goals. Should the refuge implement a mule deer hunt, accommodations for hunters with disabilities will be developed in refuge non-wilderness.

2.6.3.2.3 Small Game

The refuge will consider implementing a small game hunt for quail, dove and rabbit. This hunt will be administered by AGFD, subject to Arizona hunting regulations. Hunting will commence only upon determination that the U.S. subpopulation of Sonoran pronghorn has stabilized and would not be jeopardized by such hunts, that the hunt is consistent with refuge management goals, and that the hunt is compatible with the refuge purpose.

2.6.3.2.4 Predators

If determined consistent with refuge management goals and compatible with the refuge purposes, public predator hunts for coyote, bobcat and mountain lion may be authorized on the refuge. These hunts will be administered by AGFD, subject to Arizona hunting regulations, and will only be implemented upon a determination that the U.S. subpopulation of Sonoran pronghorn has stabilized and would not be jeopardized by such a hunt.

2.6.3.3 Implementing Leave-No-Trace Program

Leave-No-Trace (LNT) is a set of back county travel and camping skills aimed at greatly reducing the overall impacts of outdoor recreation. The refuge provides all permitted back-country users an information packet including LNT information and detailing the generally prohibited uses of wilderness enumerated in the Wilderness Act of 1964. The refuge will continue to provide LNT information to all permitted visitors. All visitor contact refuge employees and interested volunteers will be provided annual opportunities for LNT training .

2.6.3.4 Provision of Environmental Education

The refuge will continue to respond to requests from local schools for natural history and other environmental education presentations. The refuge will also develop a Sonoran Desert ecosystem-specific environmental education program for use by staff in schools and other venues. The refuge will conduct teacher workshops on Sonoran Desert education.

2.6.3.5 Interpretation of Natural Resources

The refuge will develop an ADA compliant trail and overlook to provide viewing of the desert pupfish refugium. The overlook will be shaded for visitor comfort and will include interpretive materials describing the desert pupfish, its conservation status and the purpose of the refugium.

The refuge will expand the visitor center with additional exhibition, classroom and office space. The visitor center will be staffed seven days a week during the winter season. Refuge staff and contractors will develop a new general refuge video an interpretive pamphlet for the existing trail on the visitor site and additional interpretive displays for the visitor center. Refuge staff will lead guided interpretive walks and offer

lectures and workshops on Sonoran Desert natural resources at the visitor center.

Should ongoing efforts to acquire a 12-hectare (30-acre) site adjacent to the current refuge visitor center site be successful, the refuge will develop an expanded interpreted trail on that site. The trail would include placarded examples of plant species typical of the refuge's various vegetation communities, and information about their habitat value, wildlife use and any traditional cultural uses of the plant or its seeds and fruits.

The refuge will develop additional interpretive signage and overlooks in non-wilderness areas. Pending a determination that Sonoran pronghorn populations have stabilized and that such use would not jeopardize the subspecies. Should the refuge develop a road loop in non-wilderness in cooperation with BLM, the road will include vistas, interpretive panels at vehicle pull-offs and a self-guided tour with pamphlets available at self-service boxes at the road entrance.

The refuge will continue to participate in the Sonoran Shindig, National Wildlife Refuge Week observances and other festivals.

The refuge will work with the FAA, military and other lessees of the Childs Mountain site to secure their immediate site boundary and attempt to upgrade the road to Arizona Department of Transportation safety standards, so that the Childs Mountain watchable wildlife site can be opened to general use.

2.6.3.6 Managing Visitor Camping

Camping is considered necessary to support hunting, wildlife observation and photography, given the remoteness of the refuge, the difficulty of access to much of the refuge and the nocturnal or twilight activity of many desert wildlife species. The refuge offers both back-country and vehicle accessible camping. The following rules will be enforced to protect refuge resources and maintain wilderness character. Camping will remain prohibited within 400 meters (1/4 mile) of any wildlife water; gathering dead and down wood will be allowed, and the maximum length of stay will remain 14 consecutive days. The three developed, vehicle accessible, primitive camping areas with minimal amenities at Papago Well, Tule Well and Christmas Pass will be retained. Two additional primitive campsites will be developed on Charlie Bell Road and along the Daniels Arroyo Road, both in refuge non-wilderness, pending a determination that neither campsite would jeopardize the continued existence of Sonoran pronghorn.

2.6.3.7 Pack and Saddle Stock Restrictions

Pack and saddle stock will be permitted under the general access permit, with the following restrictions aimed at protecting refuge resources. Travel will be limited to the administrative trails, dry washes and along the base of the mountain ranges; pack and saddle stock will not be allowed to graze on refuge or be watered in any refuge water holes, tinajas or tanks; certified weed-free feed will be used (feed pellets or processed and pelletized feed) on the refuge and for three days prior to entry to prevent introduction of exotic species seeds in manure and no species known or suspected to carry diseases pathogenic to desert bighorn sheep or Sonoran pronghorn will be permitted on the refuge.

2.6.4 Goal: Cultural Resources Management

Protect, maintain and interpret cultural and historic resources on Cabeza Prieta NWR, in cooperation with Tribal governments and the State of Arizona to benefit present and future generations.

2.6.4.1 General Provisions

This goal is addressed as described above in Section 2.1.4 under Elements Common to All Alternatives.

2.6.4.2 Onsite Interpretation

Refuge staff will develop panels interpreting the early history of Ajo with placards on the refuse heaps on the visitor center site. The refuge will develop a general history tour that will interpret non-sensitive cultural and historic resources.

2.6.4.3 Site Stabilization/Patrols

Refuge staff will periodically inspect known sites for damage, and develop stabilization measures if needed. Refuge law enforcement staff will periodically patrol known sites to apprehend unauthorized individuals and discourage unauthorized entry.

2.6.4.4 Inventory

Refuge staff will work with the State Historic Preservation Office and the Tohono O’odham Tribe to investigate known or suspected undocumented cultural sites. Additionally, some cultural resource sites are likely to be discovered during the refuge-wide survey for critical desert resources described in Section 2.6.1.5 above.

2.6.4.5 Training

The refuge will provide training to border law enforcement personnel regarding the sensitivity of refuge cultural resources and avoiding damage to cultural resource during border law enforcement operations.

2.6.5 Staffing

In order to implement this management alternative, the refuge will need to add five full time positions beyond the level of the no-action scenario. These positions, two wildlife biologists, one maintenance worker, one law enforcement officer and one outdoor recreation planner, reflect increased wildlife monitoring, law enforcement and visitor services efforts. The required staffing level is summarized in Table 2.8. The cost of implementing this staffing level and its impacts on the local and regional economy are summarized below in Section 4.6.1.1.

Position	Number	Grade Level
Project Leader	1	GS-14
Deputy Project Leader	1	GS-13
Wildlife Biologist	4	GS-12, GS-11, GS- 9
Outdoor Recreation/ Outreach Specialist	2	GS-12, GS-9
Law Enforcement (Supervisory)	1	GS-11
Law Enforcement	4	GS-9
Maintenance Worker	3	WG-10
Office Assistant	1	GS-5

Table 2.9: Summary comparison of the management alternatives organized by planning issues identified in scoping (Section 1.12)

Issue	Alternative 1, No Action	Alternative 2	Alternative 3	Alternative 4 Preferred alternative	Alternative 5
Wildlife & Habitat Management					
Managing Healthy Ecosystems	Climate monitoring Some wildlife monitoring Buffelgrass and trespass livestock control	Same as No Action	Same as No Action plus additional wildlife monitoring, remote sensed change detection analysis, development of wild plant nursery	Same as No Action plus additional wildlife monitoring, beyond that of Alternative 3, remote sensed change detection analysis.	Same as No Action plus greatest intensity of wildlife monitoring of any alternative, remote sensed change detection analysis
Endangered Species	Implement Sonoran pronghorn recovery, Protect lesser long nosed bat roost with fence	Same as No Action	Same as No Action, except that water is supplied to charcos only during extreme drought	Same as No Action, plus installation of a gate at entrance to lesser long nosed bat roost if unauthorized access becomes a problem.	Same as Alternative 4 program plus annual Sonoran pronghorn population surveys.
Desert Bighorn Sheep	Population surveys every three years 15 developed waters maintained and supplied Study of sheep water use No numerical population goal Annual hunts	Population surveys every three years 14 developed waters in wilderness dismantled Study of sheep water use Population goal of 100-200 sheep No hunts	Population surveys every three years Developed waters supplied only during extreme drought Sheep water use study Population goal of 250 to 300 sheep No hunts during drought years	Population surveys every three years 15 developed waters maintained, supplied and upgraded Sheep water use study Population goal of 500 to 700 sheep Annual hunts	Population surveys every three years Developed waters maintained, supplied, upgraded and supplemented Sheep water use study Population goal of 900 to 1,200 sheep Annual hunts

Table 2.9: Summary comparison of the management alternatives organized by planning issues identified in scoping (continued)					
Issue	Alternative 1, No Action	Alternative 2	Alternative 3	Alternative 4 Preferred alternative	Alternative 5
Predators	Coyote control as prescribed by Sonoran pronghorn recovery plan	Same as No Action	Same as No Action, plus collaring studies of coyote and mountain lion	Same as Alternative 3 plus control of mountain lions if studies indicate	Same as Alternative 4
Wilderness Stewardship					
Wildlife Management in wilderness	Maintenance of, and water supply to, 14 desert bighorn sheep waters, 20 Sonoran pronghorn waters, 2 dual-species waters Capture and collar of Sonoran pronghorn when conditions allow	Maintenance of, and water supply to only the 20 waters serving Sonoran pronghorn No capture and collar of Sonoran pronghorn in wilderness Structural improvements to other developed waters removed	Same as Alternative 2 except that water supplied to desert bighorn sheep developed waters during extreme drought Water supplied to 2 charcos in Sonoran pronghorn habitat only during extreme drought	Same as No Action, plus improvement of developed waters to require less maintenance/ water hauling, and better blend visually into surroundings Possible development of additional waters, should research validate their need	Same as Alternative 4 plus development of additional desert bighorn sheep waters and forage enhancements for desert bighorn sheep

Issue	Alternative 1, No Action	Alternative 2	Alternative 3	Alternative 4 Preferred alternative	Alternative 5
Wilderness Character Restoration/protection	234 km (145 mi) of administrative trails open to management vehicular use, Abandoned vehicles removed as discovered Annual monitoring of 10 wilderness sites for impacts	137 km (85 mi) of administrative trails open to management vehicular use, Abandoned vehicles removed as discovered Annual monitoring of 10 wilderness sites for impacts, results tracked on database	202 km (125 mi) of administrative trails open to management vehicular use, Abandoned vehicles removed as discovered Annual monitoring of 10 wilderness sites for impacts, biennial analysis of aerial photos to quantify trail development, all results tracked on database	202 km (125 mi) of administrative trails open to management vehicular use, Abandoned vehicles removed as discovered Annual monitoring of 10 wilderness sites for impacts, biennial analysis of aerial photos to quantify trail development, all results tracked on database	Same as Alternative 1 plus biennial analysis of aerial photos to quantify trail development, all results tracked on database
Wildlife Dependent Visitor Services					
Wilderness recreation	Camping and hiking encouraged, charcoal fires and stoves only 14 day length of stay limit (LSL) Pack/Saddle stock requires special use permit (SUP)	Camping and hiking encouraged, charcoal fires and stoves only 8 person party size and 7 day LSL Pack/Saddle stock not allowed	Camping and hiking encouraged, charcoal fires and stoves only 8 person party size and 7 day LSL Pack/Saddle stock requires SUP	Camping and hiking encouraged, carried-in, non-native firewood allowed, at vehicle camps, dead/down firewood allowed in backcountry 4 vehicle party size, 8 person party size and 14 day LSL Pack/Saddle stock requires SUP	Camping and hiking encouraged, gathering dead/downed firewood allowed No party size restrictions, 14 day LSL Pack/Saddle stock allowed with general entry permit

Table 2.9: Summary comparison of the management alternatives organized by planning issues identified in scoping (continued)					
Issue	Alternative 1, No Action	Alternative 2	Alternative 3	Alternative 4 Preferred alternative	Alternative 5
Permitting & Access	Joint entry permit with BMGR, BLM	Same as No Action	Same as No Action	Same as No Action	Refuge only permit, accessible by telephone or internet
Motorized Access in Non-wilderness	Driving allowed only on roadway, pull-offs allowed on center 30 m (100 ft) of road corridors Registered, street-legal vehicles only 4WD required on El Camino del Diablo and Christmas Road, high clearance on Charlie Bell Road	Same as No Action	Same as No Action	Same as No Action, plus licensed, street-legal motorcycles and ATVs allowed on refuge. Motorcycles and ATVs must carry a visibility flag (see text) Road loop developed in Childs Valley non-wilderness when Sonoran pronghorn population stabilized	Driving only on roadway, pull-offs anywhere within road corridors Copper Canyon Road loop developed with BLM if feasible 4WD required on El Camino del Diablo, Charlie Bell and Copper Canyon Roads maintained for standard passenger cars ATVs and motorcycles allowed
Hunting	Annual desert bighorn sheep hunt	No hunting	Annual desert bighorn sheep hunt, prohibited during extreme drought years	Annual desert bighorn sheep hunt Possible mule deer, small game, & predator hunts (pending Sonoran pronghorn population stability & compatibility determination)	Same as Alternative 4

Table 2.9: Summary comparison of the management alternatives organized by planning issues identified in scoping (continued)					
Issue	Alternative 1, No Action	Alternative 2	Alternative 3	Alternative 4 Preferred alternative	Alternative 5
Environmental Education and Interpretation	Interpretive materials at visitor center and Childs Mountain Watchable Wildlife Site Sonoran Shindig	Same as No Action	Same as No Action, plus Sonoran Desert specific education program for school use New refuge video Carhart Center wilderness video available for viewing at visitor center Material interpreting importance of bats as pollinators Additional interpretive signs in non-wilderness	Same as Alternative 3 plus enlarged visitor center Interpreted accessible trail and overlook at desert pupfish refugium Longer interpreted trail at visitor center site if 12 hectare (30 acre) adjacent site is acquired	Same as Alternative 4
Camping	Three designated campsites with tables and charcoal grilles Charcoal fires and fuel stoves only Maximum length of stay is 14 days	Same as No Action, plus 8 person party size and 7 day stay limitations	Same as Alternative 2	Same as No Action Plus 4 vehicle party size limit, 8 person party size limit Wood fires allowed with non-native wood at vehicle campsites and dead/downed wood in backcountry	Same as No Action, plus two additional campsites developed in non-wilderness Wood fires allowed with dead and down fuel

Table 2.9: Summary comparison of the management alternatives organized by planning issues identified in scoping (continued)					
Issue	Alternative 1, No Action	Alternative 2	Alternative 3	Alternative 4 Preferred alternative	Alternative 5
Cultural Resources Management	No on-site interpretation Site surveys prior to ground disturbance	Same as No Action	Same as No Action	Same as No Action, plus periodic cultural site inspections and stabilization if necessary	Same as Alternative 4
Border Law Enforcement/Illegal Entry	Beyond control of refuge Desert & wilderness training offered to border law enforcement staff	Same as No Action	Same as No Action	Same as No Action	Same as No Action
Military Use	Limited to provisions stipulated by PL106-65, Title XXX, including maintenance of communications infrastructure, over flight, and occasional area access restrictions in the interest of public safety.	Same as No Action	Same as No Action	Same as No Action	Same as No Action

3.0 THE AFFECTED ENVIRONMENT

3.1 GEOGRAPHIC/ECOSYSTEM SETTING

Cabeza Prieta is located along and north of the U.S./Mexico border between Yuma and Tucson, Arizona. Its 348,182 hectares (860,010) acres encompass Sonoran desert habitat and the largest wilderness managed by the U.S. Fish and Wildlife Service outside of Alaska. Together with adjacent OPCNM, the BMGR, lands held by the Tohono O'odham Nation and nearby Pinacate Biosphere Reserve in Mexico, a vast expanse of Sonoran desert is represented.

The refuge is located in the Sonoran region of the Basin and Range Province of North America. This is an extensive system of fault block mountains separated by wide alluvial valleys. The desert geologic processes produce topography characterized by stark mountains surrounded by large bajadas of alluvium (Simmons, 1965). Elevations on the refuge range from 183 meters (600 feet) MSL in the San Cristobal Valley to 1,186 meters (3,293 feet) MSL in the Growler Mountains, with the valley floors becoming progressively lower from east to west. The geology of the refuge is primarily basalts and granite, with some sedimentary material making up much of the alluvial structures and drainage corridors throughout the refuge.

The primary topographic features within the refuge include abrupt long, narrow, northwest-oriented mountain ranges (see figure 3.1 for a refuge map). Two types of mountains occur on the refuge: sierras and mesas. The sierra mountain ranges are characterized by jagged crests that vary little in height and rise steeply from valley floors. The mesas are gently inclined, or relatively flat, massive blocks cut by young canyons.

Separating the mountain ranges are broad, nearly level alluvial valleys and basins. Runoff from the mountains drains northward into the Gila River, westward to the Colorado River, and finally southward to the Gulf of California. Absence of an outlet for the draining water results in the formation of three desert playas or "dry lakes" on the refuge.

In the northeast corner of the refuge lies the Childs Mountain range. This range is approximately 14.5 kilometers (9 miles) long and is made up of volcanic layered plateaus and ridges. The Childs Mountains are approximately 460 meters (1,500 feet) above the valley floor at their highest point, and fall into the mesa-type category of mountains (Simmons 1965).

The little Ajo Mountains, which lie to the southeast of the Childs Mountain range, are composed of three groups of sierra-type hills. The longest of those groups is 8 kilometers (5 miles) long. These mountains are made up of mainly crystalline rocks and sediments. Rolling country with numerous canyons and arroyos separates the ranges. Broad pediments surround this mountain mass. The 43-kilometer (27-mile) Growler Mountain range runs through the northeast section of the refuge. The Growlers are primarily volcanic mesa-type formations. These mountains are composed of sandstone, tuft, conglomerate, and basalt. The east side gently inclines to a 460-meter (1,500-foot) western escarpment and then drops off abruptly.

The Agua Dulce Mountains, located in the lower southeast section of the refuge near the Mexican border, are approximately 19 kilometers (12 miles) long, and are northwest trending. The Agua Dulce Mountains are made up of three sierra-type masses surrounded by an extensive pediment. South of Papago Well and west of the Agua Dulce Mountains lie Davidson and O'Neill Hills. The hills are approximately 8 kilometers (5 miles) long and composed of coarse granite-gneiss or granite. These intricately faulted, miniature sierra-type mountains rise approximately 46 to 213 meters (150 to 700 feet) above the valley floor.

The Granite Mountains lie west of the Growler Mountains and Growler Valley. They are a sierra-type range extending approximately 24 kilometers (15 miles) across the BMGR and the refuge. These mountains have a jagged, sawtooth outline with the highest peak extending 305 meters (1,000 feet) above the adjacent valleys.

The basic composition of this range is granite with outcrops of grey schist. The Mohawk-Bryan Mountains are a 72-kilometer (45-mile) long, northwest trending range located west of the Granite Mountains. This sierra-type range rises steeply 457 meters (1,500 feet) above the desert floor and has a sharp jagged crest. The western slopes of the Mohawk-Bryan Mountains are generally steeper than the eastern slopes, with the composition of the range mainly granite and schist.

West of the Mohawk-Bryan Mountains lie the 40-kilometer (25-mile) long Sierra Pinta Mountains, another northwest trending, sierra-type range. The Sierra Pintas are narrow and steep with sharp peaks rising 610 meters (2,000 feet) above the valleys. These mountains are composed entirely of crystalline rock, divided by a distinct contrast between schist to the south and granite to the north.

The Cabeza Prieta Mountains lie west of the Sierra Pintas in the western part of the refuge. This sprawling, irregular mass, about 16 by 32 kilometers (10 by 20 miles), is composed of both crystalline complex rocks and overlying lavas and sediments. The varied composition of this range has produced tilted sierra-type ridges and dissected mesas and buttes with elevations of approximately 457 meters (1,500 feet). South of the Cabeza Prieta Mountains are the Tuseral Mountains, consisting of both the sierra and mesa-type topography. Although the largest part of this range is in Sonora, Mexico, approximately 6 kilometers (4 miles) extends into the refuge. The Arizona section of this mountain range rises 366 meters (1,200 feet) above the plains, with higher elevations in Mexico. These jagged and steep mountains exhibit signs of post-volcanic faulting.

Located outside the refuge's western border are the Tinajas Altas Mountains. This sierra-type, northwest trending mountain range is composed almost entirely of granite and related intrusive crystalline rocks.

The Pinacate Lava flow, which originated from the Pinacate Volcanic Field in northern Sonora, is located in the south-central part of the refuge. The northern tip of this flow extends 10 kilometers (6 miles) into the refuge and has an area of 78 square kilometers (30 square miles). The composition of the Pinacate Lava flow is olivine basalt combined with recent alluvial deposits. This is the most recent formation in the refuge other than the alluvial deposits in valleys.

Surrounding the northern, western, and eastern edges of the Pinacate Lava Flow is an area of wind blown sand deposits known as the Pinta Sands. These sands have blown eastward up against the Sierra Pintas from the Gulf of California, and are covered with vegetation making them fairly stable when undisturbed. This vegetation is thought critical in the diet of the Sonoran Pronghorn (Carr 1971).

Five major northwest trending valleys occur on the refuge. From east to west these are the Growler Valley, the San Cristobal Valley, the Mohawk Valley, the Tule Desert, and the Lechuguilla Desert. The southern Tule Desert drains into two large playas--Las Playas and Pinta Playa. A third playa -- Dos Playas -- is located in the Mohawk Valley. The playas occasionally hold water following rainstorms, but are very flat and composed of fine textured soils that are often high in salt content, thus resulting in limited plant growth.

Minerals containing thorium, uranium, copper, selenium, galena, gold, silver, rare earth, and tellurium are found on the refuge. The nonmetallic minerals of the refuge include beryl, barite, feldspar, mica, quartz, granite, limestone, marble, and strontium salts (USDI 1974).

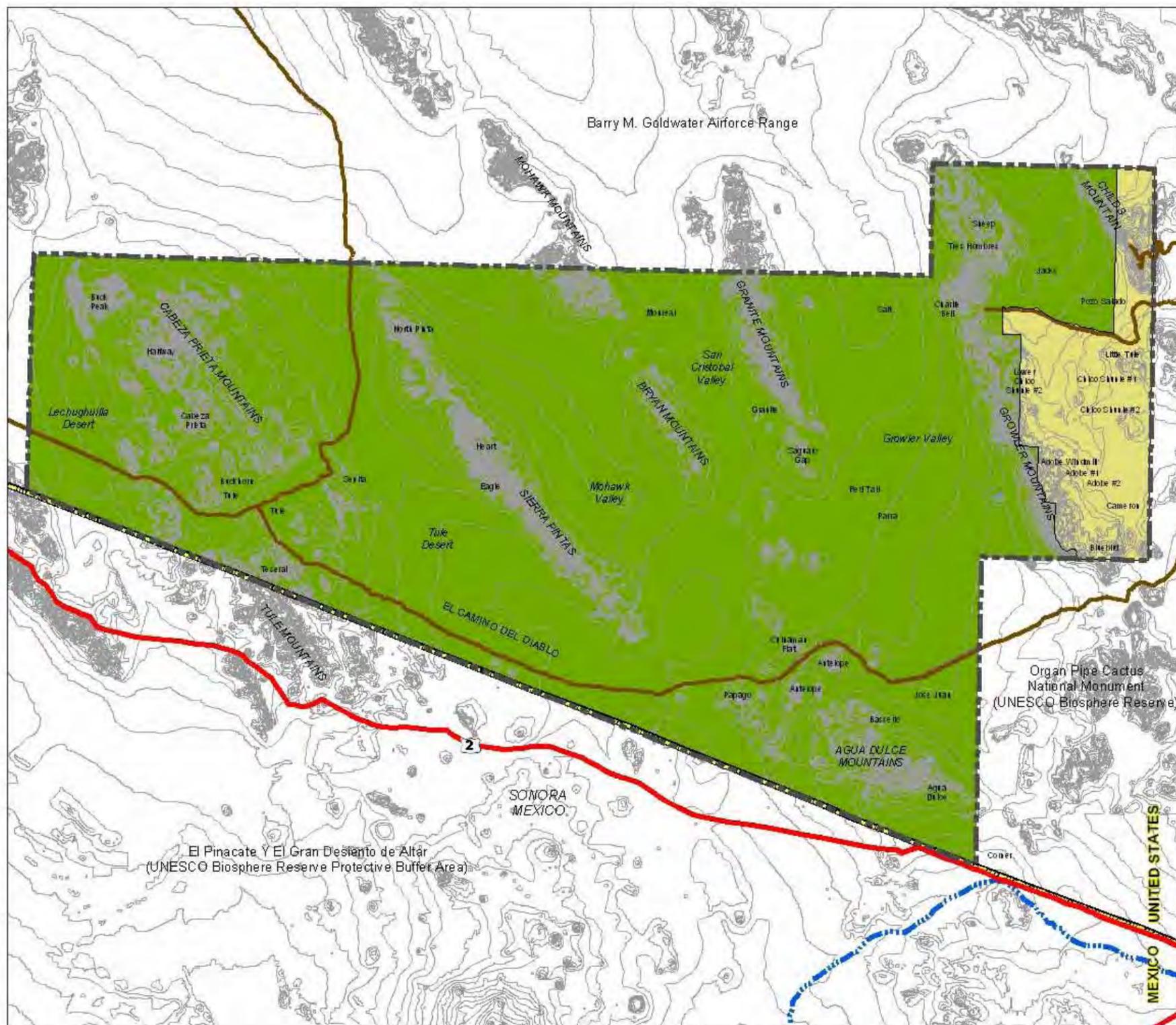
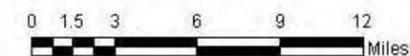


Figure 3.1 Refuge Map with Terrain Features and Jurisdictional Boundaries

Legend

- Cabeza Prieta N.W.R.
- Wilderness
- Non-Wilderness
- Public Roads
- US/Mexico Border
- Highway
- Rio Sonoyta

Sources: USFWS, 2006



**CABEZA PRIETA
NATIONAL WILDLIFE REFUGE**

COMPREHENSIVE CONSERVATION PLAN

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH & WILDLIFE SERVICE

3.2 LAND STATUS

The refuge is situated in the southwest corner of the State of Arizona and lies approximately 177 kilometers (110 miles) south of Phoenix, Arizona; 201 kilometers (125 miles) west of Tucson, Arizona; and more than 321 kilometers (200 miles) east of San Diego, California. The legal description of the refuge is as follows:

Gila and Salt River Meridian

Townships 11, 12, 13S, R. 7W

T. 14s, R. 7W, secs. 1 through 18

Tps. 11, 12, 13S, R. 8W

T. 14S, R. 8W, secs. 1 through 21, 28 through 33,

T. 15S, R. 8W, secs. 4 through 9, 16 through 21, 28 through 33,

T. 16S, R. 8W, secs. 4 through 9, 16 through 21, 28 through 33,

T. 17S, R. 8W, secs. 4, 5, 6, 8, and 9

Tps. 12 through 17S, R. 9W,

Tps. 12 through 16S, R. 10W,

Tps. 12 through 16S, R. 11W,

Tps. 12 through 15S, R. 12W,

Tps. 12 through 15S, R. 13W,

Tps. 12 through 15S, R. 14W,

Tps. 12, 13, 14S, R. 15W,

Tps. 12, 13, 14S, R. 16W.

In November of 1940, Executive Order 8598 set aside 16 hectares (40) acres in Ajo for an administrative site. Three residences have been built over the years. The remainder of the property was used as pasture for refuge horses. In 1969, Public Land Order 46171 revoked 12 hectares (30 acres) of that withdrawal and returned it to the state. A visitor center was built on the remaining 4 hectare (10 acre) site in 1980. Today the refuge is trying to lease or purchase the 12 hectares (30 acres) to add a nature trail to the visitor center. These are the only lands currently considered for acquisition.

In February 1974, FR Doc 74-5001, proposed the addition of 31,970 hectares (79,000 acres) on the west side of Cabeza Prieta NWR known as the Tinajas Altas and a change in name from Cabeza Prieta Game Range to Cabeza Prieta NWR. Public Land Order 5493 (1975) effected the name change and addition, but Tinajas Altas was withdrawn three months later. The area is currently managed by the BLM, but natural resource responsibilities were transferred to the BMGR by the Military Lands Withdrawal Act of 1999. An integrated natural resource management plan for BMGR was completed during 2006.

3.3 THE PHYSICAL ENVIRONMENT

3.3.1 Climate

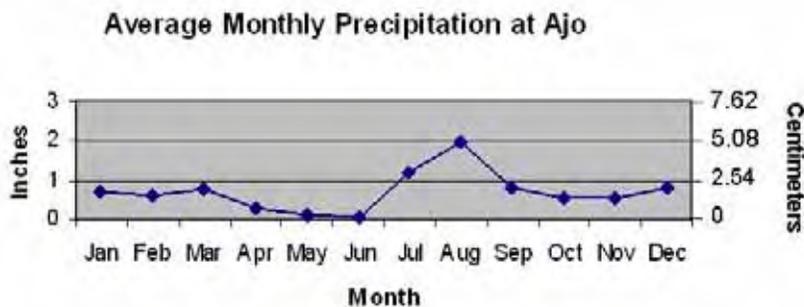
The climate of the Cabeza Prieta NWR is typical of the Sonoran Desert environment. Mean annual precipitation on the refuge is less than 26 centimeters (10 inches), varying from 23 centimeters (9 inches) on the east side of the refuge to 8 centimeters (3 inches) on the west side. Valleys within the refuge receive approximately 10 centimeters (4 inches) less precipitation than the mountain ranges (Simmons 1969). Studies conducted by the Desert Laboratory in the 1920s and 1930s provide the earliest information on refuge specific rainfall patterns. As a general rule for the study region, which extended into Mexico, they determined that given localized variations, rainfall increased with elevation. Below 305 meters (1,000 feet) above mean sea level (MSL) rainfall averaged 10.74 centimeters (4.19 inches) per year; 305-610 meters (1,000-2,000 feet) MSL averaged 20.77 centimeters (8.10 inches) per year; 610-914 meters (2,000-3,000 feet) MSL averaged 28.28 centimeters (11.03) inches per year; and above 924 meters (3,000 feet) MSL averaged

64.1 centimeters (25 inches) per year. The study did include an exception for the lowest mountain ranges which may be dryer at the top (USFWS 1952). The refuge is located between 209 meters (685 feet) MSL (along Mexican border in the Pinta Sands area) and 974 meters (3,196 feet) MSL elevation (highest point in Growler Mountains). Rainfall studies conducted on the refuge 1991 through 1994 indicated variability in excess of 26 centimeters (10 inches) from location to location in one year, and as much from year to year at a given location (Comrie and Broyles 1997).

Most of the precipitation occurs from July to September in the form of intense thundershowers. Moisture responsible for these storms (monsoons) originates almost entirely from the Gulf of California, and can drop large amounts of precipitation in short periods of time. Usually storms are localized in nature. The intensity of the storms results in rapid runoff, making most of the moisture unavailable to plants. Another wet period occurs from December to February, generally as widespread gentle rains. These rains originate off the Pacific Coast as frontal systems and because of the moderate nature of this precipitation; the water is able to soak into the soil providing moisture for vegetation.

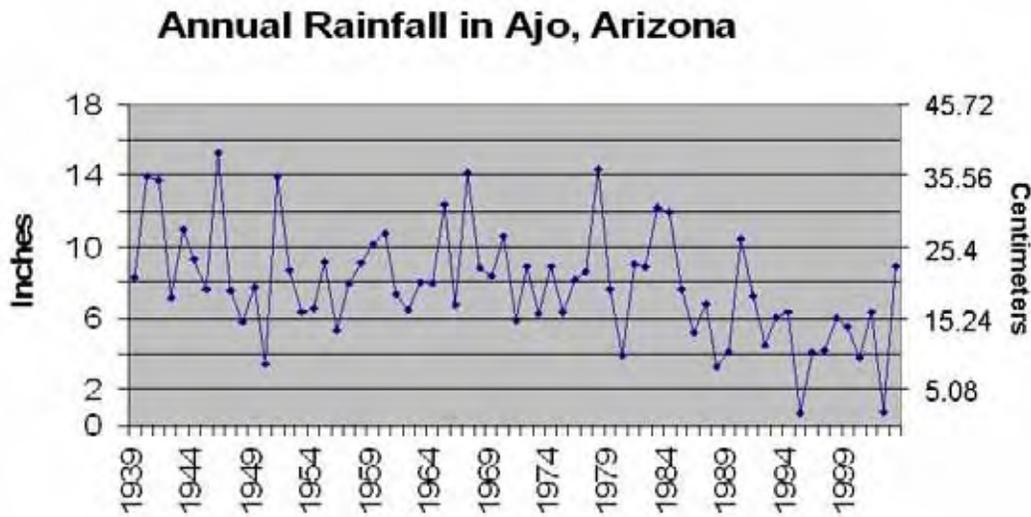
The driest months on the refuge are May and June, when the relative humidity commonly drops to 10 percent or lower. A second, less extreme dry period occurs between September and December (Smith 1974). The highest relative humidity is recorded during the late summer rainy seasons. Heavy thunder showers nearly saturate the air resulting in relative humidity of 80 to 90 percent. Figure 3.2 shows average monthly precipitation in Ajo.

Figure 3.2



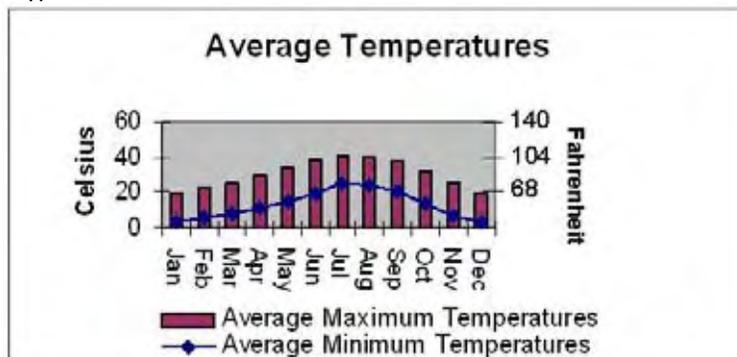
Seasonal rainfall averages for the Ajo weather station are as follows: Winter (January-April) 5.46 centimeters (2.15 inches), Summer (May-August) 7.86 centimeters (3.10 inches), and Fall/Winter (September-December) 6.70 centimeters (2.64 inches) for a total rainfall average of 20.02 centimeters (7.88 inches) (Western Regional Climate Center 2004) In 65 years of records at the Ajo Station, there are very few “average” years (figure 3.3 presents annual rainfall totals for the Ajo Station). Rainfall totaled within 1.28 centimeters (0.5 inch) of that amount only 12 years, with 31 years measuring above average and 34 measuring below average rainfall. Annual totals for the years between 1943 and 2003 varied from 1.7 centimeters (0.67 inches) in 1995 to 38.79 centimeters (15.27 inches) in 1946, more than a 37-centimeter (14-inch) difference. The decade of the 1960s totaled 230.58 centimeters (90.78 inches) whereas the 1990s produced only 123.16 centimeters (48.49 inches) of rainfall. The usual pattern is a year or two above average rainfall followed by a year or two below average, but occasionally wet or dry spells last several years. The longest “wet” spell lasted from 1981-1986 with six years of above average rainfall. The longest “dry” spell lasted from 1991 to 2002 with 12 years of below average rainfall, including the two driest years recorded at Ajo (1995 and 2002). These variations must be considered when evaluating other changes over time such as vegetation or wildlife populations.

Figure 3.3



The refuge experiences some of the highest temperatures in North America (figure 3.4 provides monthly average high and low temperatures averaged from the Ajo, Welton and Tacna weather stations). The daily highs from mid-May to mid-September generally exceed 38 degrees Celsius (100 degrees Fahrenheit). Ninety consecutive days of 38 degrees Celsius (100 degrees Fahrenheit) or higher are common, with temperatures at times reaching 54 degrees Celsius (130 degrees Fahrenheit) in the canyon areas (USFWS 1971). Summer nighttime temperatures generally average between 23 and 27 degrees Celsius (73 to 81 degrees Fahrenheit), and rarely drop below the 18 degrees Celsius (65 degrees Fahrenheit). Winter months on the refuge are characterized by more moderate temperatures. Daytime temperatures average between 19 and 25 degrees Celsius (66 and 77 degrees Fahrenheit) with nighttime temperatures between 4 and 10 degrees Celsius (40 and 50 degrees Fahrenheit). There are approximately 320 frost-free days per year on the refuge.

Figure 3.4



High temperature and low humidity result in high evaporation rates for the area, ranging from 1.9 meters (74 inches) per year on the eastern edge of the refuge to 2.0 meters (78 inches) per year on the western edge. A large part of the precipitation in this area evaporates and a limited amount is used by the existing

plant life (Simmons 1969).

In the eastern portion of the refuge, westerly winds prevail during the summer and easterly winds prevail during the rest of the year with wind speeds averaging 5 to 8 kilometers per hour (3 to 5 miles per hour). In the western portion, southerly winds predominate during the summer and northerly winds prevail during the rest of the year with winds averaging 8 to 10 kilometers per hour (5 to 6 miles per hour). Strong winds of 81 to 97 kilometers per hour (50 to 60 miles per hour) may accompany storm fronts and pick up dust and sand, creating local dust storms.

3.3.2 Air Quality

Three air quality monitoring sites are located near the refuge in Ajo, Yuma and at OPCNM. The Ajo monitor had provided data on particulates and sulfur dioxides while the Phelps Dodge copper smelter was operational; it currently only provides data on particulates as the smelter is now closed. The site at Yuma monitors carbon monoxide, ozone, and particulates. The site at OPCNM measures background particulate concentrations. The Yuma site is influenced by industry and urbanization and does not accurately reflect pollution levels on the refuge itself. Extrapolating data from OPCNM site is also inaccurate due to differing micro- and meso-scale climatic conditions and terrain of the two areas (USAF 1980).

The wilderness preservation area within the refuge is a Class II prevention of significant deterioration air quality area under the Clean Air Act Amendments of 1977. This status has specific ramifications on the permitting and review of potential new sources of air pollution in the region. Currently the air quality over the refuge appears to meet federal and state standards, with the exception of the 24-hour suspended particulate standard, which could be exceeded during days with high winds.

3.3.3 Soils

Five soil types occur on the refuge. All of these soils are hyper thermic (very hot), arid in nature, and are typical of desert areas having a discontinuous pattern. The steeper mountain areas are without soil, while the more gradual mountain slopes have shallow coarse soil. Coarse grained deposits form 98 percent of the alluvial fans, bajadas, and stream channels. The average composition is 30 percent gravel, cobbles, and boulders; 40 percent sand; 25 percent silt; and 5 percent clay. Fine grain deposits of clay and silts occur in playas with dunes consisting of wind-blown sand. Most of the soil is high in salts. The coarser soils found on up-slope areas usually hold more available water than the fine textured basin soils and are able to support more diverse vegetation (USAF 1980).

Cryptogamic soil crusts, also known as cryptogam, occur widely on valley floors in the refuge. These tiny, black, irregularly raised pedestals in the sand are self-sustaining biological communities essential to the ecology of arid lands. They reduce erosion, fix nutrients, and increase water absorption, creating a more hospitable environment for other plants. Cryptogamic soils are fragile and very susceptible to damage from trampling and compaction (National Outdoor Leadership School 1994).

Desert pavement, a layer of coarse gravel and cobble-size material, occurs in the surface of the older alluvial fans. When the pavement layer is disturbed, the surface soils become more susceptible to erosion. Desert varnish, a mineralized coating, may also occur on the desert pavement.

3.4 WATER RESOURCES

3.4.1 Natural Surface Waters

The refuge lies within the Colorado River Basin where ground and runoff water in the northwest trending valleys flow toward the Gila River. No perennial water bodies exist on the refuge and supply of surface water is scarce, varying with the seasons. At times there is great surface runoff from summer rains, but most of this is rapidly consumed by evaporation and infiltration in the alluvial valleys. All streams within the refuge are ephemeral, flowing only during or after rains. Usually only a section of any one stream flows at one time. The largest surface water area is the ephemeral Las Playas. Smaller surface water areas include Dos Playas and Pinta Playa. These playas occasionally hold water for a few days after a very heavy rain.



Natural tinajas occur in the mountain ranges throughout the refuge. A tinaja is a hole or depression in the rock formed by scouring water that holds water for a varying length of time after rains. Virtually all the natural water sources on the refuge have been developed to increase the volume of water stored after storm events. Waters such as Heart Tank, Buckhorn Tank, Cabeza Prieta Tanks and Agua Dulce Springs are examples of natural waters that have been developed by the refuge. Refuge staff was able to identify 10 natural sites, but refuge reports from the early years mention others that have not been located (Van Riper *et al.* 1987). In an article examining water resources available to prehistoric peoples, Broyles (1996) identified and estimated quantities for 15 sources located on the refuge. Most of these natural tinajas were later developed to increase water-holding capacity.

In a study on waterholes in the Cabeza Prieta Mountains, Childs (1998) measured 53 individual holes with a total volume of 20,982 liters (5,543 gallons) and measuring from 7 centimeters (2.7 inches) to 120 centimeters (46.8 inches) in depth. The author cautioned that this estimate represents maximum capacity for the pools during high levels of precipitation. Childs states “most of the pools will dry within several weeks if there is no precipitation.” Childs identifies the sequence of tinajas known as Cabeza Prieta Tanks as the largest in the area, holding 16,830 liters (4,446 gallons) and found two other unnamed pool sequences, which held 1,885 liters (498 gallons) and 1,522 liters (400 gallons) respectively. The three pool sequences together comprise 96 percent of the range’s water with the developed tank holding 80 percent of the range’s water. These three pool sequences hold water the longest, with Cabeza Prieta Tanks being the last to dry up. A 2.8 by 9.8 meter (9 by 32 foot) dam was built across the drainage at Cabeza Prieta Tanks in 1938. It has since filled with sediment and no longer holds surface water, but does hold water in the sediment, releasing it slowly through cracks in the dam. Two other developed tanks in the range were not included in the study because of the intensive human alterations at Halfway and a dynamited tinaja at Cabeza Prieta Tanks.

Agua Dulce, the other well-known natural water source, is a natural seep in the southeast corner of the refuge. It is thought to be generated from an artesian system, but further study is warranted regarding the geohydrology that is active at the spring.⁷ Agua Dulce was formerly thought to be perennial, but has been

⁷ A draft report entitled “An Investigation into the Hydrology and Ecology of Agua Dulce, Cabeza Prieta NWR” was issued in September 1996. The report presents a summary of past research and observations in the area of the Agua Dulce seep and tank and the results of a field investigation and water quality monitoring of the seep undertaken by the Branch of Water Resources in May 1996.

dry for several years in the 1990s, likely due to water table depression caused by well pumping in Ajo.

3.4.2 Developed Waters

There are 34 operational developed waters on the refuge (see table 3.1 and figure 3.5). Twenty-seven are located within the wilderness area. Several additional wells and livestock waters⁸ were developed by early ranchers but are now inoperable either due to sand/salt intrusion or damage to the wells.

Although livestock wells and waters existed prior to establishment of the refuge, the first water developments for wildlife were constructed in the 1950s. The early developments were located in the mountains and constructed primarily for desert bighorn sheep. Later developments were created for pronghorn and drinkers were added to benefit quail, deer, javelina and other wildlife. Early refuge annual narratives indicate that locals believed both the bighorn and pronghorn left the refuge in the summer, traveling to Mexico for food and water. In part, water was developed to keep sheep and pronghorn from leaving the refuge. Wildlife managers then believed water to be the most important factor limiting populations of desert animals, especially bighorn sheep. Water was believed to increase range carrying capacity, redistribute populations into unused areas, hold populations to prevent migration, and prevent population crashes



Dam at Heart Tank- this developed structure increases the capacity of Heart Tank, a natural tinaja

USFWS Photo

during droughts. While recent inquiries and studies, including a 1995 study by Broyles have questioned this reasoning, developed water is an established wildlife management tool.

Five types of water developments are found on the refuge (see table 3.1): buried reservoirs with collection points and drinking troughs ("improved waters"), runoff tanks (modified tinajas), charcos, wells, and tanks with drinkers. Improved waters are typically constructed of one or more 1780-liter (470-gallon) pipes connected to water collection points in natural drainage courses and wildlife drinking troughs. The tanks are covered with native soil, in Sonoran pronghorn habitat, or cement shaped and tinted to resemble native rock, in desert bighorn sheep habitat, and have very little visual impact on the surroundings. Runoff tanks mimic natural tinajas and are the next most natural looking structures. They are created by either blasting holes in rock or building small dams in mountain washes. A few hold water throughout the season. Charcos are dugout ponds also locally called repressos. An area is bulldozed and lined to hold water. The charcos dry up during the driest time of year. Tanks and drinkers were added to charcos and other sites to augment water in dry months. These structures require hauling water once or twice each year. Most of the wells are located outside of wilderness. They were developed for livestock when grazing was permitted and now feed drinkers for wildlife. Most are located in pronghorn habitat, but levels of use by pronghorn are poorly understood.

Also included are discussions of the hydrologic and ecologic characteristics of the seep and interpretations of the hydrologic interrelationships of the seep, spring, and tank. A final version is pending receipt of water sample analysis from American Environmental Network, Inc. (contract laboratory). Additional sampling may be necessary to draw final conclusions.

⁸ Van Riper, 1987, listed these 16 wells as no longer in operation: Bluebird Mine Well, Corner Well, Monreal Well, New Well, Sahuaro Gap Well, Salt Well, Lower Well, Sam Clark Tank, Seven Wells, Suni Well (2), West Well, Pozo Salado, Dan Drift Well, McMillan Well, Point of Pintas Ranch, Steel Tanks.

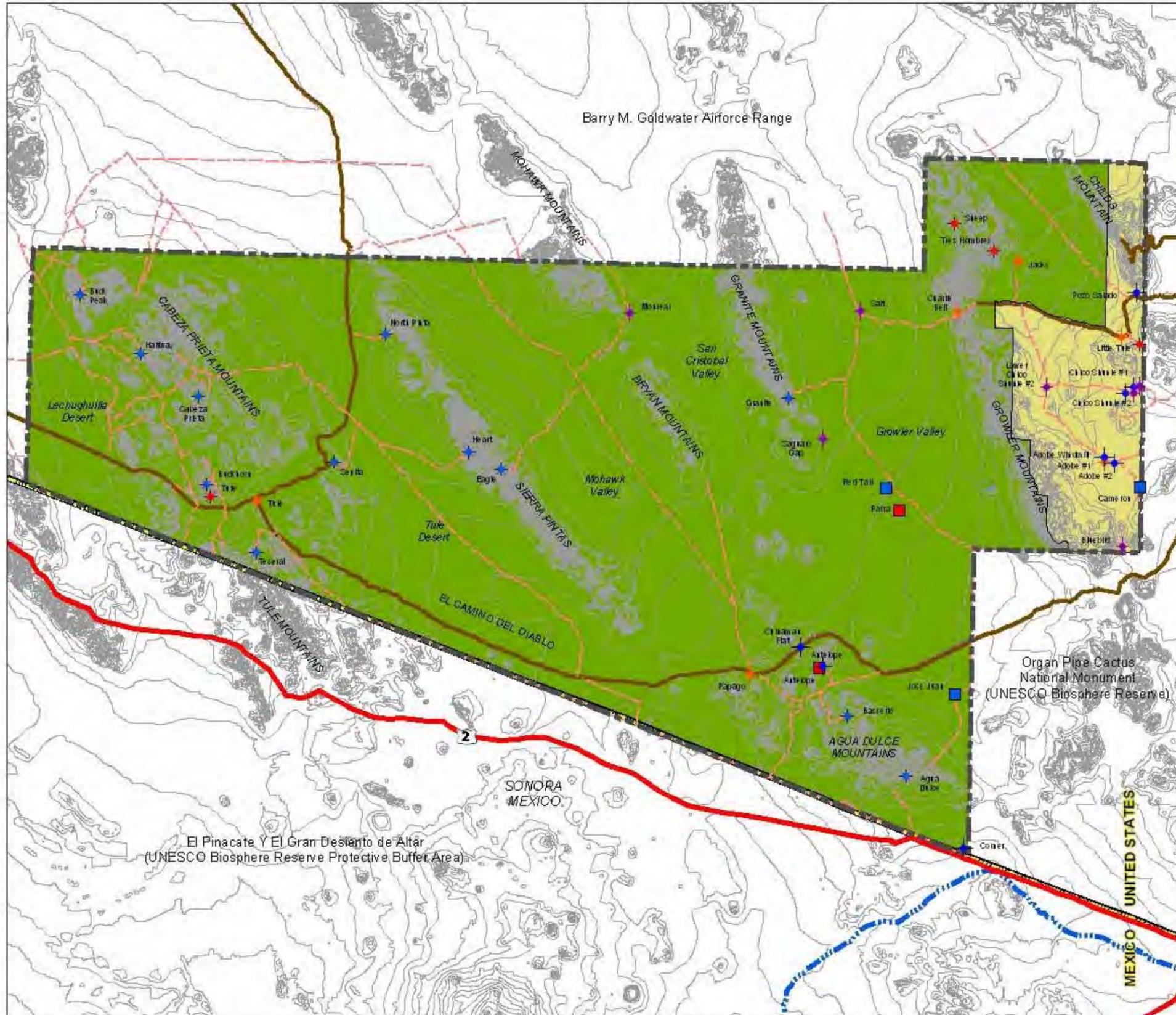
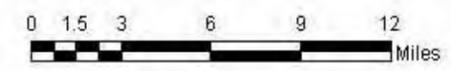


Figure 3.5 Developed Waters

- Legend
- Cabeza Prieta N.W.R.
 - Wilderness
 - Non-Wilderness
 - Public Roads
 - Administrative Trails
 - US/Mexico Border
 - Highway
 - Rio Sonoyta
 - Active Well
 - Active Tinaja / Tank
 - Inactive Tinaja / Tank
 - Inactive Well
 - Capped Well
 - Active Charco
 - Inactive Charco

Sources: USFWS, 2006



**CABEZA PRIETA
NATIONAL WILDLIFE REFUGE**
COMPREHENSIVE CONSERVATION PLAN

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH & WILDLIFE SERVICE

Table 3.1 Developed Waters of Cabeza Prieta National Wildlife Refuge			
Name/Habitat	Type of water	Wilderness	Current Activity
Adobe/ pronghorn	Well, tank & drinker	No	Monitoring and maintenance, some water hauling
Adobe House/ pronghorn	Well, tank and drinker	No	Recently redeveloped, monitoring and maintenance
Agua Dulce/ bighorn	Runoff tank with dam	Yes	Monitoring; proposed for redevelopment
Antelope/pronghorn	Improved water	Yes	Monitoring, maintenance, emergency hauling only
Bassarisc/ pronghorn and bighorn	Improved water	Yes	Monitoring, maintenance, emergency hauling only
Buckhorn/ bighorn	Runoff tank	Yes	Monitoring, maintenance, hauling, redevelopment proposed
Buck Peak/ bighorn	Runoff tank	Yes	Recently redeveloped, monitoring and maintenance, some water hauling
Cabeza Prieta/bighorn	Runoff tank	Yes	Monitoring & maintenance
Charlie Bell/ bighorn & pronghorn	Well, tank and drinker	Yes	Monitoring and maintenance
Chico Shunie/ pronghorn	Well, tank and drinker	No	Nonfunctional
Childs Mountain/ bighorn	Parabolic collector	No	Monitoring, maintenance, and hauling
Eagle/bighorn	Runoff tank	Yes	Monitoring, maintenance, hauling, redevelopment proposed
Granite/bighorn	Runoff tank	Yes	Monitoring, maintenance, hauling, redevelopment proposed
Halfway/bighorn	Runoff tank	Yes	Recently redeveloped, monitoring and maintenance, some water hauling
Heart/bighorn	Runoff tank	Yes	Recently redeveloped, monitoring and maintenance, some water hauling
Jacks/pronghorn	Well, tank & drinker	Yes	Monitoring, maintenance, hauling, redevelopment proposed
Jose Juan/pronghorn	Charco, tank & drinker	Yes	Monitoring, maintenance & hauling
Little Tule/pronghorn	Well, tank & drinker	No	Monitoring, maintenance, hauling, redevelopment proposed
Lower Well/pronghorn	Well	No	Recently redeveloped, monitoring and maintenance
North Pinta/ bighorn	Runoff tank	Yes	Recently redeveloped, monitoring and maintenance, some water hauling
Papago/pronghorn	Well, tank & drinker	No	Monitoring, maintenance & hauling
Redtail/pronghorn	Charco, tank & drinker	Yes	Monitoring, maintenance, & hauling
Senita/bighorn	Runoff tank	Yes	Monitoring, maintenance, hauling, redevelopment proposed
Tiller/pronghorn	Well, tank & drinker	No	Monitoring & maintenance

Table 3.1: Developed Waters of Cabeza Prieta National Wildlife Refuge (continued)			
Name/Habitat	Type of water	Wilderness	Current Activity
Tule/bighorn	Runoff tank	Yes	Monitoring, maintenance & hauling
Tuseral/bighorn	Runoff tank	Yes	Monitoring, maintenance, hauling, redevelopment proposed
9 emergency waters/ pronghorn	New and improved waters of limited storage	Yes	Monitoring, maintenance & hauling; enlargement and improvements proposed

3.4.3 Ground Water

Deep alluvial sediments in the valley floors provide large reservoirs for groundwater. The water has accumulated over thousands of years with very small annual increments added. The valley east of the Growler Mountains is known to have shallow groundwater, as does Copper Canyon in the northeastern portion of the refuge. A few wells ranging in depth from 9.1 meters to 122 meters (30 to 400 feet) have been developed that use these two groundwater resources. The wells are operated by windmill.

The extent and nature of dependable groundwater is not yet fully known, but there is a possibility that agricultural uses in Mexico are diminishing supplies. According to the Arizona Water Commission there is no potential in the area for groundwater development for irrigation supplies, and only limited potential for development of groundwater for municipal and industrial supplies (Arizona Water Commission 1975).

Little information is available on the quality of groundwater on the refuge. Many areas of the refuge have groundwater that is unsuitable for domestic, municipal, and industrial water supplies. All of the refuge's groundwater supplies are unsuited for irrigation water because of high salt content, extreme depth making it too costly to reach, or insufficient yield (Arizona Water Commission 1975).

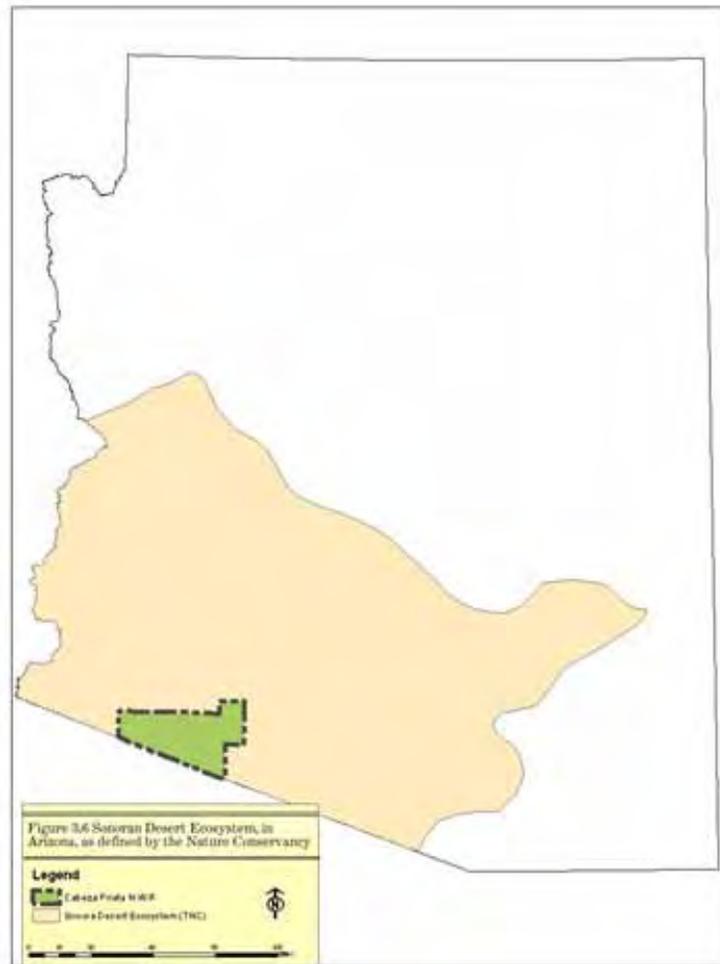
3.5 REFUGE HABITAT AND WILDLIFE RESOURCES

3.5.1 Biotic Community and Biodiversity

Cabeza Prieta NWR is located within the Tropical-Subtropical Desertland climatic zone (Brown 1994). This climatic zone includes many of the world's deserts such as the Kalahari and Namib which are located on or near the Tropic of Cancer or Tropic of Capricorn and have developed because prevailing winds have lost their moisture by the time they reach these areas. Within that zone, the refuge is part of the Sonoran Desert scrub biome or habitat type as described by Brown (1994). Arizona contains approximately 34 percent of the total range of this habitat type.

The Sonoran Desert (figure 3.6) is unique because its biseasonal rainfall makes it lush by desert standards. The desert is fairly young, having developed only 8,000 to 9,000 years ago. As a young desert, the Sonoran Desert lacks a distinctive fauna of species evolved to its conditions, rather the common animals of the desert are found throughout the drier regions of the Southwest. The Sonoran Desert differs from other American deserts in that it is dominated by trees and large cacti rather than low shrubs and is sometimes referred to as an arboreal desert. The flora is derived from subtropical elements to the south. The refuge is located towards the center of the Sonoran Desert region, on the edge of two subdivisions and contains 400 plant species from 68 families (see plant list, Appendix E).

The refuge's sporadic rainfall, varied geographically and temporally (see discussion above under Physical Environment), is the principal factor affecting plant growth. The amount and seasonal distribution of precipitation has the greatest influence on distribution of plant species.



Two of the six subdivisions of the Sonoran Desert (Brown 1994) are represented on the refuge. The Lower Colorado Valley subdivision is the largest and most arid subdivision of the Sonoran Desert, extending from Palm Springs, California to the west, to Phoenix, Arizona on the north, and from midway on Baja to Caborca in Mexico where it is bisected by the Gulf of California. Most of the refuge is located in this subdivision as it contacts the Arizona Upland on its eastern boundary. It is differentiated from the Arizona Upland by lower rainfall and higher winter minimum temperatures. The Lower Colorado Valley subdivision generally occurs on lower bajadas and the inner mountain alluvial plains. In the Creosotebush-White Bursage Series, vegetation is simple and open, consisting predominately of low open stands of widely spaced creosotebush

and white bursage. Diversity increases in washes where a Mixed Scrub Series includes: honey mesquite, ironwood, blue paloverde, smoketree and jojoba. The Saltbush Series is represented in only a tiny area on the extreme southeast corner of the refuge. Here the soil is finer, holds water longer and supports saltbush.



Harris' hawk on saguaro cactus skeleton

drawing by Bonnie Swarbrick

In other regions of the Sonoran Desert, most of this Saltbush Series is now under cultivation. More arid areas may be devoid of perennials, covered instead with varnished pebbles called "desert pavement". In wet years, playas (broad basins that hold water temporarily) can be covered with dense annuals.

Only a few large mammals are represented here including desert bighorn sheep, Sonoran pronghorn, bobcat, mountain lion, and coyote. Other mammals include rabbits, burrowing rodents, and bats. Bird diversity and abundance is low, consisting of arid adapted resident species and Neotropical migrants moving through the refuge in the spring and fall. Reptiles, on the other hand, are well represented by unique species. The banded sand snake and flat-tailed horned lizard are sand adapted reptiles found only in the Lower Colorado Subdivision and Mohave Desert. Rocky outcrops, bajadas, washes, and plains all support varied reptiles, including six species of rattlesnakes, desert tortoise, and numerous lizards including Gila monster. A few species of amphibians also occur throughout the refuge inhabiting water catchments and natural ephemeral water sources following the summer rains and inhabiting borrows during non-breeding periods.

The Arizona Upland subdivision is found on the upper bajadas and lower altitudes of the refuge's mountains. This division is the Sonoran Desert of postcards and is the best-watered desert in North America. A number of other species found mostly in washes in the previous division occur commonly here, but foothill paloverde and saguaro dominate. Ironwood is excluded from cold valley floors because of its frost intolerance. Creosote remains as a low, shrubby layer. Cacti form an important element with many largely confined to this subdivision. Cane cholla, chain fruit cholla, and barrel cactus are only a few of the species found here. Other species include whitethorn acacia, limber bush, ocotillo, jojoba, fairy feather duster and cacti such as Engelmann prickly pear.

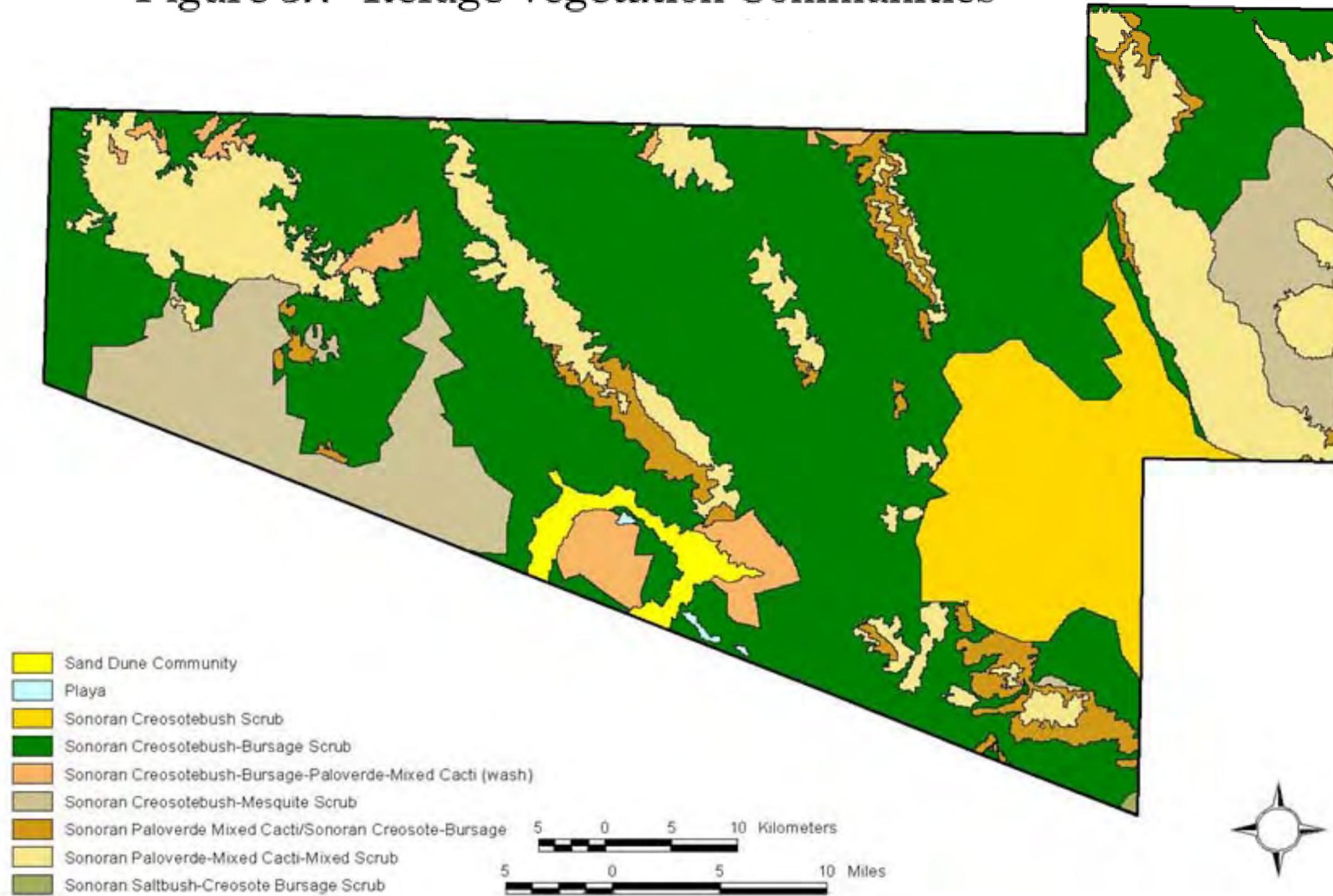
This division may support mule deer, javelina and bobcat, as well as other small mammals, including California leaf-nosed bat, California myotis, black-tailed jackrabbit, and numerous rodents. Its bird life is more diverse than that of the Lower Colorado Valley subdivision, with many species common to Mexico's thornscrub to the south. Harris' hawk, Inca dove, and elf owl, represent this group, whereas cactus wren, curve-billed thrasher, and greater roadrunner are more widespread. Several lizard species are limited to this region including regal horned lizard and Gila monster.

The contact between these subdivisions is characterized by a broad area where floristic complexity increases from the simple Lower Colorado to more diverse associations of the Arizona Upland.

3.5.2 Plant Resources

The refuge supports 400 documented plant species (species list Appendix E). Figure 3.7 is a map of plant communities on the refuge. No endangered plant species has been identified on the refuge, although the threatened Pierson's milkvetch has been documented on BMGR and may occur on the refuge. The once endangered Kearney desert sumac is found on the refuge in the Cabeza Prieta Mountains and immediately

Figure 3.7 Refuge Vegetation Communities



outside the refuge's western boundary in the Tinajas Altas Mountains. Although the Kearney sumac is rare in the United States, it is common in some areas of Mexico. Other species of interest specific to this region of the southwest and Mexico include: Ajo lily, chain-fruit cholla, saguaro, desert spurge, dune sunflower, silver cholla, Spanish needles, blue sand lily, desert rock daisy, elephant tree, ironwood, and senita cactus.

Overgrazing by domestic stock has affected the soils and vegetation. Overgrazing occurred over much of the refuge from the late nineteenth century until the Cameron grazing lease was discontinued in 1981. Overgrazing in the Sonoran Desert tends to increase soil erosion, decrease overall plant species diversity and favor increases in creosotebush density in valleys (Hall *et al.* 2001). Desert ecosystems recover slowly from overgrazing, and the effects of overgrazing are still apparent on some areas of the refuge. The Arizona Upland subdivision, where plant diversity is higher than in the Lower Colorado subdivision and soil types are more susceptible to erosion, is more prone to adverse effects from overgrazing. In the early years after refuge establishment, burros were common on the refuge and congregated in washes. Mortality to mesquite and paloverde from girdling by burros in washes impacted bird species dependent on this habitat. Burros were largely removed when aerial bombing began in 1942, and wash vegetation has been recovering.

Invasive species such as red brome, fountain grass, Sahara mustard and buffleggrass threaten to change the structure and species composition of the Sonoran Desert. These exotics allow fire to invade a plant community that has evolved without fire. Cactus in particular and some perennial trees and shrubs are killed. This disruption is predicted to impact bird and other wildlife species.

Plant resources in this region also have cultural significance. Traditional and present day Native Americans utilize plant resources for food, medicine, tools, building materials, baskets and other containers, clothing, and ceremonial purposes. Some of the more important cultural plants found on the refuge include: creosote bush, agave, beargrass devil's claw, mesquite, organ pipe cactus, saguaro, desert bean, ocotillo, coyote gourd, and amaranth.

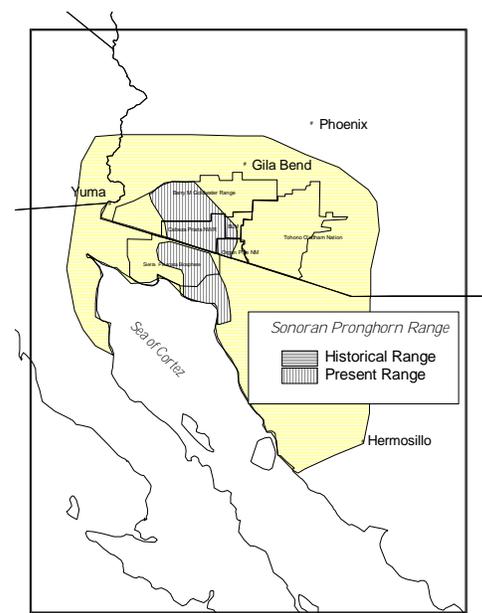
3.5.3 Mammals

Forty-two species of mammal are known to inhabit Cabeza Prieta. Mammals can cope with high daytime temperatures and arid conditions in a variety of ways. Many are nocturnal, live below ground, and possess various physiological, morphological, or behavioral adaptations. The majority of mammals found on the refuge are small nocturnal animals that inhabit burrows. This includes numerous species of pocket mice, kangaroo rats, wood rats, and foxes. In addition, bats represent the most diverse group of mammals, with eleven species observed on the refuge. Typical mammal species found in the Lower Colorado River Valley subdivision include: desert kangaroo rat, round-tailed ground squirrel, kit fox, and badger. Typical species for the Arizona Upland division include the majority of bat species including California leaf-nosed bat, lesser long-nosed bat, and pocketed free-tailed bat. Other species include Arizona pocket mouse cactus mouse, southern grasshopper mouse, and desert bighorn sheep. Other species are found to inhabit both subdivisions including desert cottontail, pocket gopher, and coyote.

3.5.3.1 Federal Endangered Species

3.5.3.1.1 Sonoran Pronghorn (*Antilocapra americana sonoriensis*)

The Sonoran pronghorn, one of five recognized subspecies of pronghorn, was classified as an endangered species on March 11, 1967 (32 FR 4001). The Sonoran pronghorn is distinguished from other races of pronghorn by its smaller size, paler color, and certain cranial features. The relationships and taxonomic validity of the five subspecies are currently



under review, and the genetic makeup of Sonoran pronghorn relative to the other four subspecies is being investigated by scientists in the U. S. and Mexico. Although genetic markers evaluated to date show some similarity, the genetic “relatedness” between Sonoran pronghorn and one or more of the other races of pronghorn needs additional work. Regardless of the outcomes of this work, the subspecies *sonoriensis* was properly described and named by a knowledgeable authority who determined that it differed substantially from other subspecies. The subspecies designation will continue to be valid until a thorough reassessment, using an appropriate series of specimens, comes to a different conclusion that is generally accepted by the mammalogical community. In the event Sonoran pronghorn are eventually found to be genetically or otherwise “indistinct” from one or more of the other subspecies, it would likely continue to be managed under the “distinct population segment” provision of the Endangered Species Act.

Pronghorn in general are long-legged, small-bodied ungulates that are endemic to North America and are distinguished from all other ungulates in the world by their horns. While both sexes have horns, the males’ are much larger. The unbranched, boney horn core is part of the skull and is covered with a black sheath. Only the sheath is shed annually in the fall. This feature, more than any other, is responsible for the pronghorn’s classification as the sole surviving species in the family Antilocapridae. Pronghorn are probably best known for their amazing running ability and endurance, and uncanny eyesight. Easily the fastest land mammal in the New World, the pronghorn is capable of sustained speeds of 64-72 km/hr (40-45 mph), with short bursts approaching 100 km/hr (62 mph). The pronghorn’s large, forward set eyes are an adaptation for spotting potential threats at distances as great as 6.4 km (4 miles) in the open habitats they prefer.

Pronghorn have a harem or polygynous mating system (i.e., one male breeds with more than one female). Female pronghorn become sexually mature in their second year and males at about one year of age (O’Gara 1978). Pronghorn bucks rarely breed at this early of an age, however, due to competition with older, more dominant bucks. The rut in Sonoran pronghorn generally occurs July to September. Pregnancy lasts an average of 252 days (O’Gara 1978), an extended period relative to other ungulate species of comparable size. Pronghorn invariably produce twins. Sonoran pronghorn fawns are dropped in February through May, a period that coincides with spring forage abundance. Total fawn biomass (twins) is high relative to body mass of does, and is partly a consequence of the length of gestation. The high maternal investment in reproduction (i.e., lengthy gestation, obligate twinning, high fetus biomass to doe ratio, rapid fawn growth, early weaning) has been speculated to be an evolutionary adaptation to predation (Byers 1997). Pronghorn fawns suckle almost exclusively the first month of life. From week four to six, the doe initiates the weaning process and an age of 12 weeks fawns are fully weaned (Byers 1997) but nursing has been observed as late as September. Sonoran pronghorn fawns grow rapidly in the presence of nutritious forage and adequate moisture; given those conditions, a 5 to 6-month-old is virtually indistinguishable from an adult to all but the most experienced eye (J. Hervert, AGFD, pers. comm.). Fawns are able to easily outrun even the fleetest of predators by about 45 days of age (Byers 1997).

3.5.3.1.1.1 Status and Trends

The Sonoran race of pronghorn occurs at the southern edge of the species’ geographic range in some of the more hostile environmental conditions. It is probably not a coincidence that the three desert subspecies are experiencing the greatest survival problems (Yoakum and O’Gara 2000). Sonoran pronghorn require vast areas of unencumbered open range to meet their annual needs for survival and reproduction. This includes the ability to freely travel long distances between localized, seasonally sporadic rainfall events in search of sustenance. Unfortunately, Sonoran pronghorn have been extirpated from much of their historic habitat in the U.S. and Mexico, and presently occupy less than 10 percent of their suspected former range. Sonoran pronghorn are split into three subpopulations, one in southwestern Arizona, and two in northern Sonora, Mexico. The single U.S. subpopulation is effectively segregated from Mexico by an incomplete, and often cut or washed out International Boundary fence, and by Mexico Highway 2. The two Mexican subpopulations are separated by Mexico Highway 8, although this road may not be as complete a barrier as Mexico Highway 2 and the International Boundary fence.

The U.S. subpopulation currently occupies approximately 6,500 square kilometers (2,500 square miles) of federal lands in southwest Arizona, including portions of the Barry M. Goldwater Range, Cabeza Prieta National Wildlife Refuge, OPCNM, and a small area of Bureau of Land Management lands east of the refuge and west of Highway 85. The refuge lies at the heart of the Sonoran pronghorn range in Arizona, and connects locations used on the Barry M. Goldwater Range and OPCNM. Recent (1994 and later) aerial telemetry work shows that Sonoran pronghorn are most frequently found on

the refuge in the valleys and bajadas of the Pinta Sands, Mohawk Valley, San Cristobal Valley, and Growler Valley.



Remains of radio collared Sonoran pronghorn believed to have died from drought stress during the summer of 2002

Photo by John Hervert, AGFD

Although probably never abundant, Sonoran pronghorn were observed in every open valley from Nogales, Mexico to Yuma, Arizona, during the course of an International Boundary survey from 1892 to 1894. Their numbers had dwindled in the U.S. by the early 20th Century. In 1907 E.A. Mearns described pronghorn by as a rare animal in the region. Nelson (1925) estimated that there were 105 Sonoran pronghorn in Arizona in 1924. Nichol (1941) estimated there were 60 pronghorn in southwestern Arizona in 1941, not including OPCNM, and Halloran (1957) reported that there were probably fewer than 100 Sonoran pronghorn in the United States in 1956. Sonoran pronghorn numbers were qualitatively estimated between 50 and 150 from 1968 to 1981. No reliable observations of Sonoran pronghorn on the Tohono O’odham Reservation have been made since 1970. Until recently, no Sonoran pronghorn have been confirmed east of Highway 85 on OPCNM since 1972. This changed when two collared Sonoran pronghorn independently crossed this highway, apparently in response to extreme drought conditions, during the summer of 2002. One of the animals returned west following the onset of rain in September 2002. The second was an apparent victim of the drought.

The U.S. subpopulation of Sonoran pronghorn is censused in December of even years (since 1992) using an aerial line transect technique that is both statistically valid and directly comparable between years. Population estimates for 1992 to 2004 are shown in table 3.2:

Date	Pronghorn seen on transects	Total number of pronghorn seen	Population estimate	95% Confidence Interval
Dec 1992	99	121	179	145-234
Mar 1994	100	109	282	205-489
Dec 1996	71	95	130	114-154
Dec 1998	74	98	142	125-167
Dec 2000	67	69	99	69-392
Dec 2002	18	18	21	18-33
Dec 2004	39	39	58	40-175

With the exception of 1994 and 2004, biennial population estimates show a downward trend. The 1994 estimate may be slightly inflated due to inconsistent survey timing. The decline in numbers from 1992 to 2002 is supported by other survey data including high adult mortality, low fawn survival and recruitment, and smaller average herd sizes.

The timing, duration, distribution, and amount of winter rains and the summer monsoon are highly variable and unpredictable from one year to the next in the arid Sonoran Desert. As a rule, winter rains tend to be widespread and gentle, allowing much of the moisture to soak into the ground and be available for plant growth. In contrast, summer monsoon rains are often localized, torrential, and large amounts lost to run-off. Fawn production and survival are positively correlated with the amount of rain received from December to March. Good winter rains create good spring “green-up” conditions, including an abundance of annual forbs that are preferred food items in the diet of Sonoran pronghorn. Body condition of late pregnancy females is a function of spring forage conditions, which in turn likely influences the number of fawns born, a doe’s ability to produce milk, and how long fawns survive. Fawn survival is further enhanced by the timing, distribution, and amount of rain that falls, and is not lost to run-off, during the summer monsoon. Monsoon rains, if they fall early enough, can extend the spring “green-up” and stimulate the production of summer forbs and perennial plant growth. For example, precipitation during the winter of 2000/2001 was widespread and fell in reasonable amounts. Climatic conditions in 2001 were favorable for fawns. Recruitment of fawns (i.e., survival of fawns to reproductive age) was estimated 78 fawns recruited per 100 does in the population. Extrapolating these data indicate that about 50 fawns were added to the population in 2001, which likely resulted in a population (accounting for some adult mortality) similar to that of December 1998. Conversely, winter rains for 2001/2002 failed to materialize and it appears that recruitment of the 2002 fawn crop was negligible. Well above average winter rains in the winter of 2003/2004 and summer rains in 2004 allowed excellent recruitment of the population’s 2004 fawn crop, resulting in the increased population size observed in December 2004. The year of 2005 started well with good winter and spring rains but the summer monsoon was light and there was no rain from October 15 through March, 2006. The fawn survival appeared to be good in 2005 and the population was estimated at 75 animals. Fawns born early in late February 2006 were affected by the drought but later fawns will have a good chance of surviving in 2006 as range conditions improved greatly with the March precipitation.

3.5.3.1.1.2 Habitat Requirements

3.5.3.1.1.2.1 Topography

Pronghorn are creatures of wide-open spaces where their excellent vision and uncanny running ability allow them to elude even the fastest predators. Sonoran pronghorn prefer the wide, fairly flat, alluvial valleys and basins separating the extensive system of fault block mountains on the refuge, where visibility is at a premium and their unique predator-avoidance skills are used to best advantage. These valleys are criss-crossed with an intricate network of small and large, often heavily vegetated, xeroriparian washes. Sonoran pronghorn generally use valleys during the cooler months, and whenever summer and/or winter rainfall creates favorable forage conditions. In early summer prior to the advent of summer monsoon rains, or other periods of extended drought when nutritious forage becomes scarce in valleys and open areas, pronghorn move onto bajadas surrounding the large mountain ranges. These broken, generally highly dissected areas retain more moisture than open areas. As a consequence they are typically more heavily vegetated with tree species and columnar cacti. The trade-off in these areas is poorer visibility and greater risk of predation. Certain low, wide passes through mountain ranges, such as Charlie Bell Pass and Bluebird Pass in the Grouser Mountains, provide important travel corridors or shortcuts from one valley to the next.

3.5.3.1.1.2.2 Vegetation

Valley floors tend to be dominated by creosote and white bursage and vegetation diversity is low. Pronghorn use these areas extensively during wet winters when their preferred forage, annual forbs, are widespread and abundant (Hervert *et al.* 2000). Heavily vegetated desert washes are preferred habitats for pronghorn during the dry, summer season because of increased forage and as thermal cover during the heat of the day (Hervert *et al.* 2000). Common perennial plant species in desert washes include a variety of leguminous tree and shrub species (e.g., foothills palo verde, ironwood, mesquite, catclaw), cacti (e.g., saguaro), other woody plants (e.g., range ratany, burrobrush, bursage), and grass (e.g., galleta). Bajadas

were used extensively in all seasons as a source of perennial browse, particularly after ephemeral forage had dried up elsewhere. Plant diversity and density is generally higher on bajadas, and green forage tends to persist longer due to more mesic conditions relative to valley floors (Hervert *et al.* 2000). Bajada vegetation gives the appearance of a mixed scrubland of trees, shrubs, and cacti, with palo verde, ironwood, mesquite, catclaw, creosote, triangle-leaf bursage, range ratany, saguaro, barrel cactus, cholla (e.g., chainfruit, staghorn, and teddy bear), and ocotillo commonly observed. (Wright and deVos 1986).

Generally, pronghorn are selective, opportunistic foragers, taking the most palatable and succulent plants available in all seasons (Authenreith 1978, Allen *et al.* 1984). The Sonoran pronghorn diet is highly variable between seasons and years, depending on forage availability (Hervert *et al.* 2000). A total of 132 plant species were detected in the diet of Sonoran pronghorn during the course of one study (Hervert *et al.* 2000). Browse and forb species were preferred food species, with browse comprising the highest percentage of pronghorn diet in all seasons except wet summers. Browse was particularly important when forbs were not available. Forbs were the main diet component during wet summers when available and succulent. Although a variety of species of cacti were taken in all seasons, use of chainfruit cholla increased significantly during dry, summer months. Grasses were not an important component of the diet except new lush growth during wet summers (Hervert *et al.* 2000).

3.5.3.1.1.2.3 Water

High density populations of American pronghorn are associated with abundant drinking water (Sundstrom 1968, Kindschy *et al.* 1978, Yoakum 1980), while low densities exist in semi-arid regions and deserts with little water (J. D. Yoakum as cited in O'Gara and Yoakum 1992). Use of free-standing water by Sonoran pronghorn, however, is not clearly understood. It has been suggested that Sonoran pronghorn do not require free water and never drink (Monson 1968), apparently meeting their moisture requirements from metabolic water and pre-formed water in the diet. A recent survey of historical records, supplemented with direct observation and photographs of Sonoran pronghorn using a variety of developed waters, conversely concluded that the species does drink from free water when it is available, at least during times of heat and water stress (Morgart *et al.* 2005)

Metabolic water is formed by the oxidative breakdown of food in the digestive tract. Certain small desert animals, such as the kangaroo rat, are known to meet all of their moisture requirements through the production of metabolic water (Schmidt-Nielsen 1979). The cost of producing metabolic water is higher in larger animals, however, in terms of moisture loss through increased respiration.

Preformed water occurs naturally in vegetation. Preformed water is not a byproduct of the metabolic breakdown of food, and is generally easily absorbed by the animal. The amount of preformed water in forage varies with the plant part, life stage, plant greenness, succulence (e.g., cacti may contain large amounts of preformed water after rains), temperature, humidity, and time of day. Fox *et al.* (2000) found that under certain drought conditions, larger Sonoran pronghorn could not meet their water requirements solely from water contained in forage plants. Furthermore, they were unable to model for requirements of Sonoran pronghorn in different physiological states, when water demands are likely greater on the animal, such as pregnancy and lactation. Preliminary investigations suggest that Sonoran pronghorn are likely able to survive using only pre-formed water in vegetation for much of the year, particularly during cooler winter months, and during periods of adequate rainfall and green forage conditions. During extended hot and dry periods, or during times of extreme drought, however, access to free water may be critical to survival (J. Hervert, AGFD, pers. comm., J. Morgart, USFWS, pers. comm.). Extreme drought occurred across all of Sonoran pronghorn range in Arizona in 2002 when 85 percent of the U.S. herd was lost.

3.5.3.1.1.3 Decimating Factors

The 1998 Final Revised Sonoran Pronghorn Recovery Plan lists lack of recruitment, insufficient forage and/or water, drought coupled with predation, barriers to movement, illegal hunting, habitat degradation from livestock grazing, diminishing size and loss of access to the Gila and Sonoyta Rivers, and human encroachment as contributing factors in the population decline of Sonoran pronghorn.

The number of pronghorn in currently occupied habitat in the U.S., estimated at 58 animals in December 2004, is critically low. The minimum size at which an isolated group of this species can be expected to maintain itself without the deleterious effects of inbreeding is not known. A population viability analysis (PVA) workshop conducted in 1996 modeled the U.S. subpopulation of Sonoran pronghorn (Defenders of Wildlife 1998). A PVA is a form of risk assessment that predicts the probability of a population going extinct under different scenarios of biological and environmental change (Scott *et al.* 1994). The PVA model using VORTEX computer software suggested that the U.S. subpopulation was at serious risk of extinction due to population fluctuations, periodic decimation during droughts (especially of fawns), small present population size, limited habitat preventing expansion to a more secure population size, and expected future inbreeding depression (Defenders of Wildlife 1998). The results of the PVA modeling exercise must be interpreted with caution because many of the population parameter inputs used to explore the risk of extinction were unknown, but arrived at by best biological judgment and consensus of participants in the workshop (Defenders of Wildlife 1998).

The Sonoran pronghorn subpopulation in the U.S. appears to be most sensitive to the number of fawns that survive to adulthood (Defenders of Wildlife 1998). Approximately 35 fawns for every 100 adult females need to be recruited each year in order for the U.S. subpopulation to grow (J. J. Hervert, pers. comm.). Fawn recruitment in Sonoran pronghorn is highly variable from one year to the next, and has only approached or exceeded this level in two out of the last 8 years (table 3.3) (Hervert *et al.* 2000; J. J. Hervert, AGFD, pers. comm.).

Date	No. of fawns/100 does	Average winter rainfall
December 1995	12	Above normal
December 1996	0	Below normal
December 1997	0	Below normal
December 1998	33	Above normal
December 1999	0	Below normal
December 2000	14	Below normal
December 2001	78	Above normal
December 2002	8	Below normal

Fawn recruitment is a function of forage condition which is in turn influenced by the amount and timing of rainfall. Early fawn survival is positively correlated with the amount of winter rain and is inversely correlated with the number of days between the last winter rain and the first summer rain (Hervert *et al.* 2000). Adequate winter rains are critical for the production of spring annuals. Female pronghorn depend

upon an abundance of green, highly nutritious annual forbs in the early spring for fetus development and lactation. Low quality and quantity of forage in poor rainfall years may preclude Sonoran pronghorn from producing adequate milk to keep fawns alive until weaned, generally 12 weeks or longer. Fawn data for 2003-2005 is in prep.

3.5.3.1.1.3.1 Hunting

Hunting of wild game in southwest Arizona was pervasive during the frontier period through the 1940s. Some commercial use of Sonoran pronghorn occurred in the early 1900s to feed miners, railroad workers, and other laborers in the region (Sue Rutman, NPS, pers. comm.). Hunting of Sonoran pronghorn in the U.S. was banned in the early 1920s (Wright and deVos 1986). Commercial hunting operations continued to offer illicit guided hunts for bighorn sheep and Sonoran pronghorn at least throughout the 1930s. One well known guide in Sonoyta, Mexico, was very successful at taking Sonoran pronghorn. His business was active in the 1930s and attracted clients from across the U.S. and Mexico (Sue Rutman, NPS, pers. comm.). In addition to commercial hunting pressure, residents of the Ajo-Sonoyta area hunted Sonoran pronghorn to supplement their diet (USFWS 1939, 1940, 1946a, 1946b, 1951, 1954, 1966, 1971; National Park Service 1939, 1941). Controlling illegal hunting on OPCNM and the Cabeza Prieta Game Range was one of the first management priorities when the two units were established in the late 1930s. Currently, poaching in the U.S. is not identified as an issue although it may still be a problem in Mexico (Wright and deVos 1986, USFWS 1998).

3.5.3.1.1.3.2 Domestic Livestock

Livestock grazing has the potential to alter pronghorn habitat more than any other anthropogenic activity (Leftwich and Simpson 1978, Kindschy *et al.* 1982, Yoakum *et al.* 1996), especially in the arid Sonoran Desert. Cattle and other domestic livestock were first brought to northwestern Sonora, Mexico, in 1694 by Father Kino, a Jesuit priest (Wildeman and Brock 2000). One of the more important livestock ranches established by Kino was located near present day Sonoyta, Mexico, just south of the International Border at Lukeville, Arizona. In 1702, Kino's ranch had more than 3,500 head of cattle (Officer 1993). By 1751, however, this herd had disappeared (Officer 1993). Overgrazing well into the nineteenth century caused widespread habitat changes (e.g., erosion, species composition) throughout much of the Sonoran Desert, particularly in more settled areas such as central Sonora, Mexico (Sheridan 2000). This apparently was not the case for much of southern Arizona because conflicts between settlers and Native Americans throughout the 1800s limited grazing (Sheridan 2000). American ranchers were raising livestock by the early 1900s in much of the area that would later become OPCNM (Rutman 1997) and Cabeza Prieta Game Range (CPNWR files, Ajo, Arizona). Because there was no International Boundary fence until 1947, livestock from the U.S. and Mexico ranged freely across the border (Rutman 1997). Accurate figures describing livestock numbers in the region are sparse, but Rutman (1997) cites estimates of 1,000 head of burros and horses in 1942 on the southern half of OPCNM, and as many as 3,000 cattle on OPCNM at one time. Livestock grazing and range management programs have had a greater effect on the vegetation of southeastern Arizona than any other single land use (Bahre 1991). While this relationship may not be as well documented for southwestern Arizona (Hastings and Turner 1980), it still has relevance. The BMGR was closed to livestock use in 1941 (Executive Order 8892), although trespass grazing occurred, at least sporadically, until the late 1970s (Sue Rutman, NPS, pers. comm.). Cattle were removed from OPCNM and CPNWR in 1978 and 1983, respectively (USFWS 1998). Habitat alteration (caused in part by livestock grazing) was a leading cause in the decline in Sonoran pronghorn numbers (Wright and deVos 1986).

3.5.3.1.1.3.3 Livestock-borne Disease

Little is known regarding the influence disease has on the population dynamics of Sonoran pronghorn. Extensive control of other pronghorn populations by an epizootic is uncommon (Yoakum *et al.* 1996, Yoakum and O'Gara 2000). Pronghorn in general are susceptible to a variety of bacterial, rickettsial, and viral diseases, and internal and external parasites (Jessup and Boyce 1996). Bluetongue is arguably the most

important epizootic of pronghorn (Yoakum *et al.* 1996, Yoakum and O’Gara 2000) as evidenced by a 1976 outbreak in eastern Wyoming in which at least 3,200 pronghorn died. A second outbreak in the northeastern part of Wyoming in 1984 killed at least 300 more (Thorne *et al.* 1988).

Blood samples from Sonoran pronghorn were collected during capture operations in 1997, 1998 and 2000.; and all subsequent blood samples from captures show exposures to livestock diseases. Serological examination revealed a nearly 100 percent incidence of exposure to bluetongue and epizootic hemorrhagic disease (EHD) viruses in Sonoran pronghorn (AGFD unpubl. data), which is exceedingly high compared to pronghorn exposure rates outside of Arizona (B. W. O’Gara, USFWS, Montana Cooperative Wildlife Research Unit [retired], pers. comm.). Both viruses are closely related and difficult to distinguish, and are collectively referred to as hemorrhagic disease (Thomas 1981). Exposure to bluetongue by pronghorn is widespread throughout Arizona, although actual effects on populations in the state are unclear (Heffelfinger *et al.* 1999). Livestock are the primary reservoir for the bluetongue virus and EHD (Jessup and Boyce 1996) and the likely avenue of transmission to pronghorn is by biting midges (*Culicoides* spp.). This insect breeds in damp or watery habitats (muddy areas), a condition that may only exist in Sonoran pronghorn habitat around some wildlife waters (such as charcos) or in wet years when water persists in playas and other natural collection basins for extended periods. The AGFD is currently working on collecting biting midges from Sonoran pronghorn range for disease testing (S. S. Rosenstock, AGFD, pers. comm.). Bluetongue primarily affects animals in late summer (July to September) during the peak of insect activity and coincident with the pronghorn breeding season (Heffelfinger *et al.* 1999). A viremic female may be in poor reproductive condition or her behavior altered enough to effect breeding (Heffelfinger *et al.* 1999). Viremic males may be unsuccessful in defending breeding territories or females. Other diseases tested for in Sonoran pronghorn included leptospirosis, parainfluenza 3, infectious bovine rhinotracheitis, bovine viral diarrhea, and bovine syncytial virus. All tests were either negative, or in the case of one Sonoran pronghorn that tested positive for parainfluenza 3, not a health concern at the detection level (AGFD, unpubl. data). No Sonoran pronghorn so far captured or observed (including mortality investigations) have shown any obvious clinical signs of disease (J. Hervert, AGFD, pers. comm.).

3.5.3.1.1.3.4 Predation



Coyote at developed wildlife water

USFWS Photo

Various predatory birds and mammals kill pronghorn. In general, predation on pronghorns is significant when predator numbers are high relative to pronghorn numbers (Yoakum *et al.* 1996, Yoakum and O’Gara 2000). Sonoran pronghorn habitat in the U.S. has been significantly altered, resulting in a small remaining population. Only anecdotal information exists at this time on predator numbers relative to Sonoran pronghorn; however, any predation on a severely depressed population may be significant (Errington 1956, Scott *et al.* 1994). Fawns up to 3 weeks of age are most susceptible to loss from predators (O’Gara and Yoakum 1992). Adult American pronghorn on the National Bison Range in Montana were not at risk from predation by coyotes due to their attentiveness and superior speed (Byers 1997). Conversely, coyotes were a serious predator of pronghorn fawns up to about 45 days of age (Byers 1997).

Coyote, mountain lion, and bobcat prey on Sonoran pronghorn (AGFD files, Region IV, Yuma, Arizona; CPNWR files, Ajo, Arizona). Predation generally has an insignificant effect except on small populations such as the Sonoran pronghorn (Lee *et al.* 1998). Coyotes are the most abundant large predator occurring within the habitat range of Sonoran pronghorn. In 27 mortality investigations not related to capture operations, coyotes killed at least six Sonoran pronghorn and are suspected in the death of another. Coyotes are thought to prey heavily on Sonoran pronghorn fawns as well. The evidence for this is mostly inferred, and consists primarily of several observations during aerial telemetry surveys of females with a newborn fawn(s) and one or more coyotes nearby. Subsequent surveys 1 to 2 weeks later located the female, but only one or no fawns (AGFD Sonoran pronghorn weekly radio telemetry forms, 1994-2001). Mountains lions in southwest Arizona prey mostly on mule deer (Cashman *et al.* 1992) but may kill

pronghorn when they use rugged terrain (Ockenfels 1994). Two adult Sonoran pronghorn were killed by mountain lion. Both ambush sites were located in small desert washes with trees that served as cover (L. Piest and J. Hervert, AGFD, pers. comm.). Finally, three adult Sonoran pronghorn were killed by bobcat. The actual number of adult Sonoran pronghorn killed by predators would likely be higher if cause could accurately be assigned in the deaths of 11 other animals.

3.5.3.1.1.3.5 Habitat Loss, Fragmentation, and other Anthropogenic Factors

De-watering of most of the lower Gila and Sonoyta rivers has likely caused significant habitat modification (Wright and deVos 1986), as has agricultural, urban, and commercial development. Highways, fences (e.g., rights-of-way, livestock allotments), railroads, and canals have caused habitat fragmentation. The single U.S. subpopulation of Sonoran pronghorn is effectively cut off from the two remaining subpopulations of Sonoran pronghorn in Mexico by Mexico Highway 2 and a partially fenced International Boundary.

Other factors that have the potential to directly contribute to Sonoran pronghorn mortality are highways, railroads, and canals. In June 1996, a dead, radio collared pronghorn was located approximately 400 meters (one quarter mile) south of U. S. Interstate 8. The animal had a broken femur and had been scavenged by vultures. The animal may have been struck by a vehicle on the interstate and then made its way south some distance before death (J. Hervert, AGFD, pers. comm.). Sonoran pronghorn were regularly seen along and east of Arizona Highway 85 many years ago (USFWS 1998). With the exception of an adult doe observed on the right-of-way of Arizona Highway 85 at the north end of Crater Range in June 1996 (R. Barry, USAF, pers. comm.) and two does that independently crossed the road on OPCNM during the extreme drought of 2002, contemporary (within the last 30 years) confirmed observations are lacking. Unconfirmed reports of Sonoran pronghorn crossing Mexico Highway 8 are occasionally received from residents of Puerto Peñasco (J. L. Bright *et al.*, AGFD, unpubl. data), although no Sonoran pronghorn from previous radio collar studies in Mexico have ever been recorded crossing this road (R. Paredes, IMADES, pers. comm.). An adult male pronghorn was struck and killed by a vehicle near kilometer post 29 on Mexico Highway 8 in July 1996. Two Sonoran pronghorn have been pulled from the Welton-Mohawk Canal on the northern end of their range (CPNWR files, Ajo, Arizona). The potential for injuries and deaths from highways, railroads, and canals remains a concern and the influence to the population from accidents could be significant (Defenders of Wildlife 1998).

The BMGR is the nation's third largest military reservation for air-to-air and air-to-ground gunnery training. It is a national security asset for developing and maintaining the aerial combat readiness skills of tens of thousands of pilots since 1941. The airspace above CPNWR is under the jurisdiction of the Air Force for the eastern portion, and the Navy for the west portion. Military activities in pronghorn habitat on and above the BMGR and above CPNWR include such things as airspace use by jets and helicopters (primarily daylight although night time missions are run), manned air-to-ground ranges, tactical air-to-ground target areas, auxiliary airfields, explosive ordnance disposal/burn areas, ground support areas, and military use roads (USFWS 1996, 1997). Air-to-ground ordnance delivery no longer occurs on the refuge. However, direct death or injury to pronghorns could occur as a result of ordnance deliveries, other objects falling from aircraft, spent shells, live rounds, aircraft crashes, or collisions with ground vehicles on BMGR. Potential impacts of normal ordnance deliveries are limited to manned and tactical ranges. On manned ranges and most areas of tactical ranges, ordnance is limited to strafing and practice bombs and rockets. High explosive delivery is limited to small areas on each tactical range. Numerous targets throughout the tactical ranges receive various degrees of strafing. Pronghorn are also exposed to some indirect impacts of military activities, primarily noise and visual, from low-level aircraft over flights, ordnance delivery, and vehicle and foot traffic. Two other military activities have potential significance for Sonoran pronghorn. Explosive Ordnance Disposal (EOD) personnel collect and destroy dangerous unexploded munitions on tactical ranges and other developed target areas. The EOD clearances occur annually on tactical ranges (and more frequently elsewhere) and can take up to several weeks. During range clearances, large six-wheeled trucks are driven in the required clearance zones around target areas at intervals ranging from 15 to 50 meters (50 to 165 feet) searching for ordnance items. Some desert vegetation is unavoidably crushed during these

operations and pronghorn may avoid the areas due to the activity and noise (USFWS 1997). The USMC conducts the Weapons and Tactics Instructor Course (WTI) twice a year (March-April and October-November). During the five days of a typical WTI course, one flight per day of two to eight helicopters (65 to 100 meters [215 to 330 feet] apart) traverse CPNWR within established flight corridors. They continue to target areas on the BMGR north and east of the refuge where they may deliver ordnance to target areas (USFWS 1996). Some ground-based activities in association with WTI exercises occur in pronghorn habitat (USFWS 1996). Finally, Sonoran pronghorn may also be affected by potential contaminant issues, such as high levels of aluminum in the soil and vegetation on BMGR and the refuge (USFWS 1997). Overall, it is determined that “there is a net benefit to endangered species from the presence of the Goldwater Range and the mitigation measures that have been put in place by the military” (2004 National Defense Authorization Act congressionally appointed BMGR endangered species task force).

The BLM, BMGR, CPNWR, and OPCNM have public use programs for lands under their jurisdiction. Types of use (e.g., season of use, duration of stay, activities engaged in) vary somewhat for each area, with highest visitation rates centered on the cooler months and unpredictable but popular “wild flower” events that occur in spring and early summer.

Approximately one third of the BMGR is regularly restricted from recreational access (including manned ranges, tactical ranges, and Moving Sands/Cactus West Target Complex) (U. S. Department of the Navy 2001). Visitation on the USAF portion of BMGR is currently restricted to the Saucedo Mountains area east of Highway 85 and outside of currently occupied Sonoran pronghorn habitat. The USAF occasionally issues special use permits to bighorn sheep tag holders to access the Mohawk, Granite, and northern Growler mountains during December on no-fly weekends (R. Barry, USAF, pers. comm.). Current Sonoran pronghorn habitat most frequently visited by recreationists on the USMC side of the BMGR includes open areas of the Mohawk Valley between the Copper and Mohawk mountains (U. S. Department of Defense 2001). The entire CPNWR (348,046 hectares or 860,010 acres) is open to recreational access. Ninety-three percent of the refuge is Wilderness and is closed to vehicle entry. The El Camino del Diablo, Christmas Pass, and Charlie Bell roads are designated corridors not included in Wilderness that allow vehicle access by the public to remote areas of the refuge. A hold harmless permit is required for all visitors to BMGR and CPNWR. OPCNM (133,830 hectares or 330,689 acres) is entirely open to visitors and is approximately 95 percent designated Wilderness. Developed facilities for public use include the visitor center near Lukeville, Arizona, one remote primitive camping area, one developed campground, and approximately 160 kilometers (100 miles) of graded dirt scenic roadways (T. Tibbitts, NPS, pers. comm.). Habitat frequented by Sonoran pronghorn on OPCNM only occurs west of Highway 85 at this time. BLM lands that provide habitat for Sonoran pronghorn primarily occur east of CPNWR and west of Highway 85. Public use in these areas generally consists of primitive camping in recreational vehicles by winter visitors. Camping stays on BLM lands are limited to 14 days.

Although recreational permits are required to access BMGR, CPNWR, and the back country of OPCNM, compilation of visitor use data is not easily standardized. No visitor use statistics are collected for the affected BLM lands (D. Carpenter, BLM, pers. comm.). Based on the number of hold harmless permits issued out of the CPNWR office, on average, visitor use of the region is on the rise, with sharp increases in “wild flower” years (V. Harp, USFWS, pers. comm.). For example, on CPNWR a total of 258 visitor permits were issued in 1992 for an estimated total of 2,277 user days. In 2000, 1,447 permits were issued out of the refuge office for an estimated total of 4,630 user days. Visitor use spiked in 1998, a good “wild flower” year, with 7,021 user days (V. Harp, USFWS, pers. comm.). Increasing visitor use of the region, particularly in back country areas, increases the potential for visitor/pronghorn interactions.

The number and frequency of undocumented aliens and drug smugglers illegally entering the U. S. on foot and by vehicle from Mexico along the southern boundaries of OPCNM, CPNWR, and the far western reaches of the BMGR has increased dramatically since January 2000 (even during the hot, dry summer months when the number of entries typically decrease). The majority of crossings occur at night, and primary travel routes are up broad valleys, across bajadas, and through mountain passes frequented by

Sonoran pronghorn. In one area, illegal traffic has created a 61 kilometer (38 mile) road since 1999 that traverses pronghorn habitat. In addition, there are hundreds, and perhaps thousands, of additional kilometers of single vehicle tracks laid down across the otherwise undisturbed desert by undocumented aliens and drug smugglers seeking new routes or to escape detection. This increase is partly a consequence of stepped-up enforcement activities by immigration authorities in urban areas along the border (e.g., Sonoyta, Douglas, Yuma). As an illustration of the scale of the problem, in 1997, 1998, 1999, and 2000, a minimum of eight, four, six, and 11, respectively, abandoned or confiscated vehicles used for smuggling UDAs were removed from CPNWR. By comparison, nine vehicles were removed in just the first three months of 2001, with an additional seven remaining in the desert (L. Williams, CPNWR, pers. comm.). The number of known (i.e., interdicted) UDAs that crossed the west half of CPNWR averaged 2,800/year from 1997 to 2000. For the first 5 months of 2001, this figure was 2,200 (Welton BP Station, unpubl. data; V. Harp, CPNWR, pers. comm.). These numbers are representative of only one portion of the current range of Sonoran pronghorn and it is a certainty that many more vehicles and individuals pass through undetected than are reflected in official tallies (based on vehicle and human tracks, other sign, sensor hits, unsuccessful pursuits by law enforcement officers, and reports by agency employees and visitors).

Increased illegal border crossings have resulted in stepped-up law enforcement activities (e.g., more officers and vehicles, increased patrolling and interdictions) with their own set of potential impacts to Sonoran pronghorn. Officers from the BP, U. S. CBP-BBP, Drug Enforcement Agency, NPS, BLM, USFWS, and County Sheriff Departments (Pima, Maricopa, and Yuma) are all charged with enforcing specific components of State or federal law. In addition, the USAF and USMC have their own security forces tasked with patrolling the BMGR and they can detain unauthorized entrants on the military range or alert other law enforcement entities to their presence. Activities performed in pronghorn habitat by the various law enforcement agencies include: routine surveillance (e.g., periodic fixed-wing flights by CBP and daily helicopter flights by the BP, placement and maintenance of sensors, foot and vehicle patrols, and temporary and semi-permanent check stations such as the one located in the O'Neill Hills on the refuge); roadblocks and hot pursuit chases; detention, arrest, and transport of undocumented aliens and smugglers; search and rescue operations; and removal of abandoned/confiscated vehicles and other contraband. In addition, different agencies periodically conduct joint field operations with large numbers of law enforcement officers (sometimes in cooperation with the Army National Guard and their helicopter units) that specifically target high traffic areas. By policy, memorandum of understanding, and/or informal agreement, use of vehicles by law enforcement officers on federal lands is generally confined to established roadways (including public use corridors and administrative trails in wilderness areas on OPCNM and CPNWR). However, during emergency situations (e.g., hot pursuit chases, search-and-rescue operations) these restrictions are often disregarded. As more law enforcement assets are deployed along the remote stretches of the Mexican border in southern Arizona and apprehensions increase, the number of attempted illegal entries through pronghorn habitat in the U. S. will likely decrease, with the undocumented aliens and smugglers shifting their activities elsewhere, at least temporarily. This trend could reverse itself sometime in the future, in an ongoing cycle, if law enforcement assets are redeployed to other "hotspots" and it becomes known that this area of the border is once again patrolled less.

3.5.3.1.1.3.6 Long-Term Climate Change

Some current analyses of climate in the southwestern U.S. show an overall trend of increasing temperatures, increasing and higher intensity rainfall, and shorter duration of snow pack cover. The causes for climate change are both natural and human-induced, particularly since the advent of the industrial age. The current climate is an interglacial period, the driest and warmest period to occur during the last 32,000 years. Over the last century, average temperatures in the southwest have increased by 1 to 1.5 degrees Centigrade (2 to 3 degrees Fahrenheit). Temperatures during the late 1990s approached the record-breaking temperatures that occurred in the 1890s. Even more rapid warming is occurring in northern Sonora, Mexico. The 1990s have been one of the warmest decades on record across the globe, potentially the warmest since the 1400s. Precipitation has also moderately increased over the last century, but less so in the Southwest than other parts of the U.S., and Southern Arizona appears to be experiencing declines.

Greater frequency of summer drought will likely increase the rate of shrub invasion in the southwest, and some attribute the ongoing expansion of creosote in southern Arizona to recent climate change. Periods of drought and “wet” years appear to be cyclical. It is unquestionable that the refuge and surrounding area are in a long cycle of relative drought. This drying trend for the region will likely have significant ramifications on the amount and duration of water that is captured and stored in current natural catchments and developed waters, and the composition and availability of preferred forage for Sonoran pronghorn.

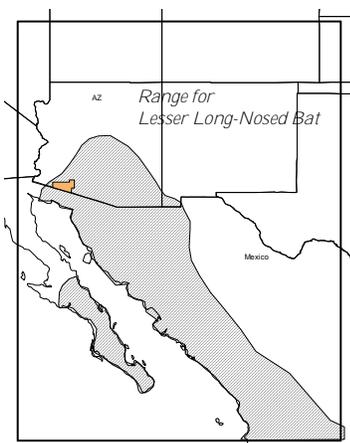
3.5.3.1.4 Recovery Objectives

Maintaining genetic diversity is a major Sonoran pronghorn management concern, in terms of defining realistic population goals and recovery objectives, relative to carrying capacity of available habitat. A Population Viability Assessment Workshop held in 1996 estimated that at least 500 animals were necessary to maintain genetic diversity of 95 percent of the pronghorn population being modeled at that time (Defenders of Wildlife 1998). When modeled at fewer than 500 animals, most scenarios resulted in maintaining less than 90 percent genetic diversity. A population of at least 300 pronghorn was necessary to ensure long-term survival, albeit with some loss of genetic diversity. The risk of extinction accelerates rapidly when the population drops well below 100 animals (Defenders of Wildlife 1998); a situation the Sonoran pronghorn currently faces.

Recovery criteria for the Sonoran pronghorn are detailed in the Final Revised Sonoran Pronghorn Recovery Plan (USFWS 1998). The Sonoran pronghorn will be considered for reclassification from endangered to threatened when:

1. There are an estimated 300 adult Sonoran pronghorn in one U.S. population and a second separate population is established in the U.S. and remains stable over a 5-year period, or
2. Numbers are determined to be adequate to sustain the population through time.

Provisions for delisting the species are not detailed in the recovery plan (USFWS 1998) due to the nature and significance of current threats (e.g., lengthy and recurring dry seasons, long-term and perhaps irreversible habitat changes brought about by past overgrazing and continued global warming, explosive increase in illegal cross-the-border activities, habitat fragmentation), unknown elements of Sonoran pronghorn life history and habitat requirements (e.g., seasonal need for free water, effects of an aging reproductive component, fawn survival, the differential role of predation on adults and young), uncertainty of availability of suitable reintroduction sites and animals for transplants, resistance to management actions on wilderness and other areas of the public lands (e.g., forage and water enhancement, habitat manipulation, predator control), and continuing uncertainty in the long-term stability and status of subpopulations in Mexico. In reality, the Sonoran pronghorn may not be fully recoverable. Based upon current research, the USFWS believes ongoing recovery efforts will in the short-term lead to downlisting the Sonoran pronghorn from endangered to threatened, and in the long-term, contribute to the delisting of the species. Tasks necessary to accomplish reclassification from endangered to threatened, as detailed in the Recovery Plan (USFWS 1998) should provide the information necessary to determine if and when delisting will be possible and what the delisting objectives and criteria should be.



3.5.3.1.2 Lesser Long-Nosed Bat (*Leptonycteris curasoae yerbabuena*)

This migratory yellowish-brown or gray bat was listed as Endangered in 1988. It is distinguished by its elongated muzzle, small noseleaf, long tongue, and minute tail that appears to be missing. Known to roost in caves and abandoned tunnels below 1,830 meters (6,000 feet) MSL, they forage at night on nectar, pollen, and fruit of agaves and columnar cacti.

3.5.3.1.2.1 Distribution

Lesser long-nosed bats are present in Arizona from April to September, spending the remainder of the year in Mexico from southern Sonora southward. A single young is born in mid-May. When young are able to fly, adults and young move to higher elevations to feed on agave nectar. The Recovery Plan was completed in 1994. Although there is controversy among bat experts, the recovery plan suggests there may be as many as 60,000 individuals that reside and feed in the southwestern U.S. (Arizona and New Mexico).

The maternity roost on the refuge is one of three known major maternity roosts in the U.S. The other two maternity roosts are located on other federal and tribal lands east of the refuge. The largest roost is used by approximately 20,000 adult females, the other two sites host up to 4,000 adult females each. A short distance south in Mexico, the Pinacate Biosphere Reserve contains a maternity roost of 100,000 bats. A few lesser long-nosed bats have also been found inhabiting smaller roost sites on the refuge. Surveys of potential roost sites within the refuge are ongoing.

The lesser long-nosed bat appears to use two migration routes. An early spring route connects maternity colonies in coastal Sonora and southwestern Arizona and Jalisco via the west coast of Mexico. The route used later in the season connects transitory roosts in southeastern Arizona with winter range via a path along the foothills of the Sierra Madre.

3.5.3.1.2.2 Habitat Requirements

Critical resources include suitable day roost sites and nearby extensive populations of columnar cacti and agaves. Criteria for suitable maternity roosts have not been identified as the conditions vary. Lesser long-nosed bats may occupy caves or mine shafts with other bat species but will occupy deeper sections. Maternity roosts are usually warm and poorly ventilated. Since all caves and mines are potential roost sites, they need to be evaluated before closing entrances that might prevent bat entry.

Lesser long-nosed bats are the major pollinators of columnar cacti and paniculate agaves and a potential seed disperser of columnar cacti which are distinctive elements of the flora of the Sonoran Desert. Their core diet is made up of nectar, pollen, and fruit of two columnar cacti and three species of agave in Arizona. They are highly mobile, foraging long distances, for up to 6 hours a night, visiting over 100 flowers per night. Refuge adult bats commuted an average of 13.8 kilometers (8.6 miles) to feeding areas when food was plentiful, and 17.6 kilometers (10.9 miles) when food is scarce.

3.5.3.1.2.3 Reasons for listing

- Long term decline in populations
- Recent reports of its absence from previously occupied sites
- Decline in the pollination of certain agaves
- Concern about death of an ecosystem if these bats are absent

Many of these early indicators have been brought into question by more recent research and the Recovery Plan determined criteria for down listing after

- Each major roost site is monitored annually for 5 years;
- Results of the monitoring indicate the population is stable or has increased;
- Sufficient progress is made in protecting roost sites and forage from disturbance or destruction;
- No new threats to the species, its roost or foraging habitats have been identified and current threats have not increased significantly; and
- The Service determines the species is no longer endangered.

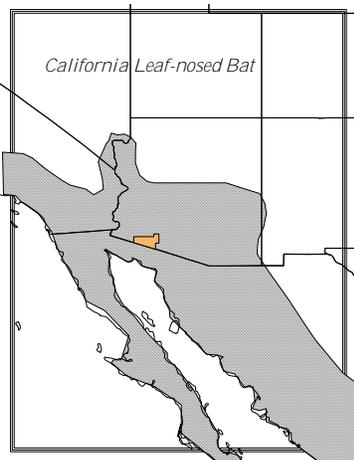
3.5.3.1.2.4 Recovery Efforts

Since most of the roost sites and forage plants are currently protected, recovery efforts included:

- Protection of all known roost sites and food plants within 81 kilometers (50 miles) of known roost sites.
- Monitoring known roost sites for 5 years.
- Continued survey for unknown roost sites.
- Development of public education/information on beneficial aspects of bats.
- Research census techniques, physical requirements for roosts, foraging ranges and other life history questions.

3.5.3.2 Species of Conservation Concern

3.5.3.2.1 California Leaf-nosed Bat (*Macrotus californicus*)



The well developed wedge-shaped noseleaf and large ears joined at their base identify this bat found below 1,220 meters (4,000 feet) MSL. They are a tropical species that never evolved the ability to hibernate and are resident and active year round. The colony spends the day in caves or mine tunnels leaving on warm nights to feed on insects. Mating occurs in the fall with a single young born in June. Food consists primarily of insects gleaned from vegetation or the ground. Water requirements are unknown. Some winter studies in California and along the Bill Williams River in Arizona have shown these bats do not use free water, however studies at OPCNM (Cockrum 1981) netted bats at water sources.

It is believed that the current distribution may be a recent development due to mining activity, which expanded roosting and maternity sites. Prior to mining California leaf-nosed bats were migratory in southwestern deserts. Maternity and all winter roosts in Arizona and California are located in abandoned mines (Dalton and Dalton 1994). They select roosts with a mean monthly temperature range of 24-32 Celsius (75-90 degrees Fahrenheit). And 32-56 percent relative humidity. Recapture results at the refuge indicate there is a single intermingling population in the Aqua Dulce Mountains. The primary known winter roost site at the refuge is Papago Mine. Individuals roosting in Cowboy or Bighorn mines showed a preference for foraging at Jose Juan Charco (in Summer) at least 10 kilometers (6 miles) distant. There is some evidence of sexual segregation among roost sites.

Bats are sensitive to disturbances and therefore need both protection and alternate sites. The sites at Cabeza Prieta are important because of the absence of mining and urban development.

3.5.3.3 Desert Bighorn Sheep (*Ovis canadensis mexicana*)

Bighorn sheep (*Ovis canadensis*) range across much of western North America, occupying open, mountainous habitat in southwestern Canada, western U.S., and northwestern



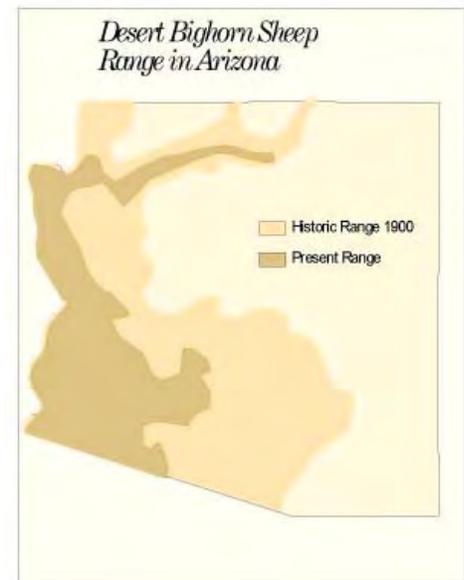
Desert bighorn sheep on Cabeza Prieta Refuge

USFWS Photo

Mexico (Manville 1980). They are relatively short-legged, stocky animals (Hansen 1980), ideally proportioned to negotiate the rugged, mountainous terrain that they prefer. Both sexes have horns, although they are much smaller in females. Horns are comprised of a bony core, covered with a horny sheath (Hansen 1980). Unlike those of Sonoran pronghorn, desert bighorn sheep's horn sheathes are permanent and not shed every year. The male's massive horns "curl" outward from the head. A large ram is a highly desired hunt trophy.

Four subspecies of bighorn sheep (and certain populations of two other races) occupy arid, desert mountain ranges in the southwest U.S. and northwest Mexico and are collectively known as "desert" bighorn sheep (Manville 1980). Desert bighorn sheep, in general, weigh less, are lighter in color, and have less heavy coats than their more northern relations. The Mexican race of desert bighorn sheep (*O. c. mexicana*) occurs on the Cabeza Prieta National Wildlife Refuge.

Desert bighorn sheep are uniquely adapted to cope with hot, dry environments. A review of the literature by Hansen (1982) indicated this may include a variety of behavioral and physiological adaptations such as: concentrating urine and removing much of the moisture from feces before elimination; rehydrating quickly upon visiting a water hole after going several days without drinking during the hottest times of the year and; absorbing water from the gut into the blood stream rapidly (and withstanding the resultant osmotic stress to the red blood cells); tolerance of high plasma concentrations and lower susceptibility to hemolysis (red blood cell breakdown) as dehydration proceeds; avoiding heat gains by minimizing activity and judicious use of shade during the heat of the day; lighter-colored coat; reduction of conductive heat gains through the legs by selective fatty acid deposition in bone marrow; a network of carotid vessels that cools the blood just before entering the brain; and timing and duration of reproduction.



The desert bighorn sheep is a wilderness-dependent species (Hendee and Dawson 2002) and, more than any other wildlife species in the desert southwest, is emblematic of wilderness and wild places. Intolerant of many human activities, this hardy species has been severely reduced or even extirpated from much of its former range, including the Pusch Ridge Wilderness Area outside of Tucson, Arizona.

3.5.3.3.1 Status and Trends

Few historic records exist that allow for a meaningful assessment of pre-settlement bighorn sheep numbers in North America, Arizona (Russo 1956, Monson 1980, Brown 1993) or the refuge. Seton (1929) estimated there were 1.5 to 2 million bighorn sheep in North America prior to the arrival of European man. Buechner (1960) reviewed the status of the species and estimated that by the late 1950s, there were as few as 25,000 bighorn sheep in North America (a reduction of more than 98 percent in numbers). The decrease in desert bighorn sheep numbers and reduction in amount of habitat occupied in Arizona is consistent with the continental decline of bighorn sheep (Brown 1993, deVos 1993).

Due to the early (pre-1900) and rapid decline of desert bighorn sheep in Arizona, reliable information on historic numbers and distribution of the species does not exist. Early surveys and anecdotal reports indicate that desert bighorn sheep were likely present in most of the desert mountain ranges across western, southwestern, and southern Arizona in the early 1800s (Brown 1993). By 1893, however, the decline in desert bighorn sheep populations in Arizona was so great that the Territorial Legislature passed a 5-year closure on taking the species (Brown 1993). By the early 1900s, bighorn sheep had been extirpated from large areas of the state and were only found in reasonable numbers in southwestern Arizona and the

Grand Canyon (Brown 1993). In 1937, a statewide inventory estimated that as few as 700 bighorn sheep remained in Arizona outside of the Grand Canyon and Lake Mead areas (Nichol 1937). Establishment of the Cabeza Prieta and Kofa Game Ranges in 1939 was prompted by the Arizona Game Protective Association, the Boy Scouts of America, and a number of individuals to save the desert bighorn sheep from extinction. At the time of establishment, the Cabeza Prieta Game Range was considered to be one of the last strongholds of the species in the state with a remnant population of 50-100 bighorn sheep.

Prior to 1955, information on desert bighorn sheep numbers on Cabeza Prieta is limited to anecdotal accounts. From 1955-1997, the refuge conducted summer water hole surveys for desert bighorn sheep. These surveys provided an interesting, if subjective, snapshot of bighorn sheep behavior, body condition, and use of water holes. Water hole count data were too variable, however, to be useful in terms of providing reliable population estimates for individual mountain ranges or the refuge.

In March 1968, the first helicopter survey for desert bighorn sheep on the refuge was flown, and spring surveys continued to be flown intermittently through 1980. These surveys were inconsistent in terms of types and numbers of helicopters flown, personnel, time spent surveying, and areas surveyed. The data gathered provided useful information on total numbers observed, distribution, and age/sex, ram: ewe and lamb: ewe ratios, but were of little value in deriving an objective estimate of total bighorn sheep numbers on the refuge.

Beginning in 1982, helicopter surveys were switched to the fall in an attempt to provide better data on which to base population estimates. A refuge employee at the time remarked that "Ultimately what we achieve in a survey such as this is an index rather than an opportunity to project population numbers." This survey was conducted in the same fashion in 1984 and 1985, but once again was unsatisfactory (in terms of providing quantifiable population estimates) for many of the same reasons as surveys performed from 1968-80.

In 1986, the AGFD, in cooperation with the Service, embarked on a 3-year study to further refine helicopter survey procedures in order to develop a repeatable, objective survey protocol that allowed for statistically valid comparisons between years. Annually, from 1986 to 1990, portions of desert bighorn sheep habitat on the refuge were flown in a standardized, systematic fashion. A group size sensitive estimator (95 percent confidence intervals) was used to derive population estimates. Population estimates for the portions of bighorn sheep habitat surveyed on the refuge during this period ranged from approximately 170 to 250 animals (AGFD, Yuma Region, unpublished data). These values were not extrapolated across the refuge, however, and are only representative of those portions of the refuge actually surveyed (approximately 33-50percent depending on the year).

Following the 1990 survey, it was decided that the survey would only be conducted once every three years. The rationale behind this decision was that it was more instructive to conduct a more extensive, "complete" survey less often, versus an annual "partial" effort (Bob Henry, AGFD, pers. comm.). A survey of this frequency still allows managers to use reasonably current information for determining annual hunt recommendations. Conversely, a sharp population decline or increase in non-survey years would not be detected. With the exception of a few minor modifications, the refuge desert bighorn sheep population survey has been conducted in a consistent fashion every third year from 1993 to 2005.

When only the same areas of the refuge flown from 1986-1999 are compared, the data suggest a growing bighorn sheep population from 1986 on, peaking in 1993, and declining thereafter. This is consistent with the 1993 - 2002 full data sets which also show a steady decline from a high of 480 in 1993 to a low of 323 in 2002 (table 3.4) (Bob Henry, AGFD, pers. comm.). This decline in numbers is particularly high on the east side of the refuge (Game Management Unit 46A).

Table 3.4: Population estimates for desert bighorn sheep (95 percent confidence interval)					
Range	1993	1996	1999	2002	2005
Growler Mountains	90 (65-168)	60 (43-113)	55 (38-107)	59 (43-103)	43. (30-84)
Agua Dulce Mountains	35 (23-86)	45 (30-96)	31 (22-59)	19 (15-30)	22 (16-38)
Granite Mountains	50 (34-104)	15 (10-32)	8 (6-14)	16 (11-33)	34 (26-51)
Childs Mountain	8 (6-14)	Not flown	18 (12-39)	6 (4-13)	7 (6-9)
Antelope Hills	2 (1-6)	Not flown	Not flown	Not flown	0
Total 46A	186 (129-377)	120 (83-241)	113 (79-219)	100 (73-178)	106 (78-182)
Cabeza Prieta Mountains	100 (68-213)	103 (71-208)	97 (67-191)	101 (70-209)	111 (78-219)
Tule Mountains	30 (22-49)	21 (14-45)	27 (19-53)	12 (8-26)	5 (3-12)
Sierra Arida	13 (8-26)	7 (6-9)	Not flown	0	Not flown
Sierra Pinta	119 (83 -232)	102 (71-203)	102 (75-181)	87 (61-168)	100 (59-203)
Bryan/Mohawk Mountains	33 (23-61)	56 (41-95)	43 (31-75)	22 (16-40)	25 (18-42)
Total 46B	293 (205-581)	288 (202-560)	269 (192-500)	223 (156-443)	241 (158-476)
Total Cabeza Prieta NWR	480 (334-958)	408 (285-801)	381 (271-718)	323 (228-621)	348 (236-658)
Note: some column totals are apparently incorrect due to rounding errors.					

3.5.3.3.2 Habitat Requirements

Topography – Desert bighorn sheep prefer rough, rocky, broken terrain with clear fields of view, and adequate escape cover. Bighorn seek the shade of vegetation, overhanging cliffs, and even caves to avoid inclement weather, the heat of the day, and survey aircraft. Bighorn typically don't run far, but instead depend on their agility and hiding ability to elude predators. Lambing and early lamb-rearing usually, but not always, occurs in the roughest terrain. Bighorn sheep habitat on the refuge is characterized by distinct mountain ranges separated by wide valleys. Some movement between mountain ranges occurs; however, it is thought to be less than on areas with more continuous habitat such as occurs on Kofa National Wildlife Refuge.

Vegetation – Desert bighorn sheep detect predators and other dangers primarily through vision and thus avoid potential predator ambush sites such as areas of dense vegetation. Bighorn are highly adaptive and opportunistic feeders, using a wide variety of plant species, including grasses, forbs, browse, and cacti (Russo 1956, Browning and Monson 1980, Morgart 1990, Dodd 1993). Forage selectivity appears to be largely a function of availability, plant condition, and season of year. Although little work has been done on

the dietary preferences of desert bighorn sheep on the refuge, some general observations of seasonal use of important forage plants are possible. Annual forbs that grow in the spring and summer in response to winter rains and the summer monsoon are avidly taken while lush and green. Grasses such as big galleta, bush muhly and grama are taken heavily in the spring and early summer when green and growing. The green leaves and new shoots of woody species such as Mormon tea, ocotillo desert thorn, and range ratany are used throughout the year when available. New shoots, leaves, and beans of leguminous desert wash species such as catclaw, littleleaf palo verde, ironwood and mesquite are especially important when other perennial and annual food sources have dried up. In early spring, the buds and flowers of brittlebush are actively sought out. Mistletoe, which parasitizes palo verde and ironwood in particular, is apparently eaten throughout the year. Finally, several species of cacti, such as saguaro and barrel cactus are also readily taken throughout the year, especially during dry periods and drought (Browning and Monson 1980).

Water – Water is absolutely essential to the survival of all wildlife (Ballard *et al.* 1988), and is especially critical for desert-dwelling species such as the desert bighorn sheep (Schmidt-Nielsen 1979, Turner and Weaver 1980). Heat dissipation and maintaining a positive water balance are two of the greatest challenges facing desert-dwellers. Water is required in a number of interrelated physiological processes including maintaining a suitable body temperature. Although desert bighorn sheep can temporarily withstand some level of dehydration (Turner and Weaver 1980), over time water gain must balance water loss. Desert bighorn sheep lose body water through respiration and evaporation, and in their feces and urine. Loss of water through respiration and evaporation increases with increasing ambient air temperature. Conversely, desert bighorn sheep may be able to concentrate their urine (Bradley and Allred 1967, Horst 1971) and reabsorb much of the water from their feces during periods of heat stress (Turner and Weaver 1970). Desert bighorn sheep are able to obtain water from three sources: metabolic, preformed, and free (Schmidt-Nielsen 1979, Turner and Weaver 1980).

Metabolic water is formed by the oxidative breakdown of forage in the digestive tract. Certain small desert animals, such as the kangaroo rat, are known to meet all of their moisture requirements through the production of metabolic water (Schmidt-Nielsen 1979). The cost of producing metabolic water is higher in larger animals, however, in terms of moisture loss through increased respiration. Animals as large as desert bighorn sheep cannot subsist on metabolic water alone (Schmidt-Nielsen 1979, Turner and Weaver 1980).

Preformed water occurs naturally in vegetation. Preformed water is not a byproduct of the metabolic breakdown of forage, and is generally easily absorbed by the animal. The amount of preformed water in forage varies with the plant part, life stage, plant greenness, succulence (e.g., cacti), temperature, humidity, and time of day. Desert bighorn sheep can go long periods without drinking during cooler months (Monson 1958, Simmons 1964, Wilson 1971) and at other times of the year when there is an abundance of lush, green forage. During cooler months, heat loading is reduced and less water has to be expended by the animal for cooling. In addition, when abundant green forage is present, desert bighorn sheep appear to be able to maintain water balance entirely on preformed and metabolic water in the diet. Conversely, during the hot, dry summer months and extended periods of drought, when preferred forage species are dead, dried out, and/or dormant, it is unlikely that desert bighorn sheep can survive for an extended period of time solely on metabolic and preformed water from grass, forbs, and woody species. This would be especially true for animals such as lambs and lactating ewes. Cactus has been variously reported to be an important component in desert bighorn sheep diet, at least seasonally (Dominguez 1976, Morgart 1990) and has been suggested to explain how some desert bighorn sheep populations survive years of severe drought (Turner and Weaver 1980). When some cacti become dehydrated, however, the water required by desert bighorn sheep to void ingested electrolytes and dry matter is greater than the water obtained from eating the cactus (Turner and Weaver 1973). Desert bighorn sheep forced to depend only on cacti for their water needs are likely to be in a condition of water deficit. Furthermore, as a state of dehydration continues, the animal restricts forage intake since the process of digestion requires water. A combination of dehydration and starvation causes animals to weaken over time. Weakened animals are more susceptible to disease and other stress-induced mortality factors. The very young, old, sick, and lame are least capable of maintaining an adequate water

balance for survival under these conditions and generally succumb first. Saguaro (Russo 1956, Simmons 1969) and barrel cactus (Jimmy Cain, University of Arizona, pers. comm.) are commonly fed on by desert bighorn sheep on Cabeza Prieta National Wildlife Refuge, particularly during the hot, dry summer months.

Desert bighorn sheep readily use free-standing water, particularly during hot, dry summer months, extended periods of drought, and vegetation dormancy. Naturally occurring, free-standing water is an uncommon, usually ephemeral commodity in the Sonoran Desert, and is only sparsely distributed across the Cabeza Prieta National Wildlife Refuge. Water developments have been the primary habitat manipulation technique employed for managing desert bighorn sheep populations on the refuge and elsewhere in the arid southwest. Free-standing water in sheep habitat on the refuge occurs in temporary pools of rain, unmodified natural tanks (e.g., Sheep, Tres Hombres), modified natural tanks (e.g., Cabeza Prieta, Heart), developed tanks (e.g., Sierra Pinta, Eagle), and windmill-fed troughs (e.g., Charlie Bell Well). The only known spring on the refuge, Agua Dulce, is no longer viable. Tanks on the refuge (both natural and developed) capture and store run-off. Water collection efficiency, storage capacity; and retention times (both within and between tanks), are highly variable from one year to the next. These variables are functions of: size of watershed; distribution, duration, and intensity of rainfall; tank sedimentation and flushing (if any) rates; tank volume; time, direction, and duration of exposure to the sun; ambient air temperature and relative humidity; exposed water surface area; wind direction, speed, and frequency; shade (natural or constructed); and amount of wildlife and illegal human use. Tanks may periodically require water hauling (via truck or helicopter) during periods of extended drought and/or heavy wildlife use.

The availability of free water is generally considered to be an important habitat requirement for desert bighorn sheep (Rosenstock *et al.* 1999). However, some populations of desert bighorn sheep (i.e., Big Hatchet Mountains, New Mexico; Little Harquahala Mountains, Arizona) are thought to persist in the absence of free water (Watts 1979, Krausman *et al.* 1985, Alderman *et al.* 1989). In both instances, however, an abundance of cacti was suggested as a potential source of pre-formed water in the diet that may have offset water demand. Conversely, water developments have been shown to increase numbers and/or expand the range of desert bighorn sheep populations in other locations (Leslie and Douglas 1979). Also, the drying of natural springs was directly implicated in the decline in bighorn sheep numbers and reduction of distribution on Death Valley National Monument (Douglas 1988).

3.5.3.3.3 Decimating Factors

It is undeniable that desert bighorn sheep have suffered huge reductions in numbers and distribution across their range relative to historic levels. This decline was so great, and concern for the long-term welfare of the species so high, that four federal wildlife refuges (known today as the Cabeza Prieta National Wildlife Refuge, Desert National Wildlife Range, Kofa National Wildlife Refuge, San Andres National Wildlife Refuge) were established in the mid 1930s to early 1940s, primarily for the protection, enhancement, and maintenance of desert bighorn sheep. Desert bighorn sheep habitat on Cabeza Prieta NWR remains essentially intact and bighorn continue to occupy virtually all the species' historic habitat on the refuge. It is likely, however, that present day numbers and densities are much reduced from the "natural" state that prevailed prior to the arrival of European man. The causes behind the general decline of this species on the refuge are as complex as they are varied, and only partially understood.

3.5.3.3.3.1 Pre-European Contact

Desert bighorn sheep were heavily hunted by Native Americans throughout the west as evidenced by vast numbers of petroglyphs and pictographs of bighorn and bighorn hunting (Grant 1980). Although there are few rock art sites depicting bighorn on the refuge, large piles of horns, the remains of earlier hunts, have been found near Cabeza Prieta and Heart Tanks (Fontana 1965, Grant 1980, Cabeza Prieta Annual Narrative Files). Eight desert bighorn sheep horns found at Cabeza Prieta Camp in 1992 were radiocarbon dated to 1860 (+ 50 years) or roughly the time of the Lincoln administration (David Siegel, USFWS pers. comm. 2003). Prehistoric hunters, wielding only primitive weapons, were known to be incredibly

effective harvesters of wild game. In some areas, this caused locally depleted game populations, particularly in the vicinity of permanent settlements. Much of the Sonoran Desert has been occupied by humans for over 12,000 years (Sheridan 2000). Although archaeological sites on the refuge have only been dated as far back as 1000-1500 A.D., human use of the area likely was prevalent prior to 200 A.D. (SWCA, Inc. 2001). Critical resources were likely too scattered and ephemeral on the refuge to support anything except seasonal settlements (SWCA, Inc. 2001). No reliable data exist on numbers of bighorn sheep in the region pre-European contact or what effects prehistoric inhabitants of the area may have had on desert bighorn sheep populations. The period immediately prior to the arrival of European man, modern firearms, domestic livestock, exotic diseases (circa 1540), and a plethora of other human caused influences (other than hunting) approximates “natural” conditions. Given the lack of long-term permanent settlements in the area, passing references by early Spanish explorers of “many wild sheep,” (Russo 1956), and until better data exists to suggest otherwise, it is assumed that desert bighorn sheep during this period were likely more abundant and occurred in higher densities across the refuge than currently.

3.5.3.3.3.2 Hunting

Over hunting (subsistence, market, sport, illegal) is often cited as a primary cause in the decline of big game populations in North America. Spanish explorers, missionaries, and settlers first brought firearms and gunpowder to the southwestern U.S. and northern Sonora, Mexico in the mid-1500s to late 1600s. These weapons, while crude and inefficient by today’s standards, allowed game to be harvested more effectively and at much greater distances. They also heralded the rapid advancement of increasingly effective weaponry culminating in the development of “modern” weapons (e.g., repeating rifles firing cartridge ammunition) by the mid-1800s. Mearns (1907) attributed the scarcity of desert bighorn sheep on the Tohono O’odham Indian Reservation, just east of the refuge, to over hunting by Indians with modern firearms, although Audubon (1906) had already described the region as devoid of game by 1849. Settlers, miners, and market hunters are often held responsible for low desert bighorn numbers after the 1880s (Brown 1993). Mearns (1907) also stated that white settlers along the Mexican border believed that desert bighorn sheep in the area were doomed to extinction. The first annual report for the Cabeza Prieta Game Range (CPNWR files), following its establishment in 1939, noted that there was a lot of illegal hunting for bighorn sheep taking place on the Game Range, and that law enforcement would be one of the major problems for the Game Range in its early years.

3.5.3.3.3.3 Domestic Livestock

More important perhaps than the introduction of firearms, early Spanish explorers, missionaries, and settlers also brought domestic livestock into the Sonoran Desert. Cattle and other domestic livestock were first introduced to northwestern Sonora, Mexico by Father Kino in 1694. In 1702, Father Kino estimated that a ranch near Sonoyta, Mexico (just southeast of the present day refuge) had more than 3,500 head of cattle (Officer 1993). Overgrazing well into the nineteenth century caused widespread habitat changes throughout much of the Sonoran Desert. Interestingly enough, overgrazing may not have been as severe across southern Arizona in the 1800s because of hostilities with Apache Indians (Sheridan 2000). By the early 1900s, American ranchers were firmly established and raising livestock in much of the area that would become Cabeza Prieta National Wildlife Refuge. Because the International Boundary fence wasn’t built until 1947, livestock from the U.S. and Mexico ranged freely across the border. Accurate estimates of livestock numbers on the refuge in the early years of the 20th Century are sparse, but in 1942 on the adjacent OPCNM, there were an estimated 1,000 head of burros and horses on the southern half of the monument, and another 3,000 cattle on the entire monument (Susan Rutman OCPNM, pers. comm. 2003). Livestock grazing was completely removed from the refuge in 1983. Cattle grazing continues to this day, however, on BLM lands just east of the refuge. In addition, the border fence with Mexico is missing, washed out, and/or cut in many places and trespass livestock regularly moves onto the refuge. Brown (1993) states that the “...coincidental evidence linking the reduction and elimination of bighorn sheep populations with the arrival of man’s livestock is overwhelming.” Livestock compete directly with desert bighorn sheep for available forage and water. This can be especially critical during periods of extended drought with little

or no green forage production. Continued overgrazing such as occurred during the early part of the 1900s, can also lead to changes in vegetation communities, favoring tree species such as mesquite and paloverde in the bajadas and foothills, and unpalatable shrubs such as creosotebush in the intermountain valleys. Given their preference for wide open vistas, increased vegetation density in these areas likely limits use by desert bighorn sheep and may hamper cross-country movements between mountain ranges.

3.5.3.3.4 Livestock-borne Disease

Brown (1993) considered diseases introduced by domestic livestock, especially sheep and goats, to be the greatest single factor in the decline and/or extirpation of many desert bighorn sheep populations in Arizona. These diseases are not natural to desert bighorn sheep, and bighorn sheep in general may be one of the most sensitive North American wild ungulates to common livestock diseases and parasites (Jessup 1985). Some of the major diseases found in desert bighorn sheep include scabies, chronic sinusitis, leptospirosis, contagious eczema, EHD, bluetongue, and pneumonia (deVos 1993). The severe impacts that various diseases, acting alone or synergistically, can have on desert bighorn sheep populations in the southwest have been documented on several occasions.

Desert bighorn sheep in the San Andres Mountains (a large portion of these mountains is located within the San Andres National Wildlife Refuge) numbered about 200 until psoroptic scabies swept through the herd and left fewer than 75 animals in a one-year period (Sandoval 1980). By 1997, only one adult ewe remained in the San Andres Mountains (Rominger 1998).



Desert bighorn sheep in Ironwood National Forest, Arizona suffering from a bacterial infection that has led to blindness. The infection is believed to have spread from domestic goats released into the forest

Photo courtesy of Brian Jansen, AGFD

In 1980, all 32 desert bighorn sheep in an enclosure on Lava Beds National Monument, California, died of *Pasteurella pneumonia* over a period of 25 days in July (Blaisdell 1982). Although never conclusively proven, the only other outside variable noted (since the previous February when the animals were severely harassed during a capture operation within the enclosure) was the presence of domestic sheep adjacent to the enclosure on several occasions. The bighorn sheep all appeared healthy prior to contact with domestic sheep.

Chronic sinusitis is a disease that causes necrosis of desert bighorn sheep skulls. The causative agent for chronic sinusitis is uncertain although it is thought to be the sheep bot fly larva (*Oestrus ovis*) with secondary infections from corynebacteria (Bunch *et al.* 1978). The disease may take several years to develop in an individual, and is thought to be terminal (Bunch *et al.* 1978). Symptoms of the disease include progressive debilitation (upwards of 50 percent weight loss), draining lesions on the forehead, broken horns, and eventual blindness. Chronic sinusitis received increased attention when 41 percent of desert bighorn sheep one year old or less in a captive herd in southwest Utah were diagnosed with the disease (Bunch *et al.* 1978). Although the disease is thought to be widespread in desert bighorn sheep populations across Arizona, until recently it had not been documented on Cabeza Prieta NWR (Bunch and Webb 1979, Scott *et al.* 1990). Recent information has shown the disease may be much more prevalent on the refuge than previously

thought and could have serious consequences for the refuge population. During a refuge-wide bighorn sheep survey in October 2002, several rams and ewes were observed with horns broken off near the base. (Morgart 2002). In addition, 7 of 11 (64 percent) pick-up skulls and mortalities over the course of the last 2 years show signs of possible chronic sinusitis infection (Cain, University of Arizona, unpublished manuscript). These skulls are in the process of being independently evaluated by an expert in this disease.

On a positive note, and with the possible exception of chronic sinusitis, desert bighorn sheep on the refuge have been found to be free of many of the common diseases found in other bighorn sheep populations across the State. In 1986, of seven bighorn sheep tested from the refuge and adjacent BMGR, only one ewe tested positive to exposure to any virus (contagious eczema) known to be a pathogen in bighorn sheep. The same animal was seropositive to leptospirosis, a contagious bacterial disease. Two ewes tested positive to respiratory syncytial virus using one test for this disease, but negative using a second test. All seven sheep tested negative for infectious bovine rhinotracheitis, parainfluenza-III, bluetongue, and epizootic hemorrhagic disease. Similar results were found in more recent (2001-2002) tests of desert bighorn sheep on the refuge (Cain, University of Arizona, unpublished manuscript 2003). These results were particularly interesting in light of the high exposure rate to bluetongue documented for Sonoran pronghorn in the area (J. Hervert, AGFD pers. comm. 2003).

Nutritionally stressed animals may be pre-disposed to disease through lowered resistance (Hailey *et al.* 1972). This may be exacerbated during prolonged periods of extreme heat and drought-related water stress, and when subjected to other human-induced stressors (e.g., excessive harassment at water holes).

3.5.3.3.3.5 Predation

Mountain lions, coyotes, bobcats, and golden eagles are all known to prey on desert bighorn sheep (Kelly 1980a). Of these four, only the mountain lion is known to prey on desert bighorn sheep on Cabeza Prieta NWR with any frequency. There are few records of mountain lions on the refuge, but they do occur at low densities across the refuge on a gradient with highest densities in the east and lowest in the west. Bighorn sheep hunters infrequently report seeing mountain lions in the Growler Mountains during the December hunt (Morgart 2003). At least three bighorn in the Tinajas Altas, Sierra Pinta, and Cabeza Prieta mountains were known to be taken by a mountain lion over the course of several months in 2002 (Cain,



Mountain lion at natural tinaja

USFWS Photo

University of Arizona, unpublished manuscript 2003; J. Hervert, AGFD pers. comm. 2003).

Finally, a mountain lion was seen in the vicinity of bighorn sheep near Heart Tank in the Sierra Pintas during the course of a bighorn sheep survey in October 2002 (Morgart 2003). Given the wide-ranging nature of mountain lions, and the general absence of their primary prey source, mule deer, it was speculated by Service and AGFD biologists on this survey that this was the same lion responsible for taking bighorn in the Tinajas Altas, Sierra Pinta, and Cabeza Prieta mountains. In mountain ranges with healthy populations of bighorn sheep, occasional lion

predation is not thought to be an issue. However, in mountain ranges with depressed bighorn numbers, the effects of lion predation could be

significant.

3.5.3.3.6 Habitat Loss and Fragmentation

The desert bighorn is a true wilderness species (Leopold 1933) that needs large, rugged expanses of mountainous terrain with wide open vistas in order to thrive. This includes reasonable interspersion of, and access to, important habitat features necessary for survival such as escape cover, thermal cover, lambing areas, movement corridors, nutritious forage, and dependable sources of water. In addition, desert bighorn generally have a low tolerance for excessive human activity, especially during critical times of the year such as lambing or periods of drought-related stress.

Habitat loss can be direct and/or indirect. For example, thousands of acres of critical bighorn habitat in the bajadas and foothills of desert mountain ranges adjacent to metropolitan areas have been lost to urban sprawl (e.g., Pusch Ridge Wilderness Area, Tucson, Arizona; Santa Rosa Mountains, Palm Springs, California). More insidious in this instance, however, is the concomitant increase in human activity (e.g., a many-fold expansion in recreational day-hiking), which can displace bighorn from an even wider area of otherwise suitable habitat. The combination of direct and indirect impacts from development and recreation eventually led to the extirpation of desert bighorn sheep in the Pusch Ridge Wilderness Area. The Cabeza Prieta NWR and surrounding lands are fortunate inasmuch as they are

generally protected by federal ownership, law, and/or withdrawal status from the threat of most development. Unfortunately, the relatively recent and growing problem of illegal foot and vehicle traffic (e.g., UDAs, drug smugglers) crossing the border from Mexico, and traversing the refuge is having an unspecified impact on all wildlife. Extensive interactions between UDAs, other illegal trespassers, and bighorn likely occur along passes through the mountains and at water developments. Passes are natural features used by illegal travelers for navigation, provide travel corridors through mountain ranges, and are used to avoid detection by law enforcement. UDAs sometimes shelter and rest at water developments during the heat of the day, preventing wildlife use of the waters and depleting water reserves meant for wildlife.

Habitat fragmentation occurs when natural dispersal routes within or between mountain ranges containing metapopulations of bighorn sheep are interrupted by linear developments (e.g., roads, railroads, fences, canals, powerlines) and/or when isolated desert ranges are surrounded by development or agriculture. Although the refuge, BMGR, OPCNM, and adjacent BLM land represent approximately 3 million acres of reasonably continuous habitat, bighorn sheep in this region have been impacted by habitat fragmentation. Specifically, U.S. Highway 85 and Mexico Highway 2 have impacted bighorn sheep movements to the east and south of the refuge, respectively. U.S. Interstate 8, a railroad, and a canal have undoubtedly influenced bighorn movements north of the BMGR. Finally, accidents can account for a significant loss of wildlife. Bighorn sheep and other ungulate species can become entangled in fences, drown in canals, or get struck by trains. As recently as 24 August 2002, an adult male desert bighorn sheep was struck and killed by a vehicle on Highway 85, just north of Ajo, in the Crater Range.

3.5.3.3.7 Long-Term Climate Change

Some current analyses of climate in the southwestern U.S. show an overall trend of increasing temperatures, increasing and higher intensity rainfall, and shorter duration of snow pack cover. The causes for climate change are both natural and human-induced, particularly since the advent of the industrial age. The current climate is an interglacial period, the driest and warmest period to occur during the last 32,000



Undocumented Aliens at North Pinta Tank, photograph taken by automated camera

USFWS Photo

years. Over the last century, average temperatures in the southwest have increased by 1-2 degrees Celsius (2-3 degrees Fahrenheit). Temperatures during the late 1990s approached the record-breaking temperatures that occurred in the 1890s. Even more rapid warming is occurring in northern Sonora, Mexico. The 1990s have been one of the warmest decades on record across the globe, potentially the warmest since the 1400s. Precipitation has also moderately increased over the last century, but less so in the Southwest than other parts of the U.S., and southern Arizona appears to be experiencing declines. Greater frequency of summer drought will likely increase the rate of shrub invasion in the southwest, and some attribute the ongoing expansion of creosote in southern Arizona to recent climate change. Periods of drought and “wet” years appear to be cyclical. It is unquestionable that the refuge and surrounding area are in a long cycle of relative drought. This drying trend for the region will likely have significant ramifications on the amount and duration of water that is captured and stored in current natural catchments and developed waters, and the composition and availability of preferred forage for desert bighorn sheep. Climate trends, coupled with a plethora of human-induced factors such as livestock-introduced diseases, livestock grazing changes in vegetation composition, habitat fragmentation, and a burgeoning problem with illegal across the border activities result in increasing challenges for managers attempting to maintain a semblance of “natural,” healthy populations of desert bighorn sheep on the refuge.

3.5.3.3.4 Management Strategies

Past and present desert bighorn sheep management strategies on the refuge include law enforcement to control poaching, protection of habitat from disturbance, removal of trespass livestock, predator control, water developments, and a closely monitored hunting program. Establishment of the Cabeza Prieta National Wildlife Refuge (and its sister refuge, Kofa NWR) in 1939 was prompted by the Arizona Game Protective Association (the predecessor of today’s Arizona Wildlife Federation), the Boy Scouts of America, and a number of individuals, to save the desert bighorn sheep from the threat of extinction. At the time of establishment, there were extensive reports of illegal hunting both on the refuge and surrounding areas and one of the first priorities was to establish a law enforcement program to address this issue. Today, there is virtually no illegal hunting of desert bighorn sheep on the refuge or adjacent federal lands, and most law enforcement efforts are now focused on stemming the flood of UDAs and drug traffic. Habitat is afforded protection by virtue of wildlife refuge designation, wilderness designation of much of the refuge, and restrictions managing human use of the refuge. Current regulations are likely adequate to control legal use of the refuge within acceptable levels in terms of impacts to refuge resources. The same claim, unfortunately, cannot be made for illegal, cross border activities.

Grazing was once widespread across the refuge, prior to its establishment as a Game Range in 1939. Most livestock grazing on the refuge was halted in 1941 as a result of the refuge’s inclusion as part of the bombing and gunnery range. The refuge shares a 90-kilometer (56-mile) border with Mexico. Prior to 1947 and the construction of the International Boundary Fence, livestock from the U.S. and Mexico ranged freely across the border. This fence was never completed on the far western end of the refuge and trespass livestock from Mexico periodically move on to the refuge to this day in this area. Various cattle operations continued to run trespass livestock in the center and western ends of the refuge into the mid 1950s, but by 1957 most illegal livestock had been removed. The Cameron Allotment on the east side of the refuge was the only entity legally running livestock. In 1983, the last of the grazing rights on the refuge were extinguished and cattle were removed from CPNWR. Today, the refuge shares a boundary with two BLM livestock allotments on its eastern edge. The livestock fence delineating this boundary is frequently cut by UDAs and occasionally washes out. Although cattle trespass on the refuge occasionally occurs, it is not considered to be a significant issue for desert bighorn sheep today. For reasons stated under the disease section, of more immediate concern is the periodic occurrence of feral goats moving onto the refuge into bighorn sheep habitat.

A dedicated predator control program was sporadically applied on the refuge in the past. In the mid-1940s the first trapper was hired with refuge funds to trap coyote and bobcat. Some use of poison was employed in 1946-47 for coyotes on the refuge. In the 1950s, both poisons and firearms were used for predator

control. Finally in 1963, the Branch of Predator and Rodent Control began a predator control program on the refuge, and primarily employed coyote getters, baits that inject poison into the mouths of animals attempting to eat them. In recent years, no predator control has been conducted. The level of predator control as described in refuge narratives and other reports likely had little influence on the refuge desert bighorn sheep population.

The primary bighorn sheep management strategy on the refuge has been a program of enhancing existing, and developing new, waters. Most of this work took place between 1948 and 1960, other than placement of a parabolic tank for bighorn sheep on Child's Mountain in the late 1980s. There is some controversy regarding the benefit that developed water provides desert bighorn sheep in natural environments. Rosenstock *et al.* concluded that water developments have benefited some, but not all, populations of desert bighorn sheep in the southwest (1999). Other researchers, however, have questioned the ultimate effect of developed waters on desert bighorn sheep and other desert wildlife, pointing out that unambiguous research into this topic is lacking, and that developed waters may introduce pathogens and support predators of, and competitors to, desert bighorn sheep populations (Broyles 1995, Krausman 2004). In a 1999 study, Broyles and Cutler found no difference in relative sheep abundance, lamb/ewe ration, yearling/ewe ratios or ram/ewe ratios in sheep populations in mountain with and without perennial sources of water. In a rebuttal review of this study, however, Rosenstock *et al.*, determined that Broyles and Cutler's characterization of mountain ranges on the refuge as having perennial water during the study period had been incorrect (2001). All of this serves to illustrate the controversy that exists regarding the relationship of desert bighorn sheep populations and developed wildlife waters.

Virtually all waters placed for bighorn sheep on the refuge are heavily used by bighorn, particularly during the hottest months of the year, and during periods of prolonged drought when preferred forage has dried up or is unavailable. Quantifiable estimates of how water developments have influenced bighorn populations on the refuge are not currently available. Subjective evaluations by professional wildlife managers strongly suggest that these waters are important for the health of bighorn populations. In the best biological opinion of knowledgeable wildlife professionals, desert bighorn sheep have habituated to water developments on the Cabeza Prieta National Wildlife Refuge over the course of the last 50 years. The refuge has cooperated with the University of Arizona on an investigation of use and dependence on developed waters by bighorn sheep.

In 1968, the refuge was opened to hunting for desert bighorn sheep. The hunt occurs during the month of December, and the number of permits allocated each year are carefully controlled through a cooperative management program between the AGFD and the refuge. The number of permits issued annually is based upon the results of the refuge-wide population survey conducted every three years. This is a very conservative hunt and permit numbers for rams have fluctuated from one to seven over the years. Desert bighorn sheep are considered to be a premier trophy animal, a once in a lifetime opportunity in Arizona, and hunters focus on taking only the largest-horned animals. In most cases, these are animals past their prime in terms of breeding potential, and animals removed by sport hunters have virtually no impact on the overall health of the population.

3.5.4 Birds

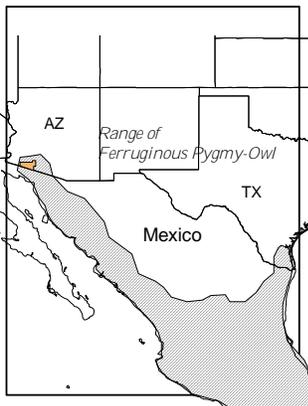
Bird species richness is relatively low in the Lower Colorado River Valley subdivision, as compared with wetter areas in Arizona, and only slightly higher in the Arizona Upland division. Typical bird species found in the Lower Colorado River Valley subdivision include: LeConte's thrasher, black-throated sparrow, verdin, loggerhead shrike, lesser nighthawk, and black-tailed gnatcatcher. Common spring and fall migrants include western wood peewee, Nashville warbler, MacGillivray's warbler, yellow warbler, Wilson's warbler, and black-headed grosbeak. Common birds wintering in this division include Cooper's hawk, ruby-crowned kinglet, Brewers sparrow, vesper sparrow, white-crowned sparrow, and sage sparrow. Typical species for the Arizona Upland subdivision include: Harris hawk, white-winged dove, greater roadrunner, mourning dove, verdin, cactus wren, black-tailed gnatcatcher, phainopepla, Gambel's quail, Costa's hummingbird, gilded flicker, and Gila woodpecker. All of these species can be found on the refuge, where

there are presently more than 212 species of birds recorded, with 41 of them known to nest there. A complete species list is found in Appendix H.

Threats to nesting birds in the Sonoran Desert include urbanization, fire, grazing, and burro browsing. The refuge is not threatened by growing urbanization, which represents the major impact to nesting birds in the Sonoran Desert, and serves as important refugia for birds sensitive to urbanization, such as cavity nesters, insectivores, ground nesting species, and species that feed in low shrubs. Black-throated sparrows and black-tailed gnatcatchers are associated with undisturbed native vegetation, and do not occur even in low-density housing developments. Other species sensitive to urbanization identified by the Arizona Partners in Flight Bird Conservation Plan include cactus ferruginous pygmy-owl, northern flicker, pyrrhuloxia, verdin, Gambel's quail, ash-throated flycatcher, greater roadrunner, rufous-winged sparrow, and ladder-backed woodpecker.

3.5.4.1 Species of Conservation Concern

3.5.4.1.1 Cactus Ferruginous Pygmy-Owl (*Glaucidium brasilianum cactorum*)



The cactus ferruginous pygmy-owl, listed as Endangered in 1997 and delisted in 2006, is a small (18 centimeter [7 inch]) diurnal owl reddish brown overall with a cream colored belly streaked with reddish brown. Its barred tail has dark and brown bars which distinguishes it from a northern pygmy-owl which has light and brown bars. Its lack of “ear” tufts and smaller size distinguishes it from screech-owls, and its black and white eye spots on the back of the head distinguish it from other small earless owls such as elf owls. They are best located by their repetitive “toot” during the day.

3.5.4.1.1.1 Distribution

The cactus ferruginous pygmy-owl occurs from lowland central Arizona south through western Mexico to the states of Colima and Michoacan, and from southern Texas south through Tamaulipas and Nuevo Leon. South of these regions and into Central America it is replaced by Ridgway's pygmy-owl. In Arizona, its range is limited to Sonoran desert scrub and riparian habitats below 1,220 meters (4,000 feet) MSL. Although its numbers appear to be stable in Mexico, this species has suffered declines in Arizona due to loss of riparian habitat and urban development. Until a few years ago, less than a dozen locations were known, all surrounding Tucson.

Pygmy-owls are now considered non-migratory throughout their range after their resident status was documented in the state. They nest in tree and cactus cavities in mature cottonwoods, mesquite bosques, and Sonoran desert scrub in Arizona, oak and bald cypress in Mexico, oak and mesquite in south Texas. The earliest nesting record is April 12th



Phainopepla

drawing by Bonnie Swarbrick



drawing by Bonnie Swarbrick

and the latest is estimated to occur the last week of May or first week in June. Juveniles remain close to adults until dispersal when they may disperse as much as 6.4 kilometers (4 miles) in Texas and 3.2 kilometers (2 miles) in Arizona before establishing their own territories.

3.5.4.1.1.2 Habitat Requirements

The cactus ferruginous pygmy-owl in Arizona is primarily associated with Arizona Upland subdivision below 1,220 meters (4,000 feet) MSL with both species and structural diversity, well-developed ground cover, mid-story, and canopy layers required to provide adequate prey base. In riparian areas, plant species may include cottonwood, willow, hackberry, and mesquite. Within desert scrub, plant species include saguaro, mesquite, paloverde and ironwood. It was historically considered a riparian species. Cactus ferruginous pygmy-owls in Tucson and OPCNM occur proximate to low-density developments adjacent to large undeveloped tracks of desert scrub.

The Arizona Partners in Flight Bird Conservation Plan identifies the following objectives:

- Maintain and increase current population in suitable habitat
- Protect known breeding locations from disturbance

and recommends comprehensive surveys throughout Arizona Uplands and riparian habitat.

Only two records exist for the refuge (Monson 1998, Cabeza Prieta Mountains; Flesch, Agua Dulce Mountains). Recent surveys on the eastern portion of the refuge did not detect any birds. A researcher from Cornell, recording bird songs by balloon, reported a suspected pygmy-owl heard while setting up his equipment. This report occurred in the general area where pygmy-owls were recently observed. A nesting pair is known from OPCNM and more are suspected on Tohono O'odham lands.

Other species associated with the pygmy-owl and that may use similar habitat and benefit by management for the owl, include: Harris' hawk, Gila woodpecker, gilded flicker, Gambel's quail, curve-billed thrasher, black-tailed gnatcatcher, phainopepla, cactus wren, verdin, elf owl, pyrrhuloxia, ash-throated flycatcher, Albert's towhee, hooded oriole, and Scott's oriole.

3.5.4.1.2 Loggerhead Shrike (*Lanius ludovicianus*)

The loggerhead shrike bears a close resemblance in size and coloration to the mockingbird, but can be differentiated by its larger head, black mask, hooked bill, and slightly different wing patch. Nicknamed "butcher birds", they impale small prey on thorns. Numbers are seriously declining in the eastern U.S. and prairie regions of U.S. and Canada. Primary cause for decline is degradation of habitat due to conversion of farm pasture in the east, and loss of native grasslands in the west in both summer breeding and wintering habitats. Primarily grassland birds, loggerhead shrikes are listed as a Migratory Nongame Bird of Management Concern by the USFWS. Conservation measures call for protection of native grasslands, controlling grazing and mowing, and maintaining brush along fence lines. Loggerhead shrike habitat is composed of grassy areas with scattered trees and shrubs.

Loggerhead shrike were identified as confirmed breeders on six blocks and possible breeders on two blocks of the Arizona Breeding Bird Atlas located on the refuge and surveyed from 1994-1997. Loggerhead shrikes have been detected on the Cabeza Prieta Breeding Bird Survey Route, which traverses the northeastern portion of the refuge, (USFWS national survey) only two out of five years. Christmas Bird Counts conducted on the refuge 23 years since 1955 have located shrikes all but one year. Numbers have ranged from one to 35 birds but because of the variability in level of expertise in volunteer counters, no conclusions can be drawn from these Christmas Bird Counts.

3.5.4.1.3 Le Conte's Thrasher (*Toxostoma lecontei*)

The Le Conte's thrasher is a pale gray bird approximately 28 centimeters (11 inches) long. It prefers sparsely vegetated habitats. The Le Conte's thrasher's breeding range currently extends from Southern Nevada and Southwestern Utah to Southeastern California and Western/Southwestern Arizona, northeastern Baja and northwestern Sonora. Uncommon and local throughout its range, the LeConte's is not known to be migratory.

Nesting occurs from February to June with two or three clutches raised in nests built of twigs and lined with three layers of flowers, leaves and fibers. Nests are usually constructed in dense thorny vegetation such as wolfberries, mesquite, paloverde, creosote, or cholla cactus.

The Le Conte's inhabits the lower valleys vegetated with creosote, dunes, and sandy washes within the Lower Colorado River Valley Subdivision, and is the only avian species diagnostic of this habitat type. Nesting tends to occur in thorny vegetation associated with solitary trees or small stands of trees. Le Conte's thrasher is a cursorial bird (i.e., adapted to running), foraging almost entirely on the desert floor, primarily under desert shrubs. The decline of its breeding range is mainly attributed to habitat degradation (destruction of litter and shrubs).

Management recommendations by the Arizona Partners in Flight Bird Conservation Plan include:

Human Disturbance

- Protect known at-risk breeding territories
- Avoid RV use on BLM lands during breeding season

Loss of Habitat

- Protect large tracts of optimal Le Conte's thrasher desert habitat

Research

- Determine whether birds will respond to rehabilitated farmland
- Conduct surveys in high-use areas with good thrasher habitat
- Evaluate use of artificial nest trees
- Determine factors limiting distribution
- Study population and range trends

The refuge contributes to conservation of Le Conte's thrasher by protecting habitat, and conducts annual surveys of the Cabeza Prieta Breeding Bird Survey Route that contribute to the knowledge about this species. Le Conte's have not been detected on the refuge during the annual Christmas Bird Count. Refuge participation in the Arizona Breeding Bird Survey resulted in confirmed breeding in the survey blocks located on Childs Mountain, Christmas Pass, Paradise Canyon, and Monreal Well, and two instances of probable/possible breeding in the Tule Mountain block. In addition, breeding surveys have been conducted throughout suitable habitat within the refuge. A long-term monitoring program examining breeding success and habitat use was initiated during the winter of 2002.

3.5.5 Reptiles and Amphibians

During the warmer portions of the year, refuge daytime high temperatures can exceed 38 degrees Celsius (100 degrees Fahrenheit) for 90 to 100 consecutive days and precipitation rates are variable, but generally low. This hot and arid climate of the Sonoran Desert provides excellent habitat for reptiles, but generally limits the diversity of amphibians. The refuge provides habitat for 17 lizard species, 20 snake species, and 4 species of toads. Species such as Couch's spadefoot toad, desert iguana, long-nosed leopard lizard, desert horned lizard, coachwhip, and western diamondback rattlesnake are found in the Lower Colorado River Valley Subdivision. Red-spotted toad, desert tortoise, chuckwalla, collared lizard, Gila monster, rosy boa,

and black-tailed rattlesnake are typically found in the Arizona Upland Subdivision. Amphibian activity usually occurs during the summer monsoon period, while snakes are most active during the warmer portions of the year. Many refuge lizard species exhibit the same activity period of the snakes, although a few lizard species are active during any warm period.

3.5.5.1 Species of Conservation Concern

3.5.5.1.1 Arizona Chuckwalla (*Sauromalus obesus*)

Chuckwallas are large, broad lizards with loose folds of skin on their neck and sides. Chuckwallas can reach 14 to 20 Centimeters (5.5 to 8 inches) from the head to the base of tail, and 41 centimeters (16 inches) in length from the head to the tip of the tail. These lizards inhabit rocky areas including lava flows, rocky outcrops, and rocky hillsides and hilltops.

3.5.5.1.1.1 Distribution and Habitat

Chuckwallas are found in almost all rocky areas within the refuge. Chuckwallas inhabit the southwestern deserts in the United States and Mexico. Active periods for chuckwallas coincide with the warmer portions of the year. Chuckwallas remain active in temperatures exceeding 39 degrees Celsius (102 degrees Fahrenheit). When disturbed, chuckwallas find shelter in rock crevices, where they gulp air to wedge themselves as a defense against predators.

3.5.5.1.1.2 Food Requirements

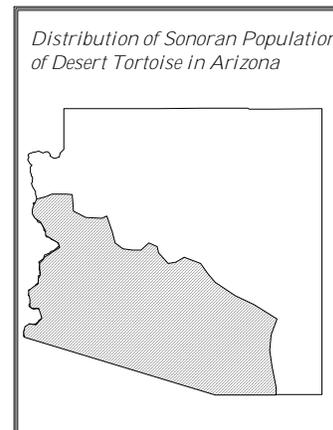
Chuckwallas are almost exclusively herbivores, consuming primarily desert annuals, a few perennials, and occasionally insects. When food resources are abundant, territorial behavior may occur with dominance hierarchy based on size. Territoriality tends to not occur during periods when food resources are scarce, however some males may defend remaining food plants.

3.5.5.1.2 Desert Tortoise (*Gopherus agassizii*)

The desert tortoise has a high-domed shell with prominent growth lines forming concentric circles on the carapace (upper side of shell). The lower shell, or plastron, has a pronounced protrusion under the head used to flip other tortoises over. Adult shell length ranges from 17.5 to over 30 centimeters (7-12 inches). The legs are covered with large scales, giving them a hobnail appearance.

3.5.5.1.2.1 Distribution and Habitat

Desert tortoise is separated into two populations. The Mojave, generally found north of the Colorado river in Arizona, is an endangered species. The rest of the state's population is considered the Sonoran population, bounded by the San Pedro River on the east, Mojave County on the north, and beyond the international boundary to the south. Density and distribution is lower in southwest Arizona where the refuge is located. Desert tortoises occur mainly on rocky slopes and bajadas of Mojave desert scrub and Arizona Upland and Lower Colorado subdivisions of the Sonoran Desert, most often in paloverde-mixed cacti associations. Boulders, outcrops, and natural cavities with enough deep soil to excavate a shelter are important components of the habitat. In Mexico, desert tortoises are restricted to arroyos, slopes, and bajadas below 800 meters (2,600 feet) MSL. Studies have found various home range sizes.



3.5.5.1.2.2 Food Requirements

Desert tortoise are primarily herbivores that consume fresh annual vegetation, cured annuals, plant litter, and perennials, but also eat arthropods, bones, soil, and feces of other vertebrates. They appear to prefer native plants to exotic plants. One study found tortoises fed mainly on grasses and forbs with seasonal additions of wildflowers in spring and cactus fruit in fall.



Desert Tortoise

FWS Photo

3.5.5.1.2.3 Abundance

The Arizona Interagency Desert Tortoise Team monitored ten sites in the Sonoran Desert in the 1990s and found that populations appear to be stable or increasing at nine of the ten sites (1996).

3.5.5.1.2.4 Threats

- Habitat fragmentation
- Habitat loss and degradation from urban and agricultural development
- Wildfires associated with invasion of non-native grasses and forbs
- Illegal collection
- Genetic contamination by escaped or released captive

3.5.5.1.3 Flat-tailed Horned Lizard (*Pyrnosoma mcalli*)

The original historical range of the flat-tailed horned lizard is recognized as extending from the Coachella, Imperial, and Borrego Valleys in Riverside, Imperial, and extreme eastern San Diego Counties, California; west of the Gila and Tinajas Altas Mountains and south of the Gila River, Yuma County, Arizona; northeastern Baja California, east of Sierra de Juarez and north and west of Bahia de San Jorge in Sonora, Mexico. The distribution of this species is now much more restricted. Although the flat-tailed horned lizard has not been documented on the refuge, researchers suspect they may be found on the Pinta Sands area.

3.5.6 Invertebrates

The Sonoran desert is known for several interesting invertebrate species including scorpions, tarantulas and millipedes, but refuge specific information regarding insect and other invertebrate species composition, density and distribution is lacking. Invertebrates play an important role in the Sonoran Desert, for example termites play an essential role in decomposing and recycling nutrients from living and dead plant tissue. Many insect species are important pollinators of wildflowers and cacti. Insects are also an important food base for many of the birds and small mammals inhabiting the refuge.

3.6 PUBLIC USE FACILITIES

Recreational developments on the refuge are limited. Roads are virtually unmaintained and passable only by 4-wheel drive or high clearance vehicles.

Access to the wilderness is provided by a non-wilderness corridor along El Camino del Diablo and the Christmas Pass Road (also called the Tacna Road). El Camino del Diablo is by far the most heavily used road on the refuge. Located near the southern border, El Camino del Diablo follows portions of the historic route of the original El Camino del Diablo and passes Papago and Tule Wells, two developed campsite areas on the refuge (each has picnic tables and charcoal fire grates). El Camino del Diablo is extremely popular among overnight users since it passes near

many of the mountain ranges and traverses the northern tip of the Pinacate Lava Flow. Access to this 4WD road is from Ajo on the east and Welton on the west of the refuge. The Christmas Pass Trail joins El Camino del Diablo on the western third of the refuge traveling north passing between the Cabeza Prieta Mountains and the Sierra Pinta Mountains before exiting the refuge at its north boundary.

Approximately 234 kilometers (145 miles) of administrative trails cross portions of the refuge within designated wilderness. Mechanical or motorized transport is prohibited from these trails but a few backpackers are starting to use them.

The only road open to vehicles in the non-wilderness portion of the refuge is the Charlie Bell Road, located in the northeast corner of the refuge south of Childs Mountain. This road extends approximately 19 kilometers (12 miles) west into the Growler Mountains, and is used primarily by day visitors.



Aerial view of El Camino del Diablo
USFWS Photo

3.7 SPECIAL MANAGEMENT AREAS

3.7.1 National Register of Historic Places District

El Camino del Diablo trail district was placed on the National Register of Historic Places in 1978 and is listed by the State Historic Preservation Office as an Arizona historic trail. The National Historic District is a 1.6-kilometer (1-mile) wide corridor centered on the original trail used by travelers in the region since the pre-European contact era. The name El Camino del Diablo - “the Devil’s Highway” - first appears in historical records from the 1850s, and was likely coined by prospectors on their way to the California gold fields and other travelers from Caborca, Mexico to Yuma, Arizona. Thousands of prospectors braved this arid route. It has earned its name as the most deadly immigrant trail where over 400 travelers perished over the years.



Marker along the historic El Camino del Diablo
USFWS Photo

3.7.2 Cabeza Prieta Wilderness

The Cabeza Prieta Wilderness was first proposed as a Wilderness Study Area in 1968 and was designated by the Arizona Desert Wilderness Act of 1990. Special provisions for border law enforcement agencies and the military were included in the act. The wilderness boundary coincides with the lands formerly withdrawn for military use.

At 325,133 hectares (803,418 acres), the Cabeza Prieta Wilderness is the largest NWR wilderness outside of Alaska. Despite its large size, this wilderness is relatively accessible to visitors due to the unique non-wilderness road corridors along El Camino del Diablo and Christmas Pass

Road. A network of administrative trails also exists in the wilderness. These are old jeep or truck trails that were established prior to wilderness designation. The administrative trails are used for vehicular access to the refuge by staff for management purposes, subject to minimum requirements analysis, but are closed to any mechanical or motorized travel by the general public.



A view of the Cabeza Prieta Wilderness
USFWS Photo

3.8 OTHER USES

3.8.1 Military Facilities and Artifacts

Past military use has left a scattering of debris throughout the refuge. These materials range from numerous .50 caliber machine gun shell casings to larger items such tow darts. The darts are wood and aluminum winged structures approximately 4 meters (13 feet) in length that were towed behind aircraft and used as targets in air-to-air gunnery targets. Analysis of aerial photographs conducted by the Air Force in 1998 yielded an estimate of more than 1,600 darts within the refuge.

3.8.2 Childs Mountain Military and FAA Surveillance Operations

The AFS is a radar surveillance station that was constructed between 1956 and 1958. Operations at the AFS were terminated in 1971, the family houses were relocated to Gila Bend, and all other facilities were removed. Remaining in place were the Air Force RCAG Operations Tower, Building 56, a hardened concrete reinforced structure, several towers used by other agencies, and a FAA radar installation that was removed prior to construction of an upgraded facility in 1999.

The FAA's ARSR-4 radar facility constructed in 1999 serves as a civilian aircraft tracking system and as a border surveillance system for the Air Force and CBP-BP. Additional commercial communications sites have been developed within the Childs Mountain site, to make use of the existing towers and advantageous terrain provided.



Volunteers dismantling a tow
dart USFWS Photo

3.9 CULTURAL RESOURCES

3.9.1 Cultural Resource Inventories



Petroglyph

USFWS Photo

Surveys are required when new projects will disturb the soil surface, such as road construction, prescribed fire activities, facilities construction and remodeling, and any other activity that has the potential to affect historic properties.

Less than one percent of the refuge has been inventoried for archeological and historic sites. The few reports and accounts available for the refuge come from a handful of limited surveys that have been conducted (Ezell 1954, Fontana 1965, Rozen 1979), as well as sporadic visits to

the area made by southwest scholars since the 1920s. There has been no authorized excavation, and there is but a single verified date of an artifact available for the

refuge, a surface collection of a sheep horn core from a site at Cabeza Prieta Tank. Despite the lack of institutional interest in the area over the years and the limitations of independent data available, enough is known about the refuge to broadly characterize the archeological and historic resources present. *The Cultural Resources Overview and Assessment, Cabeza Prieta National Wildlife Refuge* published in 2001 compiles current knowledge of cultural artifacts and use patterns on the refuge. Recent studies on nearby jurisdictions (BMGR, OPCNM) have shed additional light on the site occurrences that typify this region.

Within the refuge, 45 prehistoric and historic sites have been recorded by a statewide survey. In addition, there are numerous site “leads” and site locations that are known but have not been formally recorded.

3.9.2 Prehistoric and Historic Data

Prehistoric sites fall into categories that are limited to the surface and suggest ephemeral use or occupation of locations by widely dispersed, small groups of prehistoric hunter-gatherers. These sites are: low density artifact scatters of lithic material and ceramics, fire-burned rock and hearths, trails, bedrock mortars, rock alignments, stone piles or cairns, stone windbreaks, sleeping circles, shallow rock shelters, and petroglyphs. With only a few exceptions, the prehistoric sites so far recorded on the refuge do not exhibit any evidence of depth, subsurface features, or middens. Of particular interest are the deposits of shell debris on two sites, which point to the prehistoric shell trade route that has been postulated for the Growler Valley, and which was most probably a significant use of the range for centuries.

Ethnographically, the refuge was the homeland of the Hia C-ed O’odham (Sand Papago). The Hia C-ed O’odham were Piman-speaking, hunting/gathering populations who lived west of Ajo throughout historic times. The small, dispersed bands of Hia C-ed O’odham were encountered by Padre Kino, a late Seventeenth Century Jesuit missionary who traveled extensively in the area that became southern Arizona and northern Sonora, and by travelers on El Camino del Diablo for two centuries. While the archeological evidence does not necessarily correspond to historic linguistic groups, it suggests that Hia C-ed O’odham ancestry may extend back more than a thousand of years on the refuge.

Historic sites are primarily early 20th century mining camps and prospecting strikes. El Camino del Diablo is the fabled historic corridor that traversed parts of the refuge landscape between 1540 and the late 1800s. More a braided corridor of travel than a distinct road, it is often incorrectly equated with the modern refuge access road of the same name.

3.10 REGIONAL ECONOMIC SETTING

3.10.1 Surrounding Jurisdictions

Cabeza Prieta NWR is located in Yuma and Pima Counties in southwestern Arizona. The Mexican State of Sonora is located immediately south of the Refuge. Geographically, 60 percent of the refuge lies in southeastern Yuma County while 40 percent lies in western Pima County. The refuge headquarters is located on the northern edge of the town of Ajo, in Pima County.

3.10.1.1 Pima County

Pima County - is situated in the central portion of southern Arizona, bordering Mexico to the south, Maricopa and Pinal Counties to the north, Santa Cruz and Cochise Counties to the east, and Yuma County to the west. Pima County covers 23,786 square kilometers (9,184 square miles), consisting of the Tucson metropolitan center and scattered satellite communities in outlying areas. Most of Pima County's economic and population base is concentrated in eastern Pima County in the greater Tucson area. The San Xavier, Pascua Yaqui, and Tohono O'odham Nation lands together account for 42.1 percent, State lands 14.9 percent, federal public lands 29.2 percent and private lands 13.8 percent of Pima County's land base (Pima County Department of Transportation 2002).

By the 1950s, the rural and small town setting of Pima County had changed. Agriculture, ranching, and mining activities slowed considerably as educational, medical, and defense-funded research and manufacturing in metropolitan Tucson began to develop and expand (Arizona Department of Commerce 2002). Arizona's mild climate and relatively inexpensive cost of living also served to attract people to the area. Land development as a result of the influx of residents further changed and diversified the economic structure of the county.

Smaller rural communities in western Pima County near the refuge, including Ajo and Why, have developed a separate and distinct economic structure from eastern Pima County. Historically, western Pima County was heavily dependent on large-scale mining operations (Ajo 2001). In recent years, however, the economy has been adversely affected by the loss of mining activities in the immediate area, and the collapse of the Gulf of California shrimp industry in Mexico. In an attempt to revive the sluggish economy, recreation and tourism have been increasingly marketed as replacements to lost industries (Ajo 2001).

The town of Ajo is located immediately to the east of the eastern boundary of the refuge with its major access road being Highway 85. Until the mid 1980s Ajo was historically heavily dependent on mining operations for economic stability. In 1984, Phelps Dodge shut down the mine and smelter operation due to a drastic reduction in the value of copper and labor dispute problems (Ajo 2001). In order to replace lost mining employment and revenues, the town has marketed itself to retirees and tourists to capitalize on Ajo's mild winters and proximity to Cabeza Prieta NWR and OPCNM. According to the Ajo Community Comprehensive Plan (2001), many residents feel the key to Ajo's survival lies in converting the town into a retirement community and tourist center.

3.10.1.2 Yuma County

Yuma County is situated in the southwestern corner of Arizona, bordering Mexico to the south, California to the west, La Paz County to the north, and Maricopa and Pima counties to the east. Yuma County covers 14,473 square kilometers (5,522 square miles) of desert land accented by rugged mountains. The valley regions contain an abundance of arable land, irrigated with water from the Colorado River. Yuma County's economy is centered on its hot, dry climate, its location along the Colorado River, and its location midway between the metropolitan areas of southern Arizona and southern California. Agriculture, tourism, military and government are the County's principal industries (Arizona Department of Commerce 2002). Major communities near the Refuge include Yuma and Welton. Federal public lands account for 81.6 percent,

State lands, 7.7 percent, Native American Nation lands 1.2 percent, and private land 10.5 percent of Yuma County's land base.

3.10.1.3 Tohono O'odham Nation

The Nation of the Tohono O'odham consists of four separate reservation lands. The largest, known as the Tohono O'odham reservation, stretches 145 kilometers (90 miles) across Pima County, covering 1,122,342 hectares (2,773,357 acres) and lies immediately to the east of the town of Ajo and the Refuge. Two principal economic activities on the Tohono O'odham Nation lands include employment by Federal, state, and tribal agencies, and cattle ranching and related activities. Growth in tourism, agricultural, retail/tourism, and utilities sectors are expected as tribal development plans are implemented (Arizona Department of Commerce 2002). Proposed development projects will also provide jobs in construction as new housing units, a shopping center, a gaming center, mining and chemical concerns, and several tourism facility projects are planned (Arizona Department of Commerce 2002). A gaming facility was constructed in 1999 for the Gu Vo district located in the western region of the nation's lands.

Ethnographically, the refuge area was the homeland of the Hia C-ed O'odham (Sand Papago). Descendants of this prehistoric people have been working to establish themselves as a District of the Tohono O'odham Nation. Members of the Hia C-ed O'odham consider the refuge lands part of their ancestral lands and have requested formal participation in matters pertaining to land uses that may affect known burial grounds, trails and locations considered sacred.

3.10.1.4 Mexico

The Mexican state of Sonora is located immediately south of the refuge. Northwestern Sonora is sparsely populated, with inhabitants located in small communities or scattered on many cooperative and private farms that cover the state. The northwestern part of Sonora immediately adjacent to OPCNM is included in the Municipio of Plutarco Elias Calles. The Municipio includes the town of Sonoyta approximately 3 kilometers (2 miles) south of Lukeville, near the United States border.

The ease of access between Puerto Penasco and Arizona (via State Route 85) creates a tight symbiotic relationship through the export of shrimp from Mexico to Phoenix and Tucson, and tourism in the Gulf of California resulting from devaluation of the peso in 1980 (Arizona Department of Commerce 2002). In recent years, however, the shrimp industry has collapsed as a result of continuous over harvesting. Tourism businesses have suffered losses as inflation has countered low prices for goods and services that followed the peso's devaluation.

3.10.2 Population

The 2000 Census estimated Pima County's population at 843,746 and Yuma County's population at 160,026 (table 3.5). Sixteen percent of Arizona residents resided in Pima County while three percent resided in Yuma County (US Census Bureau). As shown in table 3.5, both Pima and Yuma County experienced a population increase from 1990 to 2000 of 26.5 percent and 49.7 percent respectively, however, Yuma County experienced a higher increase than the 40 percent population increase for the State of Arizona (US Census Bureau).

Jurisdiction	1990	2000	Percent Change
Arizona	3,665,228	5,130,632	40.0
Pima County	666,880	843,746	26.5
Yuma County	106,895	160,026	49.7
Ajo	2,919	3,705	26.9
Tohono O'odham Reservation	18,730	10,787	-42.4
Welton	1,066	1,829	71.6
Yuma	54,923	77,515	41.1

Source: US Census Bureau and Arizona Department of Economic Security

As shown in table 3.5, of the local communities surrounding the Refuge, Welton experienced the largest population increase of 71.6 percent while the Tohono O'odham Nation experienced the only population decrease of 42.4 percent from 1990 to 2000 (US Census Bureau). Subsequent to the closure of the mining operations in 1984, Ajo's population decreased by 56 percent from 5,189 to 2,919 from 1980 to 1990 (Arizona Department of Security 2001). Between 1990 and 2000, the population increased 26.9 percent as retirees have continued to move to Ajo (US Census Bureau). Since 1986, nearly 900 houses once owned by Phelps Dodge have been sold to new residents, mostly retirees (Arizona Department of Commerce 2002).

Population composition percentages are presented in table 3.6. In spite of the high proportion of non-native and non-Hispanic newcomers, the multicultural flavor of Pima and Yuma County still remains. According to the 2000 Census, 29 percent of Pima County and 50.5 percent of Yuma County's residents are of Hispanic or Latino origin, compared to the state average of 25.3 percent and the national average of 12.5 percent.

State and Counties				Communities near Cabeza Prieta NWR			
	Arizona (percent)	Pima County (percent)	Yuma County (percent)	Ajo (percent)	Tohono O'odham Reservation (percent)	Welton (percent)	City of Yuma (percent)
White	75.5	75.1	68.3	83.0	8.7	70.6	71.7
Black or African American	3.1	3.0	2.2	0.6	0.3	2.1	3.8
American Indian and Alaska Native	5.0	3.2	0.2	9.7	90.8	2.1	2.2
Asian	1.8	2.0	0.1	0.6	0.2	0.5	2.1
Native Hawaiian and Other Pacific Islander	0.1	0.1	0.0	0.2	0.2	0.4	0.3
Persons reporting some other race	11.6	13.3	23.6	10.8	0.9	27.2	23.9
Persons of Hispanic or Latino origin	25.3	29.3	50.5	37.6	7.1	40.7	45.7
White persons not of Hispanic/Latino origin	63.8	61.5	44.3	54.4	92.9	55.3	47.5

Source: US Census Bureau

3.10.3 Employment and Income

Employment status statistics for 2000 are presented in Table 3.7. In 2000, the 4.6 percent unemployment rate in Pima County was very close to the State average of 4.4 percent while the 6.1 percent unemployment rate for Yuma County was considerable higher than the State average (US Census Bureau). The Tohono O'odham Nation's 9.9 percent unemployment rate was more than double the State average in 2000. According to the Arizona Department of Commerce (2002), additional Tohono O'odham Nation jobs are expected to result from new tribal development plans and construction activities on the reservation. Due to the large number of retired residents, 64.4 percent of Ajo's and 66.1 percent of Welton's population were not in the 2000 labor force (table 3.7). In the city of Yuma, the Marine Corps Air Station and US Army Yuma Proving Grounds accounted for 5.4 percent of the 2000 labor force.

State and Counties				Communities near Cabeza Prieta NWR			
	Arizona (percent)	Pima County (percent)	Yuma County (percent)	Ajo (percent)	Tohono O'odham Reservation (percent)	Welton (percent)	Yuma City (percent)
Population in labor force	62.9	61.8	59.1	35.6	41.2	33.9	59.6
Employed	57.6	56	47.3	32.2	31.3	29.5	49.3
Unemployed	4.4	4.6	6.1	3.3	9.9	4.4	4.9
Armed Forces	0.9	1.2	5.7	0.1	0	0	5.4
Not in labor force	37.1	38.2	40.9	64.4	58.8	66.1	40.4

Source: US Census Bureau

Employment occupation trends for 2000 are presented in table 3.8. The 2000 employment occupational structure for Pima County closely matched the overall State occupational structure. In Yuma County, agricultural based employment accounts for a larger percent of employment as compared to Pima County and the State of Arizona (US Census Bureau). According to the Arizona Department of Commerce (2002), agriculture is a major economic factor in Yuma County and at the current rate of growth for Yuma-area agribusiness is expected to soon become a billion dollar industry.

State and Counties				Communities near Cabeza Prieta NWR			
	Arizona (%)	Pima County (%)	Yuma County (%)	Ajo (%)	Tohono O'odham Reservation (%)	Welton (%)	Yuma City (%)
Management, professional, and related occupations	32.7	35	26.7	23.9	23.4	20.7	30.2
Service occupations	16.2	17.6	17.7	28.8	25.7	17.5	18.8
Sales and office occupations	28.5	27.1	26.4	25.5	24	26.9	28.7
Farming, fishing, and forestry occupations	0.6	0.2	6.3	0	1.2	9.2	2.5
Construction, extraction, and maintenance occupations	11	10.7	10.7	10	13.7	9	9.8
Production, transportation, and material transport	10.9	9.4	12.2	11.8	12	16.8	10

Source: US Census Bureau

According to the Arizona Department of Commerce (2002), Federal, state, and tribal agencies are the largest employers on the Tohono O'odham Nation, with cattle ranching forming the second most important employment source. The agricultural, retail-tourism, utilities, and construction sectors are expected to grow as tribal plans are implemented (Arizona Department of Commerce 2002).

In 1980, 60 percent of Ajo's population was employed by the Phelps Dodge Corporation (Arizona Department of Commerce, 2002). Following the closure of the mining operations in 1984, employment in Ajo decreased by more than sixty percent from a labor force of 1,902 to 751 workers from 1980 to 1990. To

accommodate the increasing demand in the retirement and tourist industries in Ajo, the services sector has accounted for a majority of the shift in the employment base (Arizona Department of Commerce 2002). In 1999, Ajo's principal employment was in the tourist, service and commercial sectors (Arizona Department of Commerce 2002).

The income and poverty status for 2000 is presented in table 3.9. Per capita income is the mean income computed for every man, woman, and child in a geographic area (US Census Bureau). Individuals are classified as below poverty if their total income was less than the poverty threshold (US Census Bureau). In 2000, the US Census poverty threshold for an individual under 65 years old was set at \$8,667 (table 5). In 2000, 46.4 percent of the Tohono O'odham Nation residents were classified as below poverty while the State average was 13.9 percent. In 2000, the Tohono O'odham per capita income was \$6,998, the State average was \$ 20,275 (table 3.9). According to the US Census estimates, the Tohono O'odham Nation is severely impoverished.

Table 3.9: Regional and Local Income and Poverty Status for the Year 2000

State and Counties				Communities near Cabeza Prieta NWR			
	Arizona	Pima County	Yuma County	Ajo	Tohono O'odham Reservation	Welton	Yuma City
Per capita income	\$20,275	\$19,785	\$14,802	\$14,548	\$6,998	\$13,644	\$16,730
Percent of individuals below poverty level	13.9	14.7	19.2	22.3	46.4	21.3	14.7

Source: US Census Bureau

Yuma County's 2000 per capita income of \$14,802 was well below Pima County's per capita income of \$19,785 and the State average of \$20, 275 (US Census Bureau). In 2000, Ajo's per capita income was \$5,237 lower than the per capita income of Pima County (table 3.9). According to the Ajo Community Master Plan (2001), the lack of economic opportunities results in many young adults leaving Ajo after high school and many of those that stay are low skilled workers with little educational opportunities to advance their careers. This steady increase in services employment is generally reflected in lower paying jobs and lower household income.

Yuma County – The western 60 percent or so of refuge lands are located in Yuma County. Yuma County's economy is centered around its hot, dry climate, its location along the Colorado River, and its location midway between the metropolitan areas of southern Arizona and southern California. These natural characteristics have been reflected in an economy heavily dependent on agriculture, ranching, and tourism. Military operations are also considered important to the local economy with the Marine Corps Air Station and Yuma Proving Grounds. Yuma, 290 kilometers (180 miles) west of the refuge headquarters by road, is the only major urban center in the county. Census data report a 2000 county population of 160,026 persons, of which nearly 77,515 lived in the city of Yuma.

The Tohono O'odham Nation, headquartered in Sells, Arizona, reported a 1990 population of 18,730 and a 2000 population of 10,787, a decrease of approximately 42 percent. Between 1989 and 1991 the unemployment rate rose from 30 percent to 66 percent. This increase can be attributed to more accurate data collection and analysis.

Two principal economic activities on Nation lands include employment by Federal, state, and tribal agencies, and cattle ranching and related activities. Growth in tourism, agricultural, retail/tourism, and utilities sectors are expected as tribal development plans are implemented. Proposed development projects will also provide jobs in construction as new housing units, a shopping center, a gaming center, mining and chemical concerns, and several tourism facility projects are planned. A gaming facility was constructed in

1999 for the Gu Vo district located in the western region of the nation's lands.

Mexico -- The Mexican state of Sonora is located immediately south of the refuge. Northwestern Sonora is sparsely populated, with inhabitants located in small communities or scattered on many cooperative and private farms that cover the state. The northwestern part of Sonora immediately adjacent to OPCNM is included in the Municipio of Plutarco Elias Calles. The Municipio includes the town of Sonoyta approximately 3 kilometers (2 miles) south of Lukeville, near the border.

The community of Sonoyta has a reported population of 12,000. Approximately 9,000 inhabitants are located in the urban area, and the remaining population occupies the surrounding agricultural areas. The economic structure of Sonoyta consists of approximately 60 percent commercial and industrial services, 20 percent financial and other services. Tourism is a major component of the economic structure of the community; however, American visitors traveling to and from the Gulf areas contribute to only a part of tourism revenues received by the community. Of at least equal or greater importance than Sonoyta's tourist industry is the town's position along the major Mexican highway between the large population centers in Baja California and interior Mexico.

The ease of access between Puerto Penasco and Arizona (via State Route 85) creates a tight symbiotic relationship through the export of shrimp from Mexico to Phoenix and Tucson, and tourism in the Gulf of California resulting from devaluation of the peso in 1980. In recent years, however, the shrimp industry has collapsed as a result of continuous over harvesting. Tourism businesses have suffered losses as inflation has countered low prices for goods and services that followed the peso's devaluation.

3.10.4 Transportation

Ajo and the refuge headquarters are accessed by State Route 85. State Route 85 originates at Interstate 10, approximately 24 kilometers (15 miles) west of metropolitan Phoenix, Arizona, and terminates approximately 195 kilometers (120 miles) south at the United States/Mexico border. This highway corridor also intersects Interstate 8 at Gila Bend, Arizona, and links with State Route 86 at Why, Arizona. State Route 85 is the only port of entry to Mexico between the Yuma/San Luis and Nogales, Arizona/Nogales, Sonora, a distance of over 325 kilometers (200 miles). From Why, Arizona, to the OPCNM entrance, southbound traffic is classified as 80 percent in-state automobiles, 16 percent out-of-state automobiles, and 7 percent commercial vehicles. Northbound traffic consists of 77 percent in-state automobiles, 14 percent out-of-state automobiles, and 6 percent commercial vehicles. Arizona Department of Transportation traffic counts in 1992 revealed a peak traffic month in March and a low traffic month in August. Peak traffic days, measured in February and August, show Friday to be the busiest day, and Wednesday having the least amount of traffic.

4.0 Environmental Consequences

This section discusses and analyzes the potential environmental consequences of the proposed action, alternative actions and no action alternative. Environmental impacts, or modifications to the environment that are brought about by an outside action, can be beneficial or adverse. Impacts can be described as direct (effects that are caused by the action or occur at the same time and place) or indirect (effects that are caused by the action and occur later in time or are farther removed in distance, but are still reasonably foreseeable). Impacts can also be of long- or short-term influence. Some impacts will have irreversible or irretrievable effects on resources. Finally, cumulative impacts are those attributable to a proposed action and reasonably foreseeable related actions in combination. This analysis identifies the predicted impacts of implementing each alternative, whether direct, indirect, long-term or short-term; the cumulative impacts of the alternative and related, reasonably foreseeable actions; and any irreversible or irretrievable commitment of resources that would result.

Where measurable impacts are predicted, their significance is evaluated in consideration of both context and intensity as required by CEQ regulations (40 CFR 1508.27). A significant effect is one that results in a substantial change in environmental component in question and should have a material bearing on the decision making process.

The Service developed the predicted impacts through the use of existing research, contracted analysis and review among the interdisciplinary team. The basis for determining each impact is summarized in the text.

The resources are addressed in the same order as they were presented in Chapter 3. For each resource the potential impacts of implementing each action alternative are contrasted with the impacts of continuing the current management regime (the No Action Alternative).

4.1 PHYSICAL ENVIRONMENT

4.1.1 Climate

None of the management actions currently occurring on the refuge or proposed under any of the management alternatives would be expected to produce measurable direct or indirect, long or short-term effects on the local or regional climate. Annual thermal and greenhouse gas emissions from refuge and visitor vehicles per year are less than that emitted daily by traffic in a small American city and are dispersed over a large area. Similarly the local effects of increased humidity near developed wildlife waters are too small (30 waters over 348,182 hectares (860,010 acres) to measurably effect climate conditions. Paving, large structures or other developments that increase solar reflectivity are not proposed under any alternative.

4.1.2 Air Quality

The significance threshold for air quality impacts is any non-compliance with federal or state air quality standards. Under current management (the no action scenario) air quality on the refuge is generally very good, with the only significant events being occasional violations of the 24-hour suspended particulates standard on days of high winds when blowing dust exceeds the standard. No change in this condition should result from implementing any of the action alternatives. Air emissions generated on the refuge from all sources (law enforcement vehicles, refuge management vehicles, visitor vehicles and cooking fires) represent a very small fraction of total area emissions. As discussed below for soils, increases in soil disturbance, and thus soil particles becoming suspended on days of high winds, would be a small increment of existing disturbance under all action alternatives. The only potential cumulative negative effect would be a local increase in particulates and sulfur dioxide should the Phelps Dodge copper smelter in Ajo be reactivated. This eventuality, however, is unlikely due to the low value of copper and high cost of

reactivating the smelter (Ajo 2001).

Illegal travel across the refuge, and the border law enforcement response to this activity, causes many adverse impacts to refuge resources. DSH is currently proposing to develop a vehicle barrier on or near the International Border on the refuge. This vehicle barrier would supplement a vehicle barrier recently constructed at Organ Pipe NM. The barrier and service road along the border will be funded by the DHS. The final design barrier will allow passage of wildlife and human foot traffic, but exclude vehicles. Approximately 95 percent of the barrier and service road construction would take place within the 60-foot non-refuge and non-wilderness corridor along the border known as the Roosevelt Reservation. The overall effect to the refuge is expected to be positive because the barrier will greatly curtail illegal cross-border/cross-country vehicle traffic and allow border law enforcement operations to reduce their travel in the refuge to apprehend or rescue smugglers and illegal migrants. The barrier would require regular patrols to detect efforts to circumvent the barrier such as placement of vehicle ramps over the barrier. All environmental and NEPA clearances for construction and operation of the vehicle barrier will be obtained by DHS when actual construction is proposed.

If a vehicle barrier is constructed, considerable decreases in the amount of illegal off-road driving should result, yielding a significant reduction in the long-term soil disturbance. With reduced soil disturbance, refuge soils should gradually become stabilized, and the amount of airborne dust generated by winds across the refuge would decrease.

DHS's decision of whether or not construct a vehicle barrier is beyond the scope of this CCP. The presence or absence of a barrier is not linked to any management alternative. Any long-term improvement of air quality resulting from the construction of the vehicle barrier should thus be considered an independent, cumulative (that is, a reasonably foreseeable effect of actions related to management of the refuge) benefit to the environment of the refuge and its surroundings.

4.1.3 Soils

4.1.3.1 Soil Disturbance and Erosion

4.1.3.1.1 Off-Road Vehicle Use

Off road vehicle use, defined as operation of motor vehicles outside of established roadways open to the public on the refuge (El Camino del Diablo, Christmas Pass Road and Charlie Bell Road to eastern limit of refuge wilderness), or driving beyond the limits of administrative trails by Border Law Enforcement agents, creates a great level of new soil disturbance and erosion by destroying plant cover and soil crusts. Both plant cover and soil crust stabilize soil and recover very slowly from disturbance in the refuge's hot, dry climate. Refuge staff reports that vehicle tracks more than 20 years old remain visible on the refuge (V. Harp, USFWS, pers. comm.). Due to the sensitivity of refuge soils and vegetation to disturbance by off-road vehicle use and the long recovery time after such disturbance, any use of motorized vehicles off of the designated refuge roads and administrative trails is considered significant.

Three types of off-road driving occur on the refuge, illegal travel by UDAs and smugglers, illegal travel by refuge visitors, and travel by border law enforcement agents in hot pursuit of suspects or involved in search and rescue. According to refuge staff analysis of unauthorized road development and other changes in the refuge, most off-road driving on the refuge is illegal travel by UDAs and smugglers (C. McCasland, USFWS, pers. comm.). Off-road driving by border law enforcement personnel is limited, by memoranda of agreement (see Appendix B), to cases of hot pursuit of suspects and search and rescue operations. Although exact figures are not obtainable, illegal off-road driving by refuge visitors is not a major problem, given the low overall visitation to the refuge, warnings provided regarding the hazards of leaving the access corridors and the potential for being ticketed for engaging in this prohibited activity.

Alternative 1, No Action Scenario

Refuge staff estimates that off road driving, primarily by UDAs and smugglers, has affected approximately 61,500 hectares (152,000 acres) of refuge lands, or approximately 17.7 percent of the total refuge area. This is clearly a significant effect on the refuge's soil resource, however it is the result of activities beyond the refuge's control. Border law enforcement agencies patrol the refuge, but their ability to interdict all traffic in so large and remote an area will remain limited and illegal traffic can be expected to continue. No measurable change in illegal off-road driving by UDAs and smugglers from that of the no action scenario should result from implementing any action alternative (Alternatives 2-5). In some cases, however, implementing the action alternatives should produce changes from the no action scenario levels of off-road driving by border law enforcement agencies and illegal off-road driving by refuge visitors. As discussed in Section 7.1.2 above, DHS's proposed development of a vehicle barrier would greatly reduce soil disturbance generated by UDAs and smugglers driving off-road. This benefit, however would be independent of any management proposed in the CCP.

Alternative 2

Implementing Alternative 2 should not appreciably change levels of off-road driving by border law enforcement agencies. The level of illegal off-road driving by refuge visitors should be slightly reduced under this alternative as compared to the no action scenario. This is largely due to small reductions in visitation projected. This alternative also includes additional provision of Leave-No-Trace information to refuge visitors. This may decrease illegal off-road driving by refuge visitors to some extent, but no measurable change is anticipated.

Alternative 3

Implementing Alternative 3 could result in a small reduction in levels of off-road driving by border law enforcement agencies, as compared to the no action scenario. Under this alternative the refuge will provide formal refuge orientation and wilderness training to border law enforcement agents prior to their deployment on the refuge. This additional education will stress the importance minimizing off-road driving. The level of illegal off-road driving by refuge visitors should be slightly reduced under this alternative as compared to the no action scenario. This is largely due to small reductions in visitation projected. This alternative also includes additional provision of Leave-No-Trace information to refuge visitors, and mandates visitor viewing of the Carhart Center's Wilderness Awareness video prior to refuge entry. These additional information pieces may decrease illegal off-road driving by refuge visitors to some extent. No measurable change in off-road driving from the levels of the no action scenario is anticipated.

Alternative 4 (Preferred alternative)

Implementing Alternative 4 should not appreciably change the levels of off-road driving by border law enforcement as compared to the no action scenario. The level of illegal off-road driving by refuge visitors is also not expected to change appreciably under this alternative from that of the no action scenario. An additional deer hunt may increase overall visitation somewhat, thus increasing the opportunity for off-road driving. This hunt will not be implemented until the refuge Sonoran pronghorn population has stabilized, however, so any change would not occur until then. Additional vehicle restrictions should compensate by reducing the number of vehicles used on the refuge public access roads that are most capable of off-road driving. No measurable change in off-road driving from the levels of the no action scenario is anticipated.

Alternative 5

Implementing Alternative 5 should not appreciably change the levels of off-road driving by border law enforcement as compared to the no action scenario. The level of off-road driving by refuge visitors would be likely to increase somewhat should this alternative be implemented. New hunts and reductions in visitor

restrictions would increase visitation numbers, thus increasing opportunities for illegal off-road driving. No measurable change in off-road driving, and its effect on soils, from the levels of the no action scenario is anticipated.

4.1.3.1.2 On-Road and On-Trail Vehicle Use

Soil disturbance and erosion can occur from vehicle use on the refuge public access roads and administrative trails, particularly during times of reduced soil stability or aggressive vehicle operation. The refuge limits these impacts by closing public access roads after heavy rains and scheduling management vehicle trips. Border law enforcement vehicle patrols, however, are outside of the control of the refuge. The requirement of four-wheel-drive vehicles on El Camino del Diablo and Christmas Pass Road reduces road damage from wheel spinning in areas of steep terrain. The greatest soil disturbance from on-road and on-trail vehicle occurs when vehicles detour slightly from the existing traveled surface due to poor conditions or to reverse course. Detouring that results in vehicle use outside of non-wilderness travel corridor, in the case of refuge public access roads, or beyond the primary travel surface, in the case of administrative trails, affecting 10 or more hectares (25 acres) of previously undisturbed soil adjacent to a refuge road or administrative trail is considered a significant impact.

Alternative 1, No Action Scenario

Under the no action scenario regular border law enforcement vehicle patrols produce the greatest soil disturbance of any on-road/on-trail use. This is due primarily to the great increase in traffic load on the refuge public access roads and administrative trails these frequent patrols represent. In some areas where the primary road has been degraded by heavy use, detouring has led to widening of the affected area. Recent reinforcement of some unstable portions of El Camino del Diablo and Christmas Pass Road should greatly reduce the necessity of future detouring. Past detouring and use of the area adjacent to the road as a vehicle turnaround has impacted approximately 20 hectares (50 acres), according to refuge personnel (C. McCasland, USFWS, pers. comm.). This is considered to be a significant impact to refuge soil resources. Border law enforcement agency activities are beyond the control of refuge management and are not likely to change in the foreseeable future. They are thus considered long-term, cumulative impacts.

Use of refuge roads and administrative trails by refuge management, and use of refuge roads by refuge visitors is considerably less than that of border law enforcement personnel, and likely contributes little to the impacts of border law enforcement use of the roads.

On-road driving by UDAs and smugglers is believed to have been high in previous years, but recent increased border law enforcement presence has greatly decreased this use (C. McCasland, USFWS, pers. comm.). On-road and on-administrative trail driving by UDAs and smugglers is no longer considered an important source of soil impacts on the refuge.

Alternative 2

Implementing Alternative 2 would decrease soil disturbance caused by refuge management vehicle operation on roads and administrative trails by approximately 50 percent and refuge visitor driving on the refuge public access roads by approximately 10 percent, as compared to the no action scenario. These percentages, and those presented for the other action alternatives are computed based upon projected management travel for water hauling and other management actions and projections of changed visitation. Should this alternative be implemented, a considerable reduction of refuge management vehicle use and a slight reduction in visitation would result.

In the absence of border law enforcement driving, these reductions might have the long-term effect of allowing recovery to some administrative trails, as well as roadside areas. On-road and on-administrative trail driving by border law enforcement, however, would not change from the no action scenario level. As

noted above for the no action scenario, border law enforcement use is the overwhelming cause of soil impacts from driving on refuge roads and administrative trails.

Alternative 3

Implementing Alternative 3 would decrease soil disturbance caused by refuge management vehicle operation on roads and administrative trails by approximately 30 percent and refuge visitor driving on the refuge public access roads by approximately 5 percent, as compared to the no action scenario. This is due to a moderate reduction of refuge management vehicle use and a slight reduction in visitation, should this alternative be implemented.

As discussed under Alternative 2 above, changes in refuge management and visitor use of administrative trails and roads should not measurably affect the level of soils impact from on-road and on-administrative trail driving.

Alternative 4 (Preferred alternative)

Implementing Alternative 4 would initially result in no change from the no action scenario level of soil disturbance from on-road and on-trail driving. Over time, however, as improvements to wildlife waters are completed, refuge management driving on roads and administrative trails would decrease up to approximately 60 percent, resulting in reduced levels of soil disturbance. No measurable change in the impact of visitor driving of refuge roads would result from implementing this alternative.

As discussed under Alternative 2 above, changes in refuge management and visitor use of administrative trails and roads should not measurably affect the level of soils impact from on-road and on-administrative trail driving.

Alternative 5

Implementing Alternative 5 would initially result in an increase in soil disturbance from on-road and on-trail driving. This alternative would increase visitation, and thus on-road driving by visitors, by approximately 10 percent, and would initially increase refuge management vehicular use of refuge roads of and administrative trails by approximately 20 percent. Similar to Alternative 4, however, as improvements to wildlife waters are completed, refuge management driving on roads and administrative trails would decrease by approximately 60 percent, resulting in reduced levels of soil disturbance.

As discussed under Alternative 2 above, changes in refuge management and visitor use of administrative trails and roads should not measurably affect the level of soils impact from on-road and on-administrative trail driving.

4.1.3.1.3 Construction

Construction activities that include soil excavation and vegetation clearing have the potential of greatly increasing erosion on disturbed sites. This potential can be mitigated through the use of best management practices (BMPs) for construction such as stabilizing disturbed soil with geo-textile fabrics, limiting the area of disturbance and promptly restoring grades and vegetation upon the completion of construction. Small construction projects disturbing less than one hectare (2.5 acres) of land and mitigated through the use of BMPs should not cause any significant impacts to the soil resource.

Alternative 1, No Action Scenario

No new construction is currently proposed on the refuge.

Alternative 2 and 3

Implementing either of these alternatives would not result in any new construction on the refuge.

Alternative 4 (Preferred alternative)

Implementing Alternative 4 would result in construction of an enlarged visitor center at the refuge, as well as redevelopment of 12 developed waters on the refuge to benefit management of Sonoran pronghorn and desert bighorn sheep. This redevelopment would include excavation of space for buried tanks and water lines.

The proposed refuge visitor center enlargement would involve disturbing less than one hectare (2.5 acre) of land on the refuge visitor center site. Erosion and sedimentation impacts will be mitigated through the use of BMPs. The impacts associated with this project would be short term, non-significant soil disturbance.

Redeveloping each water would require disturbance of an area of approximately 10 by 20 meters (33 by 66 feet). Redeveloping all 12 waters would thus involve temporarily disturbing 2,400 square meters (25,800 square feet) of the soil surface. This impact would be mitigated through the use of BMPs and the short period of disturbance, not more than three days for most installations. The impacts associated with the 12 redevelopment projects would be short term, non-significant soil disturbance.

Alternative 5

Implementing Alternative 5 would result in redevelopment of 12 developed waters on the refuge, as well as construction of some new developed waters. This construction would include excavation of space for buried tanks and water lines. Impacts of such redevelopment and development of new waters would be similar to those described above for Alternative 4. Under this alternative, pull-offs and two new developed campsites will be developed in non-wilderness along Charlie Bell Road. These development projects will involve disturbing less than one hectare (2.5 acres) of land and will be sited on areas with flat topography to minimize impacts. No significant impacts are anticipated.

4.1.3.2 Cryptogammic Soil

Cryptogammic soil crusts, also known as cryptogam, occur widely on valley floors in the refuge. These tiny, black, irregularly raised pedestals in the sand are self-sustaining biological communities essential to the ecology of arid lands. They reduce erosion, fix nutrients, and increase water absorption, creating a more hospitable environment for other plants. Cryptogammic soils are fragile and very susceptible to damage from trampling and compaction (National Outdoor Leadership School 1994). Potential impacts to cryptogammic soils are primarily related to back country recreational use and illegal off-road travel, both vehicular and pedestrian, in the refuge by smugglers and UDAs.

While no refuge-wide survey for cryptogam has yet been undertaken, it is possible to estimate the refuge base of potential of cryptogam habitat. This is essentially all of the refuge having a soil substrate, that is to say, something other than bare rock, coarse gravel or shifting sand (drainage ways and sand dunes). The extent of such habitat is somewhat more than one half of the total refuge area, or approximately 192,300 hectares (475,000 acres). Within suitable habitat, the coverage of cryptogam varies considerably from absent to near total coverage. As data on the presence of cryptogam is missing, this analysis considers any vehicle use, walking or pack/saddle stock use in cryptogam habitat as a potential impact to cryptogam. Due to the fragile nature of cryptogam and its importance as nutrient fixer and living mulch in desert ecosystems, disturbance of more than one percent of the refuge cryptogam habitat (1,923 hectares [4,750 acres]) is considered a significant impact.

The continuing impact of illegal travel on the refuge is uncertain. CBP-BP activity and personnel levels were greatly increased in the summer of 2004 as part of the Arizona Border Control Initiative (ABC) in an effort to control the flow of UDAs into Arizona. The ultimate outcome of this effort can not yet be determined.

Alternative 1, No Action Scenario

The greatest existing impacts to cryptogam result from illegal travel on the refuge, by UDAs and smugglers. The estimated area heavily impacted by illegal foot travel and vehicle use is 61,540 hectares (152,000 acres), or approximately 32 percent of the total cryptogam habitat on the refuge. This significant degradation of cryptogam habitat is beyond the control of refuge management. The ABC Initiative and proposed vehicle barrier may reduce future levels of degradation, allowing slow reestablishment and recovery of cryptogam. If effective, these provisions should be considered cumulative benefits of refuge management.

Under the no action scenario, a small amount of cryptogammic soil is trampled each year by visitors to the refuge back country. The number of backcountry visitors is small (of a total 3,000 or fewer refuge visitors each year, fewer than 5 percent, or 150, travel any distance from the public access corridors on foot), thus the impact is also small. Trampling of cryptogammic soil by legitimate backcountry visitors (a direct impact of refuge operation) should be considered negligible as compared to that caused by illegal foot and vehicle traffic on the refuge.

Alternative 2

Implementing this alternative would decrease the level of impact to cryptogammic soil by refuge visitors below that of the no action scenario, as visitation would drop under this alternative and Leave-No-Trace information provided to all refuge visitors would contain information about avoiding damage to cryptogam. Impacts for cryptogam from refuge visitors and management should be considered direct and long-term but not significant. The far greater impact of illegal travel on the refuge would remain unchanged under this and all other action alternatives.

Alternative 3

Implementing Alternative 3 would also decrease level of impact to cryptogammic soil by refuge visitors below that of the no action scenario, as visitation would be somewhat lower than the existing condition and Leave-No-Trace materials would given to all visitors. Once again, this impact would be non-significant and negligible when compared to the level of ongoing impact attributable to illegal travel on the refuge.

Alternative 4 (Preferred alternative)

Implementing Alternative 4 would increase the level of impact to cryptogammic soils by refuge visitors and refuge management slightly above that of the no action scenario. This potential increase reflects both a slight increase in visitation, mitigated by provision of Leave-No-Trace materials, and the possibility that some cryptogammic soils would be damaged during redevelopment of 12 developed waters. Overall impacts to cryptogammic soils that would result from implementing this alternative would be non-significant and modest, particularly in as compared to impacts caused by illegal traffic.

Alternative 5

Implementing Alternative 5 would increase the level of impact to cryptogammic soils by refuge visitors and refuge management above that of the no action scenario. This potential increase reflects an increase in visitation, a waiving of the requirement of a special use permit for pack stock, the possibility that some cryptogammic soils would be damaged during redevelopment of 12 developed waters, and the possibility

that some cryptogamic soils would be damaged during the construction of new developed waters. The impacts of pack stock are not expected to be great, as there has not been a high demand for horse or burro packing on the refuge. Once again, this impact would be non-significant, and modest, as compared to the level of ongoing impact attributable to illegal travel on the refuge.

4.1.4 Water Resources

4.1.4.1 Surface Water

There are no naturally occurring perennial bodies of water on the refuge. Natural surface water is limited to occasional rapid runoff events after rainstorms, ephemeral pools in playas and tinajas (depressions in rock that collect and hold water after rains). In addition to naturally occurring ephemeral surface waters, there are 34 developed waters for wildlife on the refuge. These include 11 tinajas (rock basins that collect and hold runoff), two charcos (dirt basins with associated storage tanks and metered drinking troughs), 10 wells with drinking troughs, 10 underground storage tanks with collection systems and drinking troughs, and one parabolic collector (a self-contained fiberglass water collection and storage vessel with a wildlife drinking opening). Some of the developed waters are entirely new sources of surface water, while others are enhancements to existing natural tinajas. The waters have been developed to benefit a focus species at the refuge (13 are targeted to supply water to desert bighorn sheep, 19 to Sonoran pronghorn and two supply water to both species), but also affect other species. Any additional water sources in the dry Sonoran Desert are noticed and exploited by a variety of wildlife species, as well as by smugglers and UDAs crossing the desert, as has been documented by automated cameras periodically placed at the waters. These developed waters, however, are not considered to measurably affect the overall refuge surface water hydrology, given their small size in the context of the refuge.

Significant impacts to refuge water resources are those that alter surface drainage patterns for an area exceeding 5 hectares (12 acres) or materially add or detract from the baseline water supply.

This analysis of surface water resources includes consideration of effects to drainage patterns and watersheds during dry conditions, as well as direct effects to water. Roads and administrative trails that cross drainage ways can introduce a new source of sediment and alter flow regimes by diverting runoff from natural channels into depressed roadways. While no alternative proposes development of new roads or trails, considerable road development is occurring on the refuge from illegal vehicle use. These new roads may intercept sheet runoff, diverting moisture from areas down-slope. This phenomenon, while not yet formally studied for demonstrated to occur on the refuge, has the potential to adversely affect vegetation down-slope from roads by capturing and diverting water supplies (Hall *et al.* 2001, R. DiRosa, USFWS, pers. comm.). The level of illegal road development that occurs on the refuge is beyond management control, and is not likely to vary among the management alternatives. Should border law enforcement operations and a vehicle barrier succeed in reducing or eliminating future illegal road development the refuge would work to restore the old illegal roads to their natural contour.

During the duration of an experimental study being conducted by the University of Arizona, three desert bighorn sheep waters in the Sierra Pinta Mountains, North Pinta, Eagle and Heart Tanks, received no supplemental water. The study terminated in 2005, due to shortage of funds. The refuge is currently evaluating the study results to determine if there is sufficient data make a determination of whether or not to resume hauling water to these tanks. This decision will reflect the study results and the management alternative implemented.

Alternative 1, No Action Scenario

Under the no action scenario, refuge staff maintains each of the developed waters and 25 are supplied, at least occasionally, with supplemental water during dry periods. These 25 (22 during the University of Arizona study) waters are perennial or nearly perennial water sources, and may be the only sources of

surface water on the refuge during much of the dry season. Although these water sources benefit many wildlife species (see discussion under 4.2, Habitat and Wildlife Resources), their overall importance in a landscape context is limited. All 34 waters, when filled to capacity, provide somewhat less than 0.1 hectare (0.25 acre) of water surface in a refuge of 348,182 hectares (860,010 acres).

Alternative 2

Implementing this alternative would result in cessation of maintenance and supplemental water supply to the 10 developed waters in wilderness desert bighorn sheep habitat. Refuge staff would continue to maintain and supply water to the Tule Well and Childs Mountain parabolic tank, two desert bighorn sheep waters outside of wilderness, the 19 developed waters in Sonoran pronghorn habitat, and the two waters used by both species.

The 10 developed waters not receiving maintenance or supplemental water would initially cease to be perennial surface waters, but several would hold water for varying periods after rainfall. Over longer periods they would likely become filled with sediment. The resulting reduction in capacity would shorten the period during which they hold surface water. While this reduction in refuge waters would affect wildlife populations, and might affect UDAs who use the waters in emergencies (see Sections 4.2, Habitat and Wildlife Resources and 4.7.2, Social Consequences), it would not be significant on a refuge-wide basis due to the very small area of surface waters that would be affected.

Alternative 3

Implementing Alternative 3 would result in continued maintenance of all 25 developed waters currently maintained by refuge staff. Developed waters in Sonoran pronghorn habitat would continue to receive supplemental water sufficient to keep them from going dry. The 10 waters (7 waters during the University of Arizona study) in wilderness desert bighorn sheep habitat, however, would receive supplemental water only during periods of extreme drought (defined as a Palmer Drought Index of less than negative three). Under this regime these 10 developed waters would likely go dry periodically, but would be ephemeral sources water after rains and after water hauling during extreme drought. As stated above for Alternative 2, the small decrease in perennial waters that would result from implementation of this alternative, while potentially affecting some species and UDAs transiting the refuge, would not be a significant change in refuge water resources due to the very small area of surface waters that would be affected.

Alternative 4 (Preferred alternative)

Implementing Alternative 4 would result in continued maintenance of and occasional water supply to all 25 developed waters currently maintained by the refuge (water will be supplied to 22 during the University of Arizona study). When the results of the study are available, the refuge may develop additional waters in desert bighorn sheep habitat or discontinue maintenance and water supply to some existing waters in that habitat, depending on the study results. The upgrades to developed waters proposed to enhancing their efficiency and reduce their visual impact should not alter their status as perennial surface water sources on the refuge.

The overall effect of implementing this alternative on refuge waters would thus be identical to that of the no action scenario.

Alternative 5

Implementing Alternative 5 would result in continued maintenance of and water supply to all 25 developed waters currently maintained by the refuge (water will be supplied to 22 during the University of Arizona study). Under this alternative four to six additional developed waters would be created in desert bighorn habitat in the Growler, Granite and southern Sierra Pintas Mountains. As in Alternative 4, upgrades to

developed waters proposed to enhancing their efficiency and reduce their visual impact should not alter their status as perennial surface water sources on the refuge.

The additional developed waters proposed in this alternative, while potentially benefiting desert bighorn sheep and other wildlife species, would not significantly alter the overall refuge water resources.

4.1.4.2 Ground Water

Ten wells on the refuge are either currently used to supply wildlife drinking water and irrigation water to Sonoran pronghorn forage enhancement plots or are scheduled for redevelopment for those purposes. The increased well pumping volume needed to irrigate forage plots may locally depress water tables in the eastern portion of the refuge, the volume of pumping proposed, however, is very small in comparison to residential well pumping in the town of Ajo, immediately east of the refuge. Ground water pumping would be the same under Alternatives 1 through 4 and slightly higher under Alternative 5.

4.2 HABITAT AND WILDLIFE RESOURCES

4.2.1 Biotic Community and Biodiversity

The refuge is located at the junction of two of the six subdivisions of the Sonoran Desert (Brown 1994), the Lower Colorado Valley and the Arizona Upland subdivisions. This provides relatively high plant and animal species diversity. The greatest threats to the biological community integrity and biodiversity historically have been changes in plant composition in responses over grazing by domestic animals (Hall *et al.* 2001) and wildlife disease introduced by domestic animal vectors (J. Morgart, UFWS, pers. comm.). Recent threats include proliferation of non-native invasive plant species and alteration of drainage patterns by illegal road development (Hall *et al.* 2001). According to estimates developed by refuge staff, approximately 3,900 hectares (9,600 acres) are infested with Sahara mustard; approximately 55 hectares (135 acres) are infested with fountain grass and buffelgrass occurs, at lower than infestation levels, on approximately 810 hectares (2,000 acres). Significant alterations of biotic community and biodiversity include any actions that would result in loss of any native species currently occurring on the refuge.

Alternative 1, No Action Scenario

In order to detect any changes in conditions, the refuge formerly operated eight meteorological instruments that recorded precipitation, temperature, and humidity. These instruments all became dysfunctional and cannot be used until funds are acquired for their repair. The refuge established vegetation transects in 2002 for repeat monitoring to detect changes in the refuge plant community. Between 30 and 60 head of cattle typically trespass on the refuge each year. When domestic animals are found on the refuge they are removed as quickly as possible, either by contacting the owner, if known, or by humane disposal.

Existing impacts to the biotic community and biodiversity include disruption of drainage patterns by illegal road creation in areas naturally characterized by sheet flow (as described above in Section 4.1.4.1, Surface Water), infestation by non-native plant species, lingering effects of past overgrazing, and introduction of invasive plant species and diseases by trespass domestic livestock. The first two impacts significantly affect the biotic community and biodiversity of the refuge. Past overgrazing, while having created significant changes to the refuge biotic community and biodiversity, currently has a slowly decreasing effect on the refuge, as the refuge habitats recover from overgrazing. Valone *et al.* documented that recovery of perennial grasses in desert grasslands can take considerably longer than 50 years after livestock removal (2001). The importance of trespass livestock effects is low, due to the low number of animals currently entering the refuge and the refuge's ability to remove the animals fairly quickly.

Drainage alteration through road creation is a direct result of illegal travel across the refuge by UDAs and smugglers and is well documented (see figure 4.1 for a map of road development). Illegal travels are also likely responsible for much spread of invasive plants, as the seeds and other propagules of such plants adhere to clothing and vehicles and can be spread from roadsides by travelers. As the volume of illegal travelers on the refuge far exceeds that of authorized visitors or refuge management travel, illegal travelers have the greatest potential to introduce invasive plant species. These two significant impacts to the refuge biotic community and biodiversity are beyond the scope of any controls proposed in the management alternatives. Should border law enforcement activities and future construction of a vehicle barrier greatly reduce the level illegal travel through the refuge, the cumulative result would be reduction in new invasive plants introduced into the refuge. Existing infestations would likely continue to flourish.

Climate and vegetation transect monitoring efforts are aimed at establishing a baseline of information on desert conditions, invasive species infestations and plant community composition. When baseline information has been established, changes can be detected and analyzed to allow management responses. The current monitoring program, however will not directly affect the refuge biotic community or biodiversity. Monitoring programs should yield indirect, long-term beneficial effects through fostering more efficient management.

Alternative 2

Under this alternative the programs of the no action scenario would be continued. The environmental consequences would be similar to those of the no action scenario.

Alternative 3

Under this alternative the programs of the no action scenario would be continued. Additionally, the refuge would invite partners to develop experimental desert restoration sites in refuge non-wilderness. If successful restoration techniques can be developed, they would be implemented to restore degraded sites on the refuge. Under this alternative the refuge would work with the Air Force and the Arizona Department of Transportation to develop wildlife travel corridors across BMGR and State Highway 87 to link fragmented habitats.

If desert restoration experiments prove to be successful, important restoration of native habitats could result, this would be a direct, long-term beneficial effect. Re-joining fragmented habitats via wildlife travel corridors could provide a long-term benefit to wide-ranging wildlife species such as Sonoran pronghorn. In the species' current severely depleted status, however, making additional habitat available would be of limited value, as the available habitat is more than sufficient for the existing size of the populations (Krausman 2004).

Alternative 4 (Preferred alternative)

Under this alternative, the refuge would implement the programs of the no action scenario. Additionally, the refuge and the Regional Office remote sensing scientist would implement a change detection analysis program.

This program would use aerial photography sampling (i.e., photography will be taken of a random sample of the refuge, as full photographic coverage of the refuge would be too large to effectively analyze). Analysis of photography would be completed every two years and comparison of photography from different years and archival photography would allow identification of changes in vegetation community composition and density. The data generated by this monitoring project would be tracked to identify existing sources of change and evaluate their causes and importance.

The refuge would also implement a program of inspecting staff clothing and vehicles for plant seeds prior to refuge entry to limit the spread of invasive plants.

The proposed change detection analysis would have no direct effect on refuge resources, but would allow identification of areas where unnatural changes in vegetation cover or composition are occurring. A management response could then be initiated. The program of inspecting clothing and vehicles for seeds, while appropriate, would probably have little impact compared with the volume of non-native plants introduced to the refuge by illegal entrants to the refuge. Some stakeholders have argued that supplying water to developed waters creates an artificial situation and detracts from ecological integrity. The Service believes management interventions such as supplying water sources can be consistent with restoring overall ecological integrity when wildlife populations have been decimated by outside, anthropogenic factors (Schroeder, *et al.* 2004).

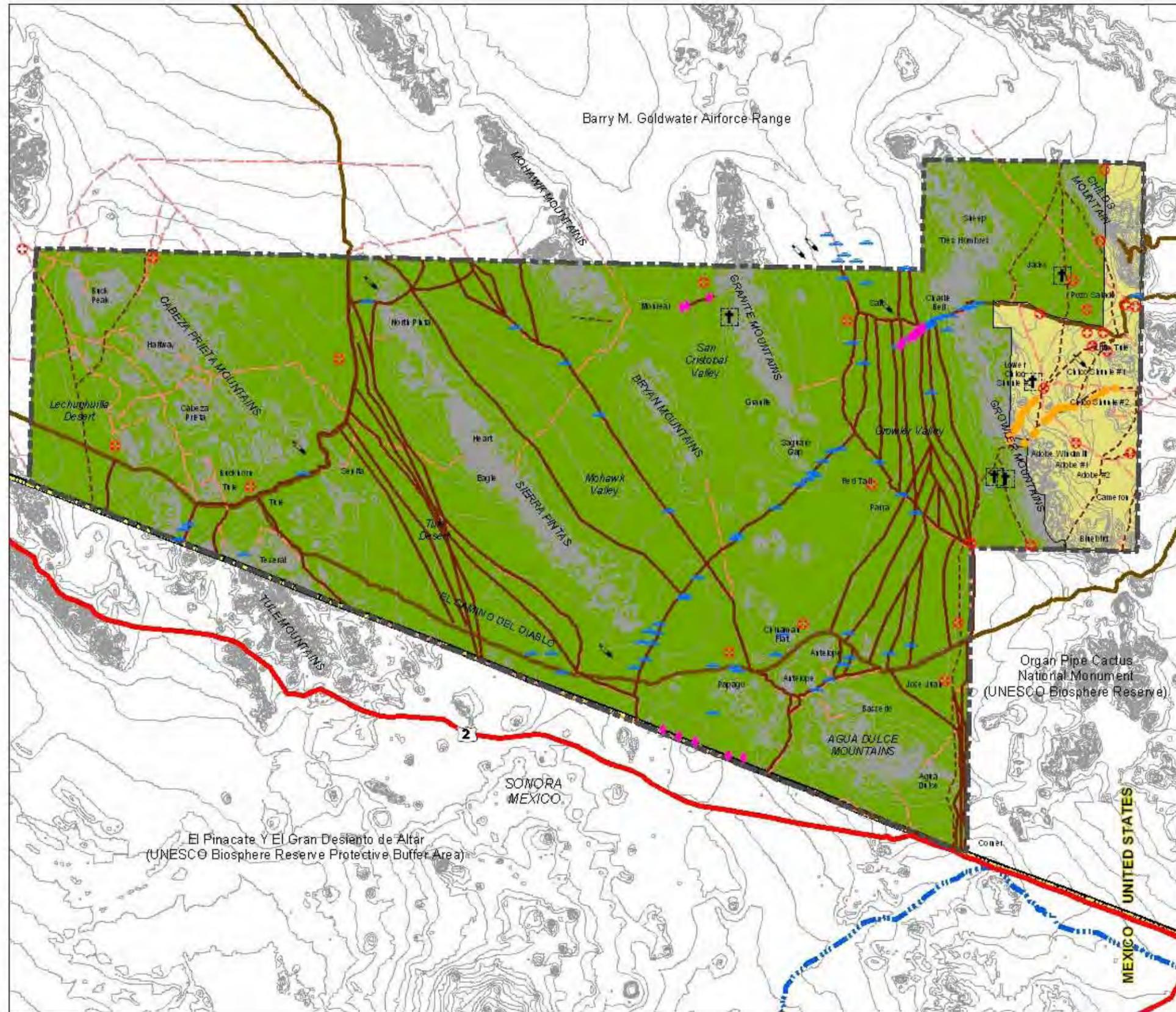
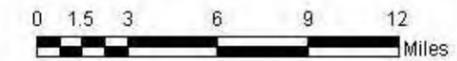


Figure 4.1 Areas of Disturbance Related to Illegal Border Crossing

Legend

- Cabeza Prieta N.W.R.
- Wilderness
- Non-Wilderness
- Public Roads
- Administrative Trails
- US/Mexico Border
- Highway
- Rio Sonoyta
- Illegal Vehicle Route
- Illegal Walking Route
- ◆ ATV/Motorcycle Tracks
- Trash
- Abandoned Vehicles
- ⊕ Emergency Rescue
- Drug Seizure
- † Death

Sources: USFWS, 2003



**CABEZA PRIETA
NATIONAL WILDLIFE REFUGE**

COMPREHENSIVE CONSERVATION PLAN

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH & WILDLIFE SERVICE

Alternative 5

In addition to the measures described for Alternative 4, the refuge would implement refuge-wide resource mapping. This mapping would allow positive identification of areas with degraded or intact ecological communities, facilitating remediation and study. Once again, this program would not directly affect refuge resource, but should have the indirect, long-term effect of enhancing restoration efficiency. The argument regarding supplying water discussed above for Alternative 4 also applies to this alternative.

4.2.2 Plant Resources

Current plant conservation efforts at the refuge are limited to monitoring and modest invasive plant control efforts.

Alternative 1, No Action Scenario

The refuge established vegetation transects in 2002 for repeat monitoring to detect changes in the refuge plant community. Refuge staff has been trained to recognize the most common invasive plant species that occur on the refuge and document their location when encountered in the field. The refuge controls small infestations of fountain grass, an invasive species with the potential to become widely established on the refuge, by hand pulling newly established patches as they are located.

As discussed above in section 4.2.1, Biotic Community and Biodiversity, the vegetation monitoring program would not yield any direct effect on refuge plant resources, but should yield indirect long-term benefits through allowing identification of trends and thus facilitating management responses. Hand pulling fountain grass should mitigate the negative effect that infestations of this invasive plant create upon the native plant community.

Alternative 2

The no action scenario monitoring and fountain grass programs would be continued under this alternative, yielding the same consequences.

Alternative 3

Under this alternative the programs of the no action scenario would be continued. Additionally, the refuge would invite partners to develop experimental desert restoration sites in refuge non-wilderness. If successful restoration techniques can be developed, they would be implemented to restore degraded sites on the refuge.

In addition to the consequences described above for the no action scenario, implementation of this alternative has the potential to benefit plant resource abundance and diversity, should effective desert restoration techniques be developed. This would be an indirect, long-term benefit for implementing Alternative 3.

Alternative 4 (Preferred alternative)

In addition to the programs of the no action scenario, this alternative would include the change detection analysis sampling described for Alternative 4 in Section 4.2.1, Biotic Community and Biodiversity above. Implementing this analysis program would not directly affect refuge plant resources, but it would allow rapid identification of changes in the refuge plant community and facilitate adaptive response to a greater than would the transect sampling described for the no action scenario. The net effect should be a long-term, indirect strongly positive result for refuge plant resources.

Alternative 5

This alternative would include the programs of the no action scenario, the change detection analysis sampling described above for Alternative 4 and refuge wide resource mapping. The resulting spatial data, used in conjunction with the change detection analysis, would allow even greater precision in identifying areas for management and remediation efforts. This would not cause direct effects on refuge plant resources, but should result in the greatest long-term, indirect benefit to refuge plant resources of any preferred alternative.

4.2.3 Mammals

The management programs for mammals are primarily described in the sections addressing Sonoran pronghorn, desert bighorn sheep, lesser long-nosed bat and California leaf-nosed bat. Any effect that reduces the mammalian diversity or decreases the population of a rare or declining mammal by more than 10 percent (to accommodate natural variation population levels) is considered significant.

Alternative 2

Cessation of water hauling to ten wildlife waters in wilderness desert bighorn sheep habitat, as proposed in this alternative, would adversely affect wildlife populations. Many species have become habituated to these water resources. While the exact amplitude of this impact is not readily ascertainable, many mammalian species other than desert bighorn sheep have been documented to use these waters (J. Morgart, USFWS, pers. comm.). Populations of these species would be adversely affected by allowing the water holes to go dry.

Alternative 3

Reduction of water hauling to ten wildlife waters in wilderness desert bighorn sheep, as proposed in this alternative would adversely affect wildlife populations. As mentioned above for Alternative 2, many species have become habituated to these water resources. While the exact amplitude of this impact is not readily ascertainable, many mammalian species other than desert bighorn sheep have been documented to use these waters (J. Morgart, USFWS, pers. comm.). Populations of these species would be adversely affected by allowing the water holes to go dry periodically.

Alternative 4 (Preferred alternative)

Under this alternative, the refuge would implement a population survey program for mule deer. If mule deer were determined to exist in populations large enough to sustain a hunt, a limited hunt would be established, when Sonoran pronghorn have recovered to the extent that such a hunt would not adversely affect pronghorn populations.

The population survey procedure would not directly affect the refuge mule deer population, but is proposed to gain additional knowledge of refuge wildlife resources. The direct effect of a mule deer hunt would be a reduction in the refuge mule deer population, as determined consistent with refuge management goals. Additionally, no hunts would be allowed for several years, given the endangered status of the Sonoran pronghorn and the requirement that any hunt not adversely affect that species.

Alternative 5

This alternative would implement the population survey and possible hunting program for mule deer described above for Alternative 4, as well as a potential small game hunt. The small game hunt would be expected to draw only a small number of hunters willing to hunt in wilderness for dove, quail and rabbit.

4.2.3.1 Federal Threatened and Endangered Species

4.2.3.1.1 Sonoran Pronghorn

As U.S. population of Sonoran pronghorn is critically endangered, any negative effect is considered significant

Alternative 1, No Action Scenario

The no action scenario and the five action alternatives all implement the Sonoran pronghorn recovery plan. The direct effects upon Sonoran pronghorn of implementing each should therefore be similar and positive. Differences in approach among the alternatives, however, result in some differences in effects.

Illegal cross-border travel through the refuge, as well as the law enforcement response to that activity, has undeniably effected the Sonoran pronghorn population. Refuge law enforcement personnel and field biologists report tremendous increases in illegal traffic through the refuge over the last five years (R. DiRosa, USFWS, pers. comm.). Although the numbers may be somewhat misleading due to recently increased enforcement efforts, records of apprehensions and arrests by the CBP-BP support this observation. Estimates of illegal travelers crossing through the refuge increased from 4,366 in 2001 and to 8,069 in 2002 (R DiRosa, USFWS, pers. comm.). While no estimates were available for 2003, refuge staff engaged in periodic aerial reconnaissance report that trail development in the Growler Valley increased dramatically between early 2003 and early 2004, suggesting continued increases in illegal traffic volume (C. McCasland, USFWS pers. comm.). As the volume of cross-border traffic has increased, so has the law enforcement effort, including high-speed chases in the refuge back country. As mapped by the refuge (see figure 4.1) much of the illegal traffic impact occurs in the Mohawk and Growler Valleys, which also have some of the highest Sonoran pronghorn use on the refuge. Due to the potential harm to Sonoran pronghorn caused by human presence those areas of OPNM, BMGR, the refuge and adjacent BLM recreation areas used by pronghorn have been closed to recreational access during the Sonoran pronghorn fawning season since 2002. The increased level of human activity in Sonoran pronghorn habitat related to illegal border traffic and its interdiction produces a significant impact on pronghorn. Additionally, as discussed above in Section 4.2.1, Biotic Communities and Biodiversity, the vehicle use in this area degrades vegetation, reducing the area's habitat value. These long-term, adverse effects on the population should be considered to exist for all management alternatives.

The ABC Initiative will increase border law enforcement use of motorcycles and all terrain vehicles in the Growler Valley. While the exact response of Sonoran pronghorn to humans or vehicles is not fully understood, fast moving, loud vehicles such as motorcycles have been documented to produce a strong flight response in Sonoran pronghorn (Hughes and Smith 1990, Krausman *et al.* 2001). Increased use of motorcycles and all terrain vehicles under ABC should thus have a negative impact on Sonoran pronghorn. This impact will be the same for all preferred alternatives and should be considered a significant, cumulative effect.

The recovery plan for Sonoran pronghorn calls for maintaining active radio collars on 10 percent of the U.S. population. Currently there are active radio collars on two pronghorn. Other components of the recovery plan currently implemented include continuing to provide perennial water sources within the Sonoran pronghorn habitat on the refuge, maintaining a semi-captive breeding enclosure, stocking the enclosure with local and Mexican sub-populations breeding stock, and experimental establishment of forage enhancement areas.

The consequence of having radio collars on only two Sonoran pronghorn is a reduced ability to monitor the population effectively and track movement of individual animals. Over time this handicap would erode management's knowledge of the population's response to various treatments or environmental conditions,

resulting in less effective management. The effect on the Sonoran pronghorn population is difficult to determine, but a long-term direct impact of reduced management efficiency leading to possible decreased population viability could occur. Adverse events, such as periods of extreme drought or disease outbreaks would have a greater decimating effect on the population due to reduced ability to identify and address populations' responses effectively.

The continued provision of perennial water sources and enhanced forage areas should produce a direct, long-term benefit to the Sonoran pronghorn population by increasing recruitment (the survival of fawns to breeding age) during periods of drought. Fox *et al.* conducted a study of water and nutrient content of forage in Sonoran pronghorn habitat in Arizona (2000). They concluded that water content of forage on the eastern third of the refuge was insufficient to meet Sonoran pronghorn water requirements during drought. Given that fawns, pregnant does and lactating does have greater water requirements than the species average (Krausman 2004), the need for perennial water and an enhanced forage base to maintain population recruitment is apparent. A recent study suggested that selective forage of chainfruit cholla cactus by Sonoran pronghorn during droughts, due to its potential water content, may reduce recruitment in the population, as this plant has little nutritional value, high selenium levels, and is probably not sufficient for growing fawns (Bright and Hervert 2005).

Alternative 2

Implementing Alternative 2 would continue the no action scenario provisions, with the addition of Sonoran pronghorn collaring operations in non-wilderness only when conditions are favorable. Low temperatures, recent rain and good forage condition are considered favorable conditions for collaring operations. Based on field experience Service and AGFD biologists believe that collaring operations in favorable conditions should not result in Sonoran pronghorn mortality from capture myopathy (J. Morgart, USFWS, pers. comm.). All collaring operations would take place outside of wilderness.

The only change in consequences from those of the no action scenario caused by implementing Alternative 2 would be the long-term gain in data on Sonoran pronghorn movements yielded from radio collaring. The proposed practice of collaring only animals found in non-wilderness data, however, could bias the data through selection of a non-representative sample of the population for collaring. This could result in a direct, long-term adverse effect on the U.S. population of Sonoran pronghorn, if biased sampling results in management responses that benefit only a small, non-representative subset of the population (Krausmann 2004).

Alternative 3

Implementing Alternative 3 would result continued water supply to developed waters in Sonoran pronghorn habitat, with the exception that water would be hauled to Jose Juan and Redtail Charcos only during periods of severe drought (Palmer Drought Index of negative three or lower). The recovery goal of having 10 percent of the U.S. Sonoran pronghorn radio collared would also be implemented, with capture and collar operations taking place when weather conditions are appropriate, with no restrictions on collaring in refuge wilderness.

This alternative would also implement actions focused on the Service's working with other agencies (BLM, Arizona Department of Transportation, Air Force) to encourage changes off-refuge to assist Sonoran pronghorn recovery. These changes would include eliminating fencing and establishing travel corridors for Sonoran pronghorn to the east and north, as well as establishing developed waters in BMGR non-wilderness areas adjacent to the refuge wilderness.

Alternative 3 would also support habitat restoration research in non-wilderness areas on the refuge. Any restoration techniques demonstrated to be successful would be implemented on disturbed sites on the refuge, upon receipt of environmental clearances.

Alternative 3 would implement annual pathogen sampling in the developed waters and predator study and control. Monitoring wildlife water catchments in the Sonoran Desert for pathogens has been recommended (Broyles 1995).

Implementing Alternative 3 would initiate radio collar studies of coyote, focusing on their use of refuge developed waters and movement in relation to Sonoran pronghorn. When Sonoran pronghorn population numbers are less than 100 and winter and spring precipitation is less than 50 percent of average, the refuge would initiate selective removal of coyote.

The overall effect of implementing Alternative 3 upon the U.S. Sonoran pronghorn population should be slightly superior to that of the no action scenario. Radio collaring pronghorn throughout their range on the refuge will allow more effective research and survey actions, without the sampling bias described under Alternative 2 above.

This alternative includes off-refuge actions that other agencies would be encouraged to undertake. The off-refuge placement of additional developed waters should improve the habitat if water is a limiting factor, as indicated by Fox *et al.* (2000). This benefit should be considered an indirect, long-term effect of refuge management. Establishing travel corridors to the north and east of the refuge could benefit the Sonoran pronghorn by allowing access to isolated portions of their former range, corridors generally have been considered beneficial when habitats are isolated or fragmented (Noss 1987). Any benefit from the corridors would not be realized in the short term, however, as currently available habitat should be sufficient to support the greatly depressed population of Sonoran pronghorn. The effect of the off-refuge corridors should thus be considered potentially positive, indirect, long-term effects.

The effect on Sonoran pronghorn of the proposed habitat restoration experiments and developed water pathogen monitoring are entirely dependent on the results of each. To date, habitat restoration projects on the refuge have been quite limited in size and have dealt with specific disturbed areas such as old roads. If experiments determine methods to restore large areas degraded by past overgrazing or encroachment of invasive species, benefits to Sonoran pronghorn, and other native wildlife would be great (Soule and Terborgh 1999). Refuge and AGFD staffs, however, are not optimistic about finding habitat restoration techniques for the refuge that involve acceptable levels of soil and plant disturbance (J. Morgart, USFWS, pers. comm., J. Hervert, AGFD, pers. comm.). The proposed pathogen monitoring in developed waters could yield benefits if pathogens harmful to Sonoran pronghorn are identified and eliminated. The necessity of monitoring developed waters on Cabeza Prieta; however, is questionable. Twelve developed waters at the nearby Kofa NWR have been monitored monthly for more than three years and no pathogens harmful to native wildlife have been detected (Krausman 2004). While the proposed water sampling may add to the body of knowledge concerning pathogens present in developed waters, it is unlikely to directly benefit the Sonoran pronghorn population.

The proposed coyote study and control should benefit the refuge Sonoran pronghorn population. Predation can be an important limiting factor on populations that are well below carrying capacity (Ballard *et al.* 2001), as is the case for Sonoran pronghorn on the refuge. The radio collaring studies of coyote proposed would increase the likelihood of effective coyote control through increased knowledge of coyote movements and den locations (Krausman 2004). This should be considered to yield a direct, long-term positive effect on the U.S. Sonoran pronghorn population.

The effect of restricting water deliveries to Jose Juan and Retail Charcos to periods of severe drought is questionable. These waters have been criticized as poorly suited for use by Sonoran pronghorn due to build-up of woody shrubs. Some pronghorn use of the charcos has been documented, however (J. Morgart, USFWS, pers. comm.). Allowing any developed water that has been used by Sonoran pronghorn to go dry is likely to cause negative effects on the population if water is limiting.

Alternative 4 (Preferred alternative)

Alternative 4 would implement annual pathogen sampling in Sonoran pronghorn developed waters, predator studies/control, and radio collaring of Sonoran pronghorn without wilderness restrictions as described above for Alternative 3. Implementing Alternative 4 would also result in refuge-wide survey for sites appropriate for additional Sonoran pronghorn developed waters, and development of additional waters at appropriate sites. Implementing Alternative 4 would also result in location and development of additional forage enhancement plots. Otherwise, this alternative would implement the Sonoran pronghorn recovery plan in the same manner as under the no action scenario.

The overall effect of implementing this alternative on the U.S. Sonoran pronghorn population would be similar to that of the no action scenario, with the additional positive impacts of unbiased radio collaring as described above for Alternative 3.

Alternative 5

Beyond the standard measures of the Sonoran pronghorn recovery plan included in all proposed management alternatives, implementing Alternative 5 would result in the following activities. The refuge and AGFD would conduct annual population surveys for Sonoran pronghorn, rather than the two-year survey interval currently used. More frequent surveys would allow more accurate tracking of the population and rapid identification of any population trends. This, in turn, would help in gauging population response to recovery activities. Implementing Alternative 5 would result in refuge-wide survey for sites appropriate for additional Sonoran pronghorn developed waters, and development of additional waters at appropriate sites. Implementing Alternative 5 would also result in location and development of additional forage enhancement plots. Finally, Alternative 5 would also implement annual pathogen sampling in Sonoran pronghorn developed water and predator studies/control, as described above for Alternatives 3 and 4.

Implementing Alternative 5 would provide additional beneficial effects to the U.S. Sonoran pronghorn population beyond those described for the no action scenario. Decreasing the population survey interval to one year would allow enhanced understanding of the relationship to environmental variable such as management treatment to basic life history through more up-to-date population size estimates (Caughley 1977). The availability of accurate, annual population estimates would facilitate fine-tuning of management treatments, resulting in a direct, and long-term positive effect on the U.S. Sonoran pronghorn population. Providing additional forage enhancements and developed waters should result in a direct, and long-term positive effect as well, if water and forage are limiting factors on the U.S. Sonoran pronghorn population, as is suggested by Fox *et al.* (2001).

4.2.3.1.2 Lesser Long-Nosed Bat

During June of 2003, the maternity colony of lesser long-nosed bats largely abandoned the known maternity roost on the refuge. A survey conducted in May 2003 found approximately 4,500 adult bats using the roost. This is slightly higher than average use. After the abandonment in June, only 100 to 200 bats remained. Refuge biologists believe that many bats abandoned the roost due to excessive human use of its entry. Signs identified by refuge biologists suggest that smugglers frequently use the roost entrance as a shelter or storage area (C. McCasland, USFWS, pers. comm.).

Alternative 1, No Action Scenario

Current management includes occasional law enforcement surveillance of the roost site to apprehend anyone using the roost for illegal activities and visits by biologists to confirm bat use of the roost. In the early spring of 2004, the refuge installed a steel fence ranging from 2.5 to 3 meters (8 to 10 feet) high around the roost entrance to discourage human entry. The fence is constructed of 2.5-centimeter (1-inch) vertical pipes welded to cross pipes at 13 centimeter (5 inch) intervals. The tops of the vertical pipes are cut at an

angle to produce a sharp point and the top 30 centimeters (12 inches) of the pipe is bent outwards. The sharp tops and outward bend should make climbing over the fence difficult. This fence should provide an immediate positive effect to bats that were displaced by human interference. Spring, 2004 reconnaissance indicated that approximately 4,000 female bats had returned to the roost. This return to historically high use of the roost suggests that, at least in this case, bats will return to a largely abandoned roost when human use is restricted.

All of the management alternatives include survey for additional lesser long-nosed bat maternity roosts on the refuge. Survey for maternity roosts is a recovery effort established in the species' recovery plan. Bats have been observed entering and exiting several small abandoned mine adits near the primary roost, but maternity use of these smaller adits has not been confirmed.

Alternatives 2 and 3

Alternatives 2 and 3 would include development of public information about the benefits of bats, such as plant pollination. While such information might be effective in fostering public support of bat conservation, it would likely have no beneficial effect on bats using the roost, as individuals using the roost in support of illegal activities would not be likely to be influenced by information about bats.

Alternative 4 (Preferred alternative) and 5

Under these alternatives a gate would be installed on the entrance to the roost, should unauthorized users circumvent the fence. The gate would be locked open during the bat's breeding and rearing season, as juvenile lesser long-nosed bats are poor fliers and are unable to pass through any grate that will prohibit human entry. The gate will contain grates passable by adult lesser-long nosed bat so that any bats that arrive early in the spring while the gate is still closed can access the roost. When bats are absent during the winter the gate will be locked closed to disrupt of human use. The gate would be a "second line of defense" to further deter any habitual users of the roost entrance who devise a method of climbing over or otherwise circumventing the fence.

4.2.3.2 Species of Conservation Concern

4.2.3.2.1 California Leaf-Nosed Bat

The management alternatives do not prescribe any specific management activities for conservation of this species. Populations of this species on the refuge are protected from mining and urban development, the greatest threats to the species. This protection from mining and urban development should be considered a direct, long-term, positive effect on any populations of California leaf-nosed bat occurring on the refuge, under all management alternatives.

4.2.3.3 Desert Bighorn Sheep

The desert bighorn sheep is considered a refuge focus species due to the large role that concern over the species' conservation played in establishing the refuge in 1939. The approach to managing desert bighorn sheep and the numerical population goals developed for sheep are major differences among the four action alternatives. Any effect that would reduce the long-term viability of desert bighorn sheep on the refuge is considered to be significant. The cumulative effect of noise and disturbance from illegal traffic through the refuge and the border law enforcement response is considerably less important for desert bighorn sheep than that described above in Section 4.2.3.1.1 for Sonoran pronghorn. Desert bighorn sheep occupy steep, mountainous habitat much less suitable for human travel than do pronghorn, so the impact of illegal traffic and law enforcement response is spatially distant from desert bighorn sheep, other than in mountain passes.

Alternative 1, No Action Scenario

Under the no action scenario there is no established numerical goal for the refuge desert bighorn sheep population. The refuge manages rather to sustain a “healthy breeding population of desert bighorn sheep.” Population estimates for the period 1993 through present (the only period when reliable estimates are available) range from a low of 323 sheep to a high of 480 sheep. The 95 percent confidence interval for these estimates ranges from 228 to 958 sheep (see table 3.4 in Chapter 3).

Present management actions for Desert Bighorn sheep include development of, maintenance of, and supply of water to 15 developed waters in sheep habitat; aerial population surveys every three years; an annual limited sheep hunt; and an experiment by the University of Arizona investigating sheep movement in response to water availability, currently in the data analysis phase. The water available in the developed waters surely is used by populations of many mammal species, although the exact effect of such use is not known.

The result of refuge management has been an increase in desert bighorn sheep population to a level considerably greater than the available estimates of 100 to 150 sheep at refuge establishment in 1939. The recent trend documented by consistent survey methods, however is of a steady, slow, decline in the refuge desert bighorn sheep population between 1993 and 2002, followed by a small increase in 2005. The decline roughly coincides with a period of drought in southwestern Arizona, and decreases in desert bighorn sheep may reflect decreased forage quality during dry periods.

The refuge has allowed a controlled hunt of desert bighorn sheep rams since 1968. The number of hunt permits is limited (it has ranged from 1 to 7 hunt permits per year since 1986) and tied to the refuge sheep population. Desert bighorn rams are hunted as trophy animals. Due to the rigorous conditions of hunting in the Cabeza Prieta wilderness, and the fact that only one desert bighorn ram hunting tag is issued to an individual in a lifetime, only old rams with large horns are typically taken by hunters on the refuge (J. Morgart, USFWS, pers. comm.). Such “trophy animals” are generally aged 10 to 16 years and have limited remaining breeding potential; their removal is considered to allow younger rams to become active breeders and not adversely affect population dynamics (Kelly 1980). The controlled hunt is thus not anticipated to result in any measurable decrease in the desert bighorn population, other than the removal of the animals actually taken, which are considered to be excess animals near the ends of their life spans.

Alternative 2

Implementing Alternative 2 would involve the adoption of a desert bighorn sheep population goal of 100 to 200 animals. This goal reflects the likelihood of a reduction in sheep population resulting from reduced management.

Under Alternative 2, the refuge would also cease to maintain and supply water to all of the desert bighorn waters in wilderness other than Charlie Bell Well and Bassarisc Tank, which are also used by Sonoran pronghorn. Other than these waters, the only developed water in desert bighorn sheep habitat that would continue to be maintained and supplied with water would be Childs Mountain Parabolic Collector, in non-wilderness. This alternative would include monthly aerial monitoring of the areas around each of the developed waters to identify any increase in mortality or changes in desert bighorn sheep movement in response to the cessation of water hauling. A final difference in management between this alternative and the no action scenario is that under Alternative 2 no desert bighorn sheep hunting would be allowed on the refuge.

The consequences to the refuge desert bighorn sheep population of implementing Alternative 2 would be a reduction in population size, potentially to a non-sustainable level susceptible to extirpation. Eliminating water hauling to and maintenance of developed waters in desert bighorn sheep habitat throughout the Cabeza Prieta wilderness would result in some or all of the waters going dry during annually or during

droughts. The precise consequences of this on refuge desert bighorn sheep populations is difficult predict, given the lack of data regarding water use by sheep. Krausman suggests that the proposed cessation of water hauling and maintenance could cause a decline in the desert bighorn sheep population, if water is a limiting factor (2004). While verification that water is limiting factor on the refuge has not been undertaken, water has typically been viewed as a limiting factor for desert bighorn sheep by researchers. Turner and Weaver state: "Lack of water is the single most limiting factor for bighorn herds in the desert. Bighorn will reluctantly move away from an area with a dried water source and attempt to reestablish themselves around a different water hole" (1980). Observations by multiple researchers suggest that desert bighorn ewes have "home waters" that they use repeatedly over many years (Simmons 1980). As the refuge developed waters have been supplying perennial or near perennial water for many years, ceasing to haul water may remove resources used habitually by the refuge desert bighorn sheep population. Finally, a group of academic wildlife biologists, state wildlife managers and federal wildlife biologists convened in 2000 to discuss long-term management of desert bighorn sheep at the refuge, were asked to predict the consequences of removing developed waters at the refuge. Although their responses varied, a consensus formed that the result would be population decreases, with increased possibility of eventual extirpation (Morgart unpublished data).

The potential for decreased numbers of desert bighorn sheep, should this alternative be implemented, should be considered a significant, direct, long-term consequence of the refuge management. The potential (although by no means certain) extirpation of the refuge desert bighorn sheep population should be viewed as an irretrievable loss of resources. Although a new population could be established through reintroduction from other existing stocks, the unique genetic characteristics of the refuge population would be lost.

Alternative 3

Implementing Alternative 3 would result in a refuge population goal for desert bighorn sheep of 250 to 300 animals. This range represents a density of animals per unit area of habitat roughly one half that of the prevailing average for desert bighorn sheep in Arizona. Lower density is considered appropriate given the moderate level of management intervention under this alternative. This range is within the 95 percent confidence interval for refuge population estimates (228 to 958), although it is lower than the lowest annual population estimate determined using the modern survey protocols (323).

Alternative 3 would include restriction of hauling water in wilderness to developed waters in desert bighorn sheep habitat. Such hauling would not be eliminated entirely, but rather restricted to times of severe drought (defined as times when the Palmer Drought Index value is negative 3 or less). In addition to limited water hauling in wilderness, Alternative 3 would implement a survey of non-wilderness desert bighorn sheep habitat on the refuge (the southeastern Growler Mountains and the eastern portion of Childs Mountain) for suitable water development sites. The refuge would continue to maintain and haul supplemental water to Charlie Bell Well and Bassarisc tank, which are used by Sonoran pronghorn as well as desert bighorn sheep, and the Childs Mountain parabolic collector, in non-wilderness.

Desert bighorn sheep hunting would continue to be permitted under this alternative, but only during years in which no drought-triggered water hauling occurred.

Many of the same concerns about disrupting habitual use of developed waters discussed for Alternative 2 apply to Alternative 3. Alternative 3's provision of water hauling during periods of severe drought, however may somewhat ameliorate those concerns, particularly if water should prove to be a limiting factor for desert bighorn sheep only during years of extreme drought. Conversely, if sheep become unaccustomed to using waters that periodically dry during moderate drought or between rains during average years, then supplying water during extreme drought years may have no benefit to desert bighorn sheep, because they would no longer be habituated to visiting the waters during dry periods. Some researchers have questioned the appropriateness of using the Palmer Drought Index in the Sonoran Desert due to high variability of rainfall with the region (Krausman, 2004).

This alternative would initiate predator studies, focusing on mountain lion and using radio collars to monitor predator movement and use of developed waters. This research is appropriate given documentation of recent mountain lion predation on the refuge (J. Morgart, USFWS, pers. comm.), and questions regarding water developments serving as predator sinks (Broyles 1995). Krausman states that a study to examine the predation relationship of desert bighorn sheep and mountain lion would be of value, but cautions that the study would be plagued by small sample size of mountain lions (2004).

The overall consequences to the refuge desert bighorn population of implementing Alternative 3 would likely be a direct, long-term decrease in population from that sustained under the no action scenario, but the magnitude of this decrease would be less than under Alternative 2.

Alternative 4 (Preferred alternative)

Implementing Alternative 4 would establish a refuge population goal for desert bighorn sheep of 500 to 700 animals. This range is within the 95 percent confidence interval for refuge population estimates observed during modern population surveys (228 to 958), although it is greater than the highest annual population estimate determined using the modern survey protocols (480). Krausman criticizes the range as possibly being too high to be maintained during times of drought (2004).

The initial water management regime under Alternative 4 would essentially maintain the no action scenario. The refuge would maintain and haul water to each of the developed waters in desert bighorn sheep habitat with the goal of preventing any water from going dry. In the longer term, this alternative would include upgrading each of the existing developed waters in wilderness to increase their water collection efficiency, reduce evaporation and reduce visual intrusion. When the results of the University of Arizona study of sheep movement in response to water availability, or other research, are available, the refuge will evaluate adding additional waters for desert bighorn sheep, or closing some of the existing waters, as indicated by research results. While a desert bighorn sheep management activity, closing some waters would likely have a detrimental effect on local populations of other wildlife species.

Alternative 4 includes a predator study program, as described for Alternative 3, and would maintain the desert bighorn sheep hunt program described for the no action scenario. Alternative 4 includes provisions for predator hunts on the refuge, but only when it has been determined that such hunting would not adversely affect the refuge Sonoran pronghorn population.

In the short term, the overall consequences to desert bighorn sheep of implementing Alternative 4 would be very similar to those of continuing the no action management scenario. The direct, long-term consequences to desert bighorn sheep of implementing this alternative should be superior to those of the no action scenario for two reasons. First, the findings of the University of Arizona water use study and other research would be used to identify beneficial water supply strategies. Second, development of improved water structures would allow water supply with less use of motor vehicles in desert bighorn habitat, thus reducing overall disturbance of sheep

Alternative 5

Implementing Alternative 5 would establish a refuge population goal for desert bighorn sheep of 900 to 1,200 animals. If 75 percent of this goal is not achieved within 15 years the refuge will be stocked with animals from other areas. This range overlaps only slightly with the 95 percent confidence interval for refuge population estimates (228 to 958). Seventy-five percent of the lower end of the goal is 675. Using the 95 percent confidence interval for the refuge population estimate, this number has been within the population estimate for three of the four years in which populations surveys were taken. It is thus unlikely that refuge stocking from off-site will occur.

The initial water management regime under Alternative 5 would essentially maintain the no action condition. The refuge would haul water to each of the developed waters in desert bighorn sheep habitat with the goal of preventing any water from going dry. In the longer term, however, this alternative would result in development of additional waters in desert bighorn sheep habitat on the refuge, particularly in the Growler Mountains and the southern Sierra Pintas. This alternative would implement a program of redeveloping the existing desert bighorn sheep waters to increase their water collection efficiency, reduce evaporation and reduce visual intrusion. The refuge would also install photovoltaic powered water level sensors with remote transmission capability, if available, to monitor the developed waters. Such sensors would facilitate ensuring that the developed waters do not go dry while avoiding any unnecessary hauling trips.

This alternative would also include forage enhancement for desert bighorn sheep. The refuge would survey desert bighorn sheep habitat for valleys or canyons in the mountain ranges that would be suitable as forage enhancement areas. Either by subtly redirecting runoff (in wilderness) or simply irrigating from a well, these areas would receive enhanced water supplies that would stimulate growth of grass or forbs as a source of additional sheep forage.

Alternative 5 includes a predator study program, as described for Alternative 3. Under Alternative 5, however, should the study program detect negative consequences to desert bighorn sheep from mountain lion predation, the refuge would initiate mountain lion control.

In the short term, the overall consequences to desert bighorn sheep of implementing Alternative 5 would be very similar to those of continuing the no action management scenario. The long-term consequences are more difficult to ascertain. The proposed additional developed waters should benefit the desert bighorn sheep population, provided that water is a limiting factor. It is the profession opinion of refuge biologists that otherwise suitable desert bighorn sheep habitat currently supports depressed populations due to the lack of reliable water sources. New water sources in the desert would also have the potential to increase some populations of other wildlife species. The consequences of the proposed forage enhancements would also not be easily determined. Proponents of this approach endorse it as having the potential to increase refuge carrying capacity for desert bighorn sheep (J. Hervet, AGFD, pers. comm.). Krausman, however, suggests that it is an unproven technique that approaches artificial feeding (2004). Artificial feeding can have negative consequences including the potential for disease transmission, disruption of animal movement patterns and distribution, alteration of community structure and general degradation of habitat (Dunkley and Cattet 2003). The proposed mountain lion control activity would have no beneficial effect desert bighorn sheep unless such predation is a limiting factor, considered unlikely by Krausman (2004). The provision to introduce animals from off-refuge populations if population goals are not met could negatively affect the refuge population through introduction of animals adapted to other conditions. Relocation of animals to under stocked or vacant habitats, however, has proven a successful management method for increasing desert bighorn sheep numbers in the Southwestern United States (Hansen *et al.* 1980)

The overall direct, long-term consequences to the refuge desert bighorn sheep of implementing Alternative 5 are thus difficult to ascertain given the presently available information. While there is some controversy regarding forage enhancement and predator control, the overall effect of implementing this alternative should be an increase in the refuge desert bighorn sheep population.

4.2.4 Birds

4.2.4.1 Species of Conservation Concern

4.2.4.1.1 Cactus Ferruginous Pygmy-Owl

The formerly endangered cactus ferruginous pygmy-owl has been recorded twice on the refuge. Currently (Alternative 1), refuge biologists conduct surveys for the owl periodically, as schedules allow. This practice

would continue under Alternatives 2 and 3. The direct consequences to cactus ferruginous owl of periodic monitoring are negligible. Should the monitoring program detect individual owls nesting on the refuge, conservation measures could be implemented and some positive affects could result. Thus the current monitoring, and that proposed under Alternatives 2 and 3 could yield indirect, long-term positive consequences for cactus ferruginous owl.

Implementation of Alternatives 4 (Preferred alternative) or 5 would result in development and use of a standard protocol for cactus ferruginous pygmy-owl surveys on the refuge. The use of a standard protocol may slightly increase the likelihood of verifying that the owl uses the refuge. The direct consequences to cactus ferruginous pygmy-owl of implementing Alternatives 4 (Preferred alternative) or 5 would be negligible. The monitoring program proposed under these alternatives, however, would have a greater likelihood of verifying the any presence of the species on the refuge, than would program of the no action scenario and alternatives 2 and 3. There would be thus a greater likelihood of indirect, long-term positive effects to cactus ferruginous pygmy-owl under Alternatives 4 (Preferred alternative) or 5 than under the no action scenario or alternatives 2 or 3. These effects would only occur, however, if the species uses habitats on the refuge.

4.2.4.1.2 Other Species of Conservation Concern

Some monitoring of various species identified as indicators of Sonoran Desert health by the Arizona Partners in Flight program or as Birds of Conservation Concern by the Service's Office of Migratory Bird Management would be conducted under each of the management alternatives. As discussed above for cactus ferruginous pygmy-owl, monitoring alone would not directly affect any of the species. The data gained by monitoring, over time, should inform management decisions. Monitoring should thus have an indirect, long-term beneficial effect on the monitored species.

Alternative 1, No Action Scenario

The refuge monitors LeConte's thrasher nests for reproductive success, renesting attempts and nest site characteristics. The Arizona Partners in Flight program lists this species as an indicator of Sonoran Desert health.

Alternatives 2 and 3

The refuge would continue to monitor LeConte's thrasher nests as described for the no action scenario.

Alternative 4 (Preferred alternative)

Under this alternative the refuge would continue to monitor LeConte's thrasher nests and also initiate additional bird monitoring. The new monitoring would include point counts for loggerhead shrike, Bell's vireo, gray vireo, crissal thrasher, yellow warbler, black-chinned sparrow and sage sparrow; determination of the age/size class of saguaros used by nesting by Gila wood pecker and glided flicker and collection of natural history information regarding cactus ferruginous pygmy-owl. The refuge would also monitor for golden eagle, prairie falcon and raven.

This enhanced monitoring would provide information on the status of several species listed by the Arizona Partners in Flight as indicators of Sonoran Desert health.

Alternative 5

Under this alternative the refuge would continue to monitor LeConte's thrasher nests and also initiate additional bird monitoring. The new monitoring would include distribution and status surveys for elf owl, Gila woodpecker, gilded flicker, loggerhead shrike, Bell's vireo, gray vireo, crissal thrasher, black-chinned

sparrow and sage sparrow; point counts for yellow warbler; determination of the age/size class of saguaros used by nesting by Gila wood pecker and glided flicker; study of habitat use by black-chinned sparrow, sage sparrow and Costa's hummingbird and investigation of natural history, juvenile dispersal, home breeding range and habitat use by cactus ferruginous pygmy-owl. The refuge would also monitor for golden eagle, prairie falcon and raven.

4.2.5 Reptiles and Amphibians

Alternative 1, No Action Scenario

The refuge will continue to survey abundance, distribution and breeding potential of amphibians, especially in developed waters. This survey should provide information about use of the developed waters by amphibians, but would provide little information about other use of refuge habitats by reptiles and amphibians.

The on-going amphibian surveys have no direct effect on the refuge amphibian populations. There are few potential indirect benefits to the populations, as no protected amphibian populations known on the refuge and management actions driven by other priorities, such as cessation of water hauling, are unlikely to be altered due to concerns over refuge amphibians.

Alternatives 2 and 3

No monitoring for reptiles or amphibians, other than described for the no action scenario, would be implemented under these alternatives.

Alternatives 4 (Preferred alternative) and 5

In addition to monitoring for amphibians as described for the no action scenario, under these alternatives the refuge would implement surveys for Gila monster, desert tortoise, chuckwalla, canyon spotted whiptail and rosy boa. The refuge would survey for the presence of flat-tailed horned lizard, an Arizona Special Status Species that has been documented to occur on Marine Corps lands to the west of the refuge.

This monitoring should provide valuable information about the presence and abundance of several reptile species on the refuge. While obtaining this information would not directly affect the reptile species in question, the data generated should establish a baseline for reptile species conservation programs. The ultimate effect of these alternatives should thus be indirect, limited positive long-term benefit to refuge reptile populations.

4.2.6 Invertebrates

No specific monitoring or management actions related to invertebrates would be proposed under the no action scenario or any of the action alternatives. Observations by refuge staff visiting developed waters for monitoring or water hauling suggest that non-native honeybees are plentiful around waterholes. A determination of whether honeybees are supported by developed waters at significantly higher levels than would otherwise exist, and if so, what effect this has on native invertebrates and plant pollination, is a suitable topic for future investigations.

4.2.7 Desert Pupfish

Although the endangered desert pupfish does not occur naturally anywhere on the refuge, a population of these fish is maintained in a refugium on the visitor center site. Native pupfish populations off-refuge should not be directly affected by the refugium. Should some of the native populations suffer extirpation or

extinction, however, a refugium population at the refuge would be important in reestablishing populations in the wild and recovering the species.

4.3 SPECIAL MANAGEMENT AREAS

4.3.1 Natural Register of Historic Places

One refuge resource is listed on the National Register of Historic Places. This is the El Camino del Diablo Trail National Register District, which crosses the southwestern portion of the refuge. This district is roughly one mile wide and is centered on the multiple paths of the original migrant trail. The trail does not exactly correspond with the path of the modern refuge road bearing the same name. Vestiges of the original trails, as well as the graves of travelers who died on the trail (mostly between the late Eighteenth and mid Nineteenth Centuries) are visible within the historic district. Any impacts to this resource are that eradicate vestiges of the historic trail are considered significant.

Under Alternative 1, the no action scenario, illegal traffic through the refuge has created the greatest damage to the historic character of the El Camino del Diablo Trail National Register District. Trail development by smugglers and UDAs crossing the district from north to south has obscured some of the wheel ruts left from early travelers. This degradation creates an irreversible and irretrievable loss of cultural resources. No change to this situation would be anticipated under any of the action alternatives. If an effective vehicle barrier is constructed along or near the refuge border (see Section 4.1.3.1.1, Off-road Vehicle Use, above), the resulting decrease in off-road illegal vehicular traffic should greatly reduce the level of future impact to this cultural resource, this would be considered a beneficial cumulative effect of refuge management.

4.3.2 Wilderness

The Arizona Desert Wilderness Act of 1990 designated 325,133 hectares (803,418 acres) of the refuge as federal wilderness. Under the provisions of the Wilderness Act of 1964 the wilderness character of these lands must be preserved. Although wilderness character is not defined in the Wilderness Act it generally is considered to include the following four traits:

- ***Untrammeled*** - wilderness is ideally unhindered and free from intentional modern human control or manipulation
- ***Natural*** - wilderness ecological systems are substantially free from the effects of modern civilization
- ***Undeveloped*** - wilderness has minimal evidence of modern human occupation or modification
- ***Outstanding opportunities for solitude or a primitive and unconfined type of recreation*** - wilderness provides opportunities for people to experience natural sights and sounds, solitude, freedom, risk, and the physical and emotional challenges of self-discovery and self-reliance (Leopold Institute 2004).

Section 2 (c) (4) of the Wilderness Act of 1964 established seven values of wilderness that contribute to wilderness value: recreational, ecological, geological, scientific, educational, scenic and cultural/historical.

As the largest National Wildlife Refuge Wilderness outside of Alaska, the Cabeza Prieta Wilderness has been a lightning rod for criticism, and support, of the Service's administration of designated federal wilderness (Ekker 2000). Due to this heightened national interest and controversy, wilderness impacts at Cabeza Prieta have greater contextual importance than would similar impacts occurring on a more obscure wilderness area. Impacts that permanently alter any of the attributes of wilderness character or wilderness value, or have a high potential to alter wilderness visitor's sense of wilderness character or values are considered significant.

Five general types of activity occurring on the refuge affect wilderness character and values. These are

military aircraft operating at low altitudes over the refuge, travel by UDAs and smugglers, border law enforcement, refuge management, and visitor use. Although the refuge has no direct control over military flights, illegal travel or border law enforcement, these activities considerably affect the wilderness resource. The consequences of these activities are analyzed for the no action alternative and remain little changed for the four proposed action alternatives.

In addition to current or proposed activities, some past activities have left artifacts or resource damage that affect wilderness character. Examples include military debris, some remnant cattle fencing, old vehicle tracks and changes in vegetative cover that have resulted from past cattle grazing.

4.3.2.1 Military Training

Under current management (No Action Alternative), military jet aircraft frequently over-fly the refuge at low altitudes (152 meters [500 feet] above ground level [AGL] on training routes and 457 meters [1,500 feet] AGL generally), and military helicopters less frequently over-fly the refuge at very low altitudes. Although military use of airspace above the refuge wilderness is consistent with the Arizona Desert Wilderness Act of 1990, and the Wilderness Act of 1964 does not include airspace above designated wilderness, the flights negatively affect wilderness solitude, recreational and scenic values. Noise impacts on the ground at the refuge from low altitude flights generally range between 45 and 55 decibels (dB), and range up to 100 dB for fighter aircraft at 152 meters (500 feet) AGL (USDOD 1998). The average range is somewhat below the noise level of typical conversation, but the higher value approximates that experienced by the operator of snowmobile or motorcycle (Noise Center 1996). In either case, aircraft noise is highly perceptible in the otherwise very quiet setting of the refuge wilderness, and adversely affects the visitor's sense of naturalness and solitude. While individual noise impacts from aircraft are short-term in duration, their recurrent nature renders them significant, long-term impacts for the life of the plan.

No change in military over-flight activities would occur under any of the action alternatives.

Many tow darts, previously used in air-to-air gunnery practice, litter some areas of the refuge wilderness. While the actual area of ground disturbance caused by each dart is small, they can create a visual disturbance due to sunlight reflecting on their shiny aluminum skin. This degrades both the scenic value and the naturalness of the refuge wilderness, and should be considered a significant, long-term impact to wilderness character.

The only current program to deal with military debris on the refuge is notification of the military when unexploded ordnance is located on the refuge. This would continue under all of the action alternatives. Under Alternatives 3, 4 and 5, the refuge would work actively with the military and volunteers to remove tow darts and tow cable from the refuge wilderness. Alternative 3 also would establish a system of prioritizing tow darts for removal from the refuge wilderness. Alternative 5 would set a goal of removing a minimum of 15 tow darts per year from the refuge. Removing tow darts from wilderness would involve short-term impacts to wilderness character from the actual removal activity, but long-term enhancement of wilderness character by eliminating non-natural structures from the wilderness. The short-term impacts of removal activity would be mitigated under Alternatives 3, 4 and 5 by scheduling the activity at time when visitors use low and thus visitors are unlikely to encounter removal crews. Given mitigation, as well as consideration that the activity reduces a long-term wilderness impact, this activity should be considered a non-significant, short-term impact. Alternatives 3 or 4 would result in a long-term reduction of the number of tow darts in wilderness. Alternative 5 would result in a similar, but accelerated reduction.

4.3.2.2 Border Law Enforcement

Border Law Enforcement activities on the refuge include regular vehicle patrols along the non-wilderness access corridors, regular low altitude helicopter patrols, frequent vehicle travel on administrative trails and trackways created by UDAs and smugglers, patrols on all-terrain vehicles over migrant trails and

maintenance of two field camps along el Camino del Diablo. While the Arizona Desert Wilderness Act of 1990 includes specific provisions allowing activities of border law enforcement agencies, these activities severely affect wilderness values and wilderness character.

Use of vehicles and low level aircraft over flights seriously undermine the refuge wilderness's naturalness, and opportunities for solitude. The presence of field camps along el Camino del Diablo, although the camps' footprints are entirely within the non-wilderness corridor, degrades the undeveloped appearance of the nearby areas of wilderness. Border law enforcement activities may also impair the recreational value of the wilderness, as many recreational users surveyed expressed negative impressions of seeing and hearing CBP-BP operations. These cumulative impacts should be considered significant, long-term degradation of the refuge wilderness character and values.

In view of the foregoing, it is important to note that border law enforcement activity, while causing adverse consequences to wilderness, serves to reduce the illegal activity within the refuge wilderness. The Environmental Planning Group, an environmental consulting firm, was hired to analyze wilderness impacts of the proposed refuge management alternatives. In its Wilderness Impact Analysis Report, EPG, determined that impacts caused by border management – both law enforcement activities and use of the refuge wilderness by UDAs and smugglers – were the most significant and extensive impacts affecting the refuge and wilderness (2004).

Illegal use of the refuge by UDAs and smugglers causes multiple adverse consequences to refuge wilderness values and character. Some smugglers and UDAs illegally operate vehicles within refuge wilderness, leaving vehicle tracks that have created well defined, easily followed illegal roads in the eastern area of the refuge wilderness (see map, figure 4.1). Another result of illegal vehicle use is the accumulation of abandoned vehicles that break down or become stuck while crossing the refuge wilderness. Refuge staff report that between 20 and 25 vehicles remain in refuge wilderness at any time, despite continuing refuge efforts to remove vehicles as soon as they are identified (DiRosa 2004).

In addition to illegal vehicle use in wilderness, both UDAs and smugglers also travel on foot through the wilderness. The estimated volume of pedestrian traffic greatly exceeds the numbers of permitted refuge visitors (DiRosa 2004). This volume is exacerbated by the fact that illegal entrants to the refuge have different priorities than refuge visitors. Their situation dictates visiting wildlife waters for shelter and drinking water, as well as discarding any items no longer needed.

Direct consequences to wilderness resources from illegal traffic on the refuge include impairment of naturalness by the presence of abandoned vehicles, vehicle tracks, and litter. The wilderness's undeveloped character and scenic value are also directly degraded by the presence of this evidence of human use. The recreational value of the refuge wilderness is indirectly degraded by the presence of UDAs and smugglers and a perceived threat to visitor safety (Burkardt and Lybecker 2004).

Border law enforcement, while generating adverse impacts to wilderness, has the potential to mitigate the ongoing adverse effects of high-volume illegal cross border traffic.

Installation of a border vehicle barrier, currently being considered by DHS, would also reduce wilderness impacts caused by UDAs using vehicles. If a viable barrier is constructed in the future, it should result in long-term cumulative benefits to refuge wilderness.

While Alternatives 3 and 4 would include additional training materials and communication with border law enforcement personnel by the refuge, the ultimate wilderness impact associated with border law enforcement would not measurably change under the no action scenario or any of the four action alternatives.

4.3.2.3 Refuge Management

Refuge management also may affect wilderness character and wilderness values. Some changes in management regime are likely to affect a variety of wildlife populations. These effects are discussed in Section 4.2.3 above.

Alternative 1, No Action Scenario

Under present management, 27 developed wildlife waters are maintained in wilderness. The presence of these developments can be viewed as contrary to the undeveloped and untrammled character of wilderness. Eighteen of these developed waters, however, were present and maintained on the refuge while the refuge wilderness proposal was being developed and the refuge was managed as “de facto wilderness.” Additionally, the refuge periodically hauls water to 20 of the developed waters in wilderness, although fewer than 20 developed waters receive hauled supplemental water each year. Refuge staff estimates that during an average year they make 9 to 18 water hauling trips, a range of 240 to 485 kilometers (150 to 300 miles) driven on administrative trails in wilderness. During a year of extreme drought, refuge staff would make between 30 and 42 water hauling trips, a range of 800 to 1120 kilometers (500 to 695 miles) driven on administrative trails in wilderness. In addition to driving related to hauling supplemental water, refuge management includes some vehicle use in wilderness for monitoring wildlife and habitats and periodic maintenance of developed waters. These activities generally require driving less than 160 kilometers (100 miles) per year on refuge administrative trails. All vehicle use in wilderness for refuge management purposes is subject to a minimum requirements analysis to verify its necessity and appropriateness.

Vehicle use in wilderness for refuge management adversely affects the wilderness’s natural character and its undeveloped character, to the extent that use of administrative trails maintains their status. The practice also has the potential to affect the scenic and recreational values of the wilderness, however this effect is limited. Refuge management vehicle use occurs almost entirely during the hot months of summer, when there is virtually no refuge visitation.

Under the no action scenario, the refuge would retain management vehicular use of 234 kilometers (145 miles) of administrative trails, subject to minimum requirements analysis.

Approximately 224 kilometers (139 miles) of vehicle trails used for management activities prior to wilderness designation but no longer used exist on the refuge wilderness. Refuge volunteers rehabilitate a limited amount of these trails, or new vehicle trails created by illegal travel on refuge, each year. This practice restores a natural appearance to the trails and discourages their continued, unauthorized use, positively influencing the natural and undeveloped character of the wilderness, as well as its scenic value. These activities would continue under all action alternatives.

The presence of developed waters in wilderness presents complex issues. Their presence should be considered a significant, long-term impact to the untrammled and undeveloped character of the wilderness, but this is mitigated by the fact that they were developed and continue to be maintained in order to support conservation of an endangered species, the Sonoran pronghorn, and a wilderness dependent species, the desert bighorn sheep (Leopold 1933). While there is no definitive evidence that developed waters are absolutely necessary to the conservation of desert bighorn sheep, such waters are an accepted component of desert bighorn sheep conservation in Arizona. Conservation of these native species supports the naturalness of the refuge. Given this mitigating factor, the Service considers the presence of developed waters a direct, non-significant, long-term impact of refuge management.

The use of vehicles in wilderness to maintain and supply developed waters and execute some refuge monitoring activities is allowed under the minimum requirements provision of the Wilderness Act of 1964 (Section 4 [c]). Generic minimum requirements determinations for refuge management actions can be found at Appendix F (these will be supplemented with determinations specific to each actually proposed activity).

The significance of this use is limited by the timing of refuge vehicle use, which occurs during the summer season when visitors are largely absent. The overall use of vehicles under prevailing (no action scenario) management requires approximately 42 to 67 hours of driving in wilderness during an average year and approximately 96 to 128 hours during a year of extreme drought, using a conservative average speed of 10 kilometers per hour (6 miles per hour) for refuge driving. Refuge vehicles thus operate in wilderness a maximum of approximately 2 percent of the time (128 hours in an 8760 hour year equals 1.5 percent) under current management. As refuge vehicles only operate on existing administrative trails, they create no new soil compaction or tracks. The overall impact the current level of refuge vehicle use should thus be considered a non-significant, long-term direct effect of refuge management. Continued vehicle use of administrative trails can also be considered a direct long-term impact to the extent that this use keeps the trail surface compacted. The process of soil recovery from compaction in the Sonoran Desert is very slow however (wheel ruts from nineteenth century migrants are visible in places on the refuge) and unrestricted use of the administrative trails by border law enforcement vehicles greatly exceeds refuge management use.

Alternative 2

Implementing Alternative 2 would result in a considerable decrease in refuge management activities conducted in wilderness. Water hauling to 10 developed waters in desert bighorn sheep habitat would be discontinued and structural improvements at those developed waters would be removed. Only 15 developed waters in Sonoran pronghorn wilderness habitat would be supplied with water sufficient to keep them from running dry during normal conditions. During periods of severe drought, the refuge would haul supplemental water to the storage tanks at Jose Juan and Redtail Charcos. During an average year, refuge staff would make 11 water hauling trips, an estimated 128 kilometers (75 miles) of vehicle use on administrative trails in wilderness (average water hauling trips are shorter when hauling to desert bighorn sheep water is discontinued, as these waters tend to be more remote from non-wilderness access ways). During years of extreme drought staff would haul water three times to those developed waters plus three times to Redtail and Jose Juan Charcos, a total of 39 trips, or 455 kilometers (283 miles) of travel on administrative trails in wilderness. During the first year of implementation, this alternative would require one-time visits to each of the developed waters requiring removal of structures, for a total of 306 kilometers (190 miles) of travel on administrative trails in wilderness. This would be a one-time use, and would result in enhanced naturalness at the sites of the nine developed water where structures would be dismantled. Vehicle use in wilderness for monitoring or maintenance would be very limited under this alternative. Fewer than 15 kilometers (9 miles) of vehicle use on administrative trails in wilderness should occur annually for these purposes. Annual collection of water samples from developed waters, as proposed by this alternative, would be conducted on foot in wilderness.

The overall use of vehicles in wilderness for refuge management under Alternative 2 would be reduced considerably from the no action scenario. Implementing this alternative would require approximately 14 hours of driving in wilderness during an average year, approximately 47 hours during a year of extreme drought and approximately 43 hours of additional driving in refuge wilderness during the initial year of implementation, using a conservative average speed of 10 kilometers per hour (6 miles per hour) for refuge driving. The mitigating factors listed for the no action scenario (vehicles operated during the summer low-visitation period, vehicles operated only existing administrative trails and roads) would also apply to this alternative. The overall impact the level of refuge vehicle use that would be generated under Alternative 2 would thus range from approximately one sixth to one third of that generated under the no action scenario. This should be considered a non-significant, long-term direct effect of refuge management.

Under Alternative 2 the refuge would close refuge management use of approximately 97 kilometers (60 miles) of administrative trails in wilderness previously open to management vehicular use. This closure would restrict the trails' use by refuge staff to haul water or conduct other refuge management activities, but would not affect the ongoing use of such trails by border law enforcement personnel.

Alternative 2 would thus result in reduced short-term, recurring impacts to wilderness naturalness solitude

and scenic values through a reduction in the amount of refuge management vehicle use in wilderness, as compared to the no action scenario. If however, cessation of water hauling to desert bighorn sheep developed waters should result in extirpation of the refuge desert bighorn sheep population, this would be considered a reduction in the natural character and ecological value of wilderness by loss of a wilderness dependent wildlife species (Leopold 1933, Hendee and Dawson 2002). Removal of developed features in wilderness and closure of approximately 41 percent of the administrative trails in wilderness would result in a reduction in long-term impacts to wilderness naturalness and untrammeled character. The importance of the trail closure, however, would be lessened by continued use of the administrative trails by border law enforcement personnel.

Alternative 3

Implementing Alternative 3 would result in a decrease in refuge management activities conducted in wilderness as compared to the no action scenario. Only developed waters in Sonoran pronghorn wilderness habitat would be supplied with water sufficient to keep them from running dry during normal conditions. Structural improvements at the developed waters in desert bighorn sheep habitat would be removed. Only during years of extreme drought would water be hauled to developed waters in desert bighorn habitat. During an average year, refuge staff would make 11 water hauling trips, an estimated 128 kilometers (75 miles) of vehicle use on administrative trails in wilderness. During years of extreme drought staff would haul water to roughly the same extent as occurs during similar years under the no action scenario, or a range of 800 to 1120 kilometers (500 to 695 miles) driven on administrative trails in wilderness. As would be the case for Alternative 2, this alternative would require one-time visits to each of the developed waters requiring removal of structures, for a total of 306 kilometers (190 miles) of travel on administrative trails in wilderness during the initial year of implementation. This would be a one-time use, and would result in enhanced naturalness at the sites of the nine developed water where structures would be dismantled. Similar to Alternative 2, vehicle use in wilderness for monitoring or maintenance would be very limited under this alternative. Fewer than 15 kilometers (9 miles) of vehicle use on administrative trails in wilderness would occur annually for these purposes.

The overall use of vehicles in wilderness for refuge management under Alternative 3 during average rainfall years would be reduced considerably from the no action scenario. Implementing this alternative would require approximately 14 hours of driving in wilderness during an average year, approximately 81 to 114 hours during a year of extreme drought and approximately 31 hours of additional driving in refuge wilderness during the initial year of implementation, using a conservative average speed of 10 kilometers per hour (6 miles per hour) for refuge driving. The mitigating factors listed for the no action scenario (vehicles operated during the summer low-visitation period, vehicles operated only existing administrative trails and roads) would also apply to this alternative. The overall impact the level of refuge vehicle use that would be generated under Alternative 3 would thus range from approximately one quarter of to roughly equivalent to that generated under the no action scenario. This should be considered a non-significant, long-term direct effect of refuge management.

Under Alternative 3 the refuge would close refuge management of approximately 32 kilometers (20 miles) of administrative trails in wilderness previously open to management vehicular use. This closure would restrict the trails' use by refuge staff to haul water or conduct other refuge management activities, but would not affect the ongoing use of such trails by border law enforcement personnel.

Alternative 3 would thus result in reduced short-term, recurring impacts to wilderness naturalness solitude and scenic values through a reduction in the amount of refuge management vehicle use in wilderness, as compared to the no action scenario. If however, cessation of water hauling to desert bighorn sheep developed waters should result in extirpation of the refuge desert bighorn sheep population, this would be considered a reduction in the natural character and ecological value of wilderness by loss of a wilderness dependent wildlife species (Leopold 1933, Hendee and Dawson 2002). Removal of developed features in wilderness and closure of approximately 14 percent of the administrative trails in wilderness would result in

a reduction in long-term impacts to wilderness naturalness and untrammeled character. The importance of the trail closure, however, would be lessened by continued use of the administrative trails by border law enforcement personnel.

Alternative 4 (Preferred alternative)

Under this alternative, the refuge initially would continue to haul supplemental water to all developed waters as described for the no action scenario. Over time, however, the refuge would initiate a program of upgrading developed waters to reduce their need for supplemental water maintenance as well as creating a more natural appearance. Prior to these upgrades, water hauling under this alternative would be similar to what occurs under the no action scenario. That would be a range of 240 to 485 kilometers (150 to 300 miles) driven on administrative trails in wilderness in average years and a range of 800 to 1120 kilometers (500 to 695 miles) driven on administrative trails in wilderness during drought years. In addition to driving related to hauling supplemental water, refuge management would include some vehicle use in wilderness for monitoring wildlife and habitats and periodic maintenance of developed waters. These activities should require driving fewer than 160 kilometers (100 miles) per year on refuge administrative trails. Annual collection of water samples from all developed waters, as proposed in this alternative would either be done in conjunction with water hauling visits or on foot in wilderness.

Redevelopment of the waters would require construction activity in wilderness. Refuge staff would mitigate these impacts by scheduling construction at times when visitor use is low, assembling as many components outside of wilderness as possible and delivering components of the waters to the site by truck (see Appendix F, Action 13 for a discussion of the decision to use a truck). Completion of the developed water upgrades should reduce the necessity of vehicle use on administrative trails in wilderness, both for water hauling and for maintenance of the waters. Experience in similar environments suggests that upgraded waters should not require supplemental water or maintenance other than during prolonged, extreme drought.

Under Alternative 4 the refuge would close refuge management of approximately 32 kilometers (20 miles) of administrative trails in wilderness previously open to management vehicular use. This closure would restrict the trails' use by refuge staff to haul water or conduct other refuge management activities, but would not affect the ongoing use of such trails by border law enforcement personnel.

The initial consequences to wilderness resources of implementing the refuge management activities proposed under this alternative would be very similar to those of the no action scenario (42 to 67 hours of management vehicle operation in wilderness during a typical year and 96 to 128 hours of such use during a year of extreme drought), with the exception that approximately 14 percent of the administrative trails network would be closed to refuge management vehicular use. This closure would not affect border law enforcement use of the administrative trails. The proposed upgrades to developed waters would create additional temporary impacts to the natural character, undeveloped character and solitude of the wilderness during installation of the upgrades. These improvements, however, should lead to a long-term decrease in refuge vehicle use and result in more natural appearing developed waters. The potential construction of additional developed waters for desert bighorn sheep, however, would add to this alternative's adverse impacts upon the natural, undeveloped and untrammeled character of the wilderness. The overall result would be an increase in the wilderness's scenic value, natural character and solitude, although developed waters would remain in wilderness.

Alternative 5

Under this alternative, the refuge initially would continue to haul supplemental water to all developed waters as described for the no action scenario. Over time, however, the refuge would initiate a program to upgrade developed waters as described above for Alternative 4. Additionally, should research suggest that additional waters would benefit desert bighorn sheep and Sonoran pronghorn, the refuge will locate sites for additional new developed waters of the upgraded design. Prior to these upgrades, water hauling under this

alternative would be similar to what occurs under the no action scenario. That would be a range of 240 to 485 kilometers (150 to 300 miles) driven on administrative trails in wilderness in average years and a range of 800 to 1120 kilometers (500 to 695 miles) driven on administrative trails in wilderness during drought years. In addition to driving related to hauling supplemental water, refuge management would include some vehicle use in wilderness for monitoring wildlife and habitats, periodic maintenance of developed waters and collection of water samples from developed waters. These activities should require driving approximately 465 kilometers (290 miles) per year on refuge administrative trails.

Redevelopment of the waters would require construction activity in wilderness. Refuge staff would mitigate these impacts by scheduling construction at times when visitor use is low, assembling as many components outside of wilderness as possible and delivering components of the waters to the site by truck (see Appendix F, Action 13 for a discussion of the decision to use a truck). Completion of the developed water upgrades should reduce the necessity of vehicle use on administrative trails in wilderness due to reduced maintenance and supplemental water requirements of such waters.

The proposal to develop forage enhancement in desert bighorn sheep habitat under this proposal would require creation of small earthen beams or other structures to redirect runoff. While such structures can likely be blended fashioned of natural materials and blended into the landscape, they are unnatural manipulation of the environment. Thus they adversely affect the natural, undeveloped and untrammelled character of the wilderness.

The entire administrative trails network would remain available for refuge management vehicular use under this alternative.

The initial consequences to wilderness resources of implementing the refuge management components of this alternative would be very similar to those of no action scenario, with a slight increase in total management vehicle use in wilderness due to increased management activities not related to water hauling. Initial total refuge management vehicle travel in wilderness would be 10 to 95 hours during a typical year and 126 to 158 hours during a drought year, assuming an average speed of 10 kilometers per hour (6 miles per hour). Construction of additional developed waters and a forage enhancement for desert bighorn sheep, however, would add to this alternative's adverse impacts upon the natural, undeveloped and untrammelled character of the wilderness. The net effect of implementing Alternative 5 would be direct, long-term adverse effects to wilderness naturalness, undeveloped character and untrammelled character greater than those of any other preferred alternative.

4.3.2.4 Public Use

Much wilderness management research has focused on the effects of recreational public use, as public use is often perceived by managers has the single greatest human influence on wilderness (Hendee *et al.* 1990). At Cabeza Prieta, however, overall visitation is low, and the fraction of visitors actually entering wilderness is a small subset of overall visitation (R. DiRosa, USFWS, pers. comm.).

Alternative 1, No Action Scenario

Under current management, all refuge visitors are required to obtain a permit prior to entering the refuge. Campfires are restricted to charcoal or fuel stoves, to limit over harvesting of the limited woody vegetation for firewood. All visitors registering for an entry permit are provided information about the hazards of backcountry travel in the desert wilderness and refuge rules and regulations. Visitors desiring to use pack or saddle stock must obtain a special use permit, as must visitors desiring to camp longer than 14 consecutive days. Camping within 400 meters (1/4 mile) of a wildlife waterhole is prohibited.

Visitor days increased from just over 2,000 at the beginning of the decade of the 1990s to just over 5,000 in 1999. Maximum visitor days reached 3000 per month in March of 1998, but in an average year such as 1997,

maximum visitor days hover short of 900 per month for approximately 5 months. This would average out to approximately 30 people present each day on the refuge during the peak season. This is very light visitation, as compared with other National Wildlife Refuges. Of this light visitation, only a small fraction, estimated to be approximately 5 percent of overall visitation (R. DiRosa, USFWS pers. comm.), travel on foot far beyond the non-wilderness public access corridors.

It is not always possible to distinguish between adverse impacts to wilderness, such as off-road vehicle tracks and litter, caused by legitimate visitors and those caused by illegal traffic. The low number of visitors and their access to information about prohibited and appropriate activities in wilderness suggest that legitimate visitors to the refuge cause little adverse impact to refuge wilderness resources.

Overall direct impacts to wilderness resources caused by refuge visitors under current management are generally limited to short-term disruption of solitude when two groups encounter one another, or from vehicle presence and noise near the non-wilderness public access corridors. Due to the very low level of visitation, however the total impact from visitors is negligible when compared to that caused by illegal travelers, border law enforcement and military over flights.

Alternatives 2 and 3

Under these alternatives visitation would be anticipated to decrease slightly below that of the no action scenario. No additional impacts to wilderness should result. Under these alternatives the maximum length of stay without a special use permit would be seven consecutive days and party size would be limited to eight persons. These restrictions are place to limit the impacts of wilderness camping. Should visitation increase dramatically in the future these restrictions would mitigate the resource damage caused by wilderness visitors.

Alternative 4 (Preferred alternative)

Under this Alternative visitation to the refuge is anticipated to increase slightly above that of the no action scenario. Allowing use of wood fires in the designated camping areas with wood not native to the Sonoran Desert is not anticipated to damage refuge resources. The refuge will continue to monitor the wilderness resource and respond to any adverse impacts. No measurable increase in adverse impacts to wilderness above those caused by the no action scenario should result from implementing this alternative. Under this alternative the maximum length of stay for camper would remain 14 consecutive days and camping party size would be limited to eight persons. Should visitation increase dramatically in the future these restrictions would mitigate the resource damage caused by wilderness visitors. Allowing street-legal ATVs and motorcycles on the refuge might increase visitation, but any such increase would likely be very small.

Alternative 5

Implementing this alternative would result in a long-term increase in refuge visitation. Additional hunting opportunities and reduced restrictions on visitor behavior could result increased numbers of visitors and greater use of pack and saddle stock. Relaxed restrictions on campfires and vehicle types allowed on the public access corridors could result in adverse impacts to the solitude of the wilderness. These impacts, however, are anticipated to be small in comparison to those caused by illegal cross-border traffic and the necessary border law enforcement response. Additionally, the development of additional campsites and other recreational amenities outside of refuge wilderness should redirect visitation away from wilderness, thus mitigating wilderness impacts from increased visitation. Should visitation increase dramatically in the future, however, unrestricted party size, unrestricted use of pack and saddle stock and relaxed control of fire and vehicle use could result in greater impacts to wilderness naturalness and solitude.

4.4 CHILDS MOUNTAIN COMMUNICATIONS SITE

The FAA, the Air Force and several commercial users lease space on this site on the summit for Childs Mountain for placement of radar and communications equipment that benefits from the mountain's high relief. While the site is outside of wilderness, the communications and radar facilities are highly visible from within wilderness. Some stakeholders have called for their removal.

Alternative 1, No Action Scenario

The facilities on Childs Mountain are operated under a memorandum of understanding between the Air Force, FAA and the Service. Upon expiration of this MOU in 2018, all facilities are required to be removed from the summit. During the duration of the MOU, the refuge considers requests for additional facilities on site based upon their footprint. Equipment that can be installed on existing towers or existing equipment pads, such as antennas, is generally permitted. Facilities that would require new ground disturbance are generally not permitted. Under the no action scenario the visual impact of the communications site will remain until 2018, when it will be removed.

Alternatives 2 and 3

Under these alternatives no new equipment would be added to the site. All facilities would be removed at the expiration of the current MOU. The effects of these alternatives would very similar to those of the no action scenario; visual impact from existing facilities until their removal in 2018.

Alternatives 4 (Preferred alternative) and 5

Under these alternatives the refuge would continue to review requests for new equipment as described above for the no action scenario. Additionally, the refuge would consider extending the duration of the MOU beyond 2018, if communication facilities are still necessary for protection of life and law enforcement. The refuge would encourage the lessees of the site to identify and remove any obsolete buildings or equipment. The effects of these alternatives are similar to those of the no action scenario, except that they may be of longer duration.

4.5 CULTURAL RESOURCES

Refuge cultural resources include petroglyphs, other prehistoric artifacts, migrant graves, ruts of the historic el Camino del Diablo and artifacts related to the early history of Ajo on the visitor center site.

Alternative 1, No Action Scenario

Currently refuge cultural resources are protected through avoidance of disturbance. Prior to any projects requiring earth moving, an archaeological review is to be completed to ensure that cultural resources are not affected. Unauthorized excavation or disturbance of cultural or historical artifacts is prohibited. The location of known cultural artifacts on the refuge is not published or otherwise publicly disclosed. The only interpretation of cultural artifacts at the refuge occurs out of context at the visitor center. This approach to cultural resource protection generally prevents disturbance of resources, but does not identify damage occurring through natural processes such as erosion or due to illegal activities on the refuge.

Alternatives 2 and 3

Under these alternatives, the cultural resources management of the no action scenario would continue. No change in consequences to cultural resources would result.

Alternatives 4 (Preferred alternative) and 5

Under these alternatives, the cultural resources management of the no action scenario would continue with the following enhancements. An old trash dump located on the visitor center site would be interpreted with placards interpreting the early history of Ajo. Refuge staff would regularly inspect known cultural resource sites to identify damage from natural processes or illegal activity. The refuge would develop and implement stabilization measures, as necessary. The refuge would develop and offer training in cultural resources protection for border law enforcement personnel.

The measures proposed for implementation under these alternatives would provide visitors with a greater appreciation of the early history of Ajo and should afford refuge cultural resources with greater protection than under the no action scenario.

4.6 SOCIOECONOMIC RESOURCES

4.6.1 Economic Consequences

The economic consequences of a national wildlife refuge to the surrounding area are generated by two sources, refuge operations and expenditures in the local economy by refuge visitors. Refuge operations include employment of refuge staff and purchases of equipment and supplies. Because of the way industries interact in an economy, a change in the activity of one industry affects activity levels in several other industries. For example, an increase in funding could allow the Refuge to start new projects or hire additional staff members. This added revenue will directly flow to the businesses from which the Refuge purchases goods and services and to the new Refuge employees. As additional supplies are purchased or as new staff members spend their salaries within the community, local businesses will purchase extra labor and supplies to meet the increase in demand for additional services. The income and employment resulting from Refuge purchases and Refuge employees' spending of salaries locally represents the *direct* effects of Refuge management activities within Ajo. In order to increase supplies to local businesses, input suppliers must also increase their purchases of inputs from other industries. The income and employment resulting from these secondary purchases by input suppliers are the *indirect* effects of Refuge management activities within the county. The input supplier's new employees use their incomes to purchase goods and services. The resulting increased economic activity from new employee income is the *induced* effect of visitor spending. The sums of the direct, indirect and induced effects describe the total economic effect of Refuge management activities in Ajo.

Any effect on the local economy that would alter the overall economy by 3 percent or more, in terms of overall expenditures, income or employment, is considered significant. Changes below this level are within the level of normal variation in the business cycle.

4.6.1.1 Refuge Operations

Alternative 1, No Action Scenario

The refuge currently employs 12 full time staff, with total salary for 2004 estimated at \$547,805. All of the employees live within the local area. As described in the Regional Economics Effects report prepared by USGS and attached to this EIS as Appendix L, refuge employment results in additional indirect and induced effects in the local economy of Ajo, Arizona, estimated at \$96,264 income per year and the 3.5 jobs. The total impact of refuge employment equals the sum salary income plus the sum of indirect income, or \$644,069 income per year and 15.5 jobs. Additionally, the refuge purchases goods and services. The estimated value of these purchases for 2004 is \$415,200, with approximately 15 percent, or \$62,280 being spent in the local area, the total influence of local spending is lower, however as some of the total goes toward non-local inventory. Refuge non-salary expenditures result in direct effects such as employment in the retail and auto repair sectors as well as indirect and induced effects. Direct effects of nonsalary expenditures are estimated at \$27,924 income per year and 1.0 job. Indirect and induced effects of nonsalary expenditures are estimated at \$11,511 and 0.4 job. The total of direct and indirect or induced effects of refuge nonsalary expenditures is estimated as \$39,435 income per year and 1.4 jobs. Total refuge staffing and budgeting impacts to the local economy, as estimated by USGS, are thus \$644,069 income per year and 15.5 jobs, or 0.88 percent of the local annual income total and approximately 1.19 percent of the local job base. These should be considered long-term, non-significant benefits to the local economy.

Alternative 2

Under Alternative 2, nonsalary expenditures would be decreased by 10 percent as compared with the no action scenario due to considerable reductions of refuge maintenance in the field. Salary expenditure would increase, however, due to the addition of one position to facilitate keeping the refuge visitor center open additional hours. This increase is reflected as a fraction of a job due to the lower than average salary of the

position that would be created. Anticipated effects of refuge salary expenditures for this alternative would be direct effects estimated at \$569,293 income per year and 12.6 jobs and indirect effects of \$100,071 income per year and 3.6 jobs. Nonsalary impacts of implementing this alternative would be an estimated direct effect of \$25,132 income per year and 0.9 job and indirect or induced effects of \$10,359 income per year and 0.3 job. The total economic effect on Ajo, Arizona, anticipated from implementing this alternative would be \$704,855 income per year, and 17.4 jobs, or 0.91 percent of local annual income and 1.22 percent of the local job base. The long-term effect of implementing this alternative would be a slight decrease in the refuge's long-term contribution to the local economy as compared to the no action scenario, but the effects would be very small in the context of the overall economy and not significant.

Alternative 3

Under Alternative 3, nonsalary expenditures would be increased by 10 percent as compared with the no action scenario to fund the additional sheep monitoring proposed. Salary expenditure would increase, due to the addition of two positions to facilitate additional refuge management and monitoring activities. This increase is reflected as a slightly less than two jobs due to the lower than average salaries of the positions that would be created. Anticipated effects of refuge salary expenditures for this alternative would be direct effects estimated at \$626,598 income per year and 13.8 jobs and indirect effects of \$110,114 income per year and 4.0 jobs. Nonsalary impacts of implementing this alternative would be an estimated direct effect of \$30,716 income per year and 1.1 jobs and indirect or induced effects of \$12,662 income per year and 0.4 job. The total economic effect on Ajo, Arizona, anticipated from implementing this alternative would be \$780,120 income per year, and 19.3 jobs, or 1.00 percent of local annual income and 1.36 percent of the local job base. Overall, the long-term economic impact of implementing this alternative would be a small increase local refuge spending, employment and income, as compared to the no action scenario. The increase would be very small, however, and is not significant.

Alternative 4 (Preferred alternative)

Under Alternative 4, nonsalary expenditures would be increased by 25 percent as compared with the no action scenario to fund construction of improved water catchments and small increases in monitoring proposed. Salary expenditure would increase to reflect the addition of three positions, a wildlife biologist, a maintenance worker and a law enforcement officer. This increase is reflected as a somewhat less than three jobs due to the lower than average salaries of the positions that would be created. Anticipated effects of refuge salary expenditures for this alternative would be direct effects estimated at \$658,433 income per year and 14.5 jobs and indirect effects of \$115,740 income per year and 4.2 jobs. Nonsalary impacts of implementing this alternative would be an estimated direct effect of \$34,905 income per year and 1.3 jobs and indirect or induced effects of \$14,388 income per year and 0.5 job. The total economic effect on Ajo, Arizona, anticipated from implementing this alternative would be \$823,466 income per year, and 20.5 jobs, or 1.06 percent of local annual income and 1.44 percent of the local job base. As in the case of Alternative 3, the long-term economic impact of implementing this alternative would be a small increase local refuge spending, employment and income, as compared to the no action scenario. The increase would be very small, however, and is not significant.

Alternative 5

Under Alternative 5, nonsalary expenditures would double as compared with the no action scenario to fund construction of improved water catchments, development of the Copper Canyon Road Loop, and the considerable increases in monitoring proposed. Salary expenditure would increase to reflect the addition of five positions, two wildlife biologists, a maintenance worker, a law enforcement officer and an outdoor recreation planner. This increase is reflected as a slightly less than five jobs due to the lower than average salaries of the positions that would be created. Anticipated effects of refuge salary expenditures for this alternative would be direct effects estimated at \$722,104 income per year and 15.9 jobs and indirect effects of \$126,932 income per year and 4.6 jobs. Nonsalary impacts of implementing this alternative would be

estimated direct effects of \$55,848 income per year and 2.1 jobs and indirect or induced effects of \$23,021 income per year and 0.7 job. The total economic effect on Ajo, Arizona, anticipated from implementing this alternative would be \$927,905 income per year, and 23.3 jobs, or 1.19 percent of local annual income and 1.64 percent of the local job base. Overall, the long-term economic impact of implementing this alternative would be a greater increase in local refuge spending, employment and income of any proposed management alternative. The increase would be very small, however, and is not significant.

Summary

The local economic effects of the no action scenario and four action alternatives are summarized in table 4.1.

Table 4.1: Summary of Refuge staffing and budgeting economic impacts					
Ajo Economy	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Total Refuge Staffing and Budgeting Impacts					
<i>(salary and non-salary)</i>					
Direct Effects					
Income (\$/year)	\$575,729	\$594,425	\$657,314	\$693,338	\$777,952
Jobs	13.0	13.5	14.9	15.8	18.0
Indirect and Induced Effects <i>(in Ajo Economy)</i>					
Income (\$/year)	\$107,775	\$110,430	\$122,806	\$130,128	\$149,953
Jobs	3.9	3.9	4.4	4.7	5.3
Total Effects					
Income (\$/year)	\$683,504	\$704,855	\$780,120	\$823,466	\$927,905
Jobs	16.9	17.4	19.3	20.5	23.3
<i>% of Total Ajo Income</i>	<i>0.88%</i>	<i>0.91%</i>	<i>1.00%</i>	<i>1.06%</i>	<i>1.19%</i>
<i>% of Total Ajo Employment</i>	<i>1.19%</i>	<i>1.22%</i>	<i>1.36%</i>	<i>1.44%</i>	<i>1.64%</i>

4.6.1.2 Visitor Expenditures

The refuge offers a variety of recreational, interpretive and educational opportunities that draw visitors. Total visitation under of each of the management alternatives was estimated by extrapolating recent visitor trends and correcting for visitor opportunities offered under each alternative. Using visitation projections developed by refuge, USGS determined the economic impacts of visitor spending from the following equation:

Number of refuge visitors x average spending x regional multiplier = Economic Impact

For the purposes of this analysis, refuge visitation projections were used as the number of refuge visitors. Results from the 2002 visitor survey (Burkardt and Lybecker 2004) on visitor spending provide the average spending per visitor day. The IMPLAN modeling system was used to derive the multipliers that capture the secondary (indirect and induced) effects needed to determine the economic impacts of visitor spending (Caughlan 2004). Brief visits to the visitor center not associated with a visit to the refuge beyond the visitor center site were not included in the economic analysis, as such visits were viewed as opportunistic brief stops by individuals passing through Ajo.

The USGS analyzed economic effects of visitor spending on statewide and local levels (Caughlan 2004). As there was no measurable difference among the statewide effects of refuge visitor spending among the management alternatives, and as that effect represented 0.0001 percent of total state income, the effects of visitor spending on the State of Arizona are not presented here. This analysis appears in Appendix L.

The impacts projected for the no action scenario and each preferred alternative are presented below. In every case the overall direct and indirect benefits to local economy would be too small to be significant, and would have no noticeable effect on the local economy.

Alternative 1, No Action Scenario

Under the no action scenario refuge visitation was estimated at 8,046 visitor days, distributed as 7,806 general recreational visitor days and 240 desert bighorn sheep hunting visitor days. The direct local economic effects of visitation derived by USGS for this alternative are \$38,547 income per year and 1.7 jobs created. Indirect and induced local effects are \$16,686 income per year and 0.5 job created. The total local economic effects of current management are estimated to be \$55,233 income per year and 2.2 jobs created, or 0.07 percent of local income and 0.15 percent of local employment.

Alternative 2

Under this alternative refuge visitation would be estimated at 7,771 visitor days, all of which would be general recreational visits, as no hunting would be allowed. The direct local economic effects of visitation derived by USGS for this alternative are \$38,372 income per year and 1.6 jobs created. Indirect and induced local effects are \$16,611 income per year and 0.5 job created. The total local economic effects of current management are estimated to be \$54,983 income per year and 2.1 jobs created, or 0.07 percent of local income and 0.15 percent of local employment.

Alternative 3

Under this alternative refuge visitation would be estimated at 7,934 visitor days, distributed among 7,771 general recreation visitor days and 163 hunter visitor days. The direct local economic effects of visitation derived by USGS for this alternative are \$38,372 income per year and 1.6 jobs created. Indirect and induced local effects are \$16,611 income per year and 0.5 job created. The total local economic effects of current

management are estimated to be \$54,983 income per year and 2.1 jobs created, or 0.07 percent of local income and 0.15 percent of local employment.

Alternative 4 (Preferred alternative)

Under this alternative refuge visitation would be estimated at 8,496 visitor days, distributed among 8,231 general recreation visitor days and 265 hunter visitor days (the increase in hunter visitor days would only occur if the proposed additional hunts were implemented). The direct local economic effects of visitation derived by USGS for this alternative are \$40,640 income per year and 1.7 jobs created. Indirect and induced local effects are \$17,593 income per year and 0.5 job created. The total local economic effects of current management are estimated to be \$58,233 income per year and 2.2 jobs created, or 0.07 percent of local income and 0.15 percent of local employment.

Alternative 5

Under this alternative refuge visitation would be estimated at 8,921 visitor days, distributed among 8,656 general recreation visitor days and 265 hunter visitor days (the increase in hunter visitor days would only occur if the proposed additional hunts were implemented). The direct local economic effects of visitation derived by USGS for this alternative are \$42,741 income per year and 1.8 jobs created. Indirect and induced local effects are \$18,502 income per year and 0.6 job created. The total local economic effects of current management are estimated to be \$61,243 income per year and 2.4 jobs created, or 0.08 percent of local income and 0.16 percent of local employment.

Summary

Table 4.2 provides a summary of the local economic effects of refuge visitor spending. Overall differences in total effects are small among the alternatives, the greatest difference between the no action scenario and one of the action alternatives being an approximate 11 percent overall increase in annual income effect from Alternative 1 to Alternative 5. This effect is so small a component of the overall local economy as not to be noticeable.

Ajo Economy	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Direct Effects					
Income (\$/year)	\$38,547	\$38,372	\$38,372	\$40,640	\$42,741
Jobs	1.7	1.6	1.6	1.7	1.8
Indirect and Induced Effects					
Income (\$/year)	\$16,686	\$16,611	\$16,611	\$17,593	\$18,502
Jobs	0.5	0.5	0.5	0.5	0.6
Total Effects					
Income (\$/year)	\$55,233	\$54,983	\$54,983	\$58,233	\$61,243
Jobs	2.2	2.1	2.1	2.2	2.4
<i>% Total Ajo Income</i>	<i>0.07%</i>	<i>0.07%</i>	<i>0.07%</i>	<i>0.07%</i>	<i>0.08%</i>
<i>% Total Ajo Employment</i>	<i>0.15%</i>	<i>0.15%</i>	<i>0.15%</i>	<i>0.15%</i>	<i>0.17%</i>

4.6.2 Social Consequences

Analyzing the social consequences of management actions on the refuge is complicated by the diversity of values among refuge stakeholders. Also complicating discussion of social values is the dichotomy between recreational values accruing to visitors, such as scenic value and solitude, and existence values accruing to individuals who may never visit the refuge, but nonetheless care that wilderness, endangered species habitats or other refuge resources are protected. The USGS social impact analysis for Cabeza Prieta NWR (Burkardt and Lybecker 2004), attached as Appendix K, considered both responses to survey of individuals who visited the refuge in 2001 and broader national opinion trends regarding refuges, wilderness, hunting, endangered species and other issues germane to the refuge. In many cases a proposed management action could be expected to elicit a negative response from some individuals and a positive response from others. Some visitors viewed developed waters as an intrusion on the refuge's wildness, while others valued developed waters highly and mentioned viewing a developed water as a high point of their visit to the refuge (Burkardt and Lybecker 2004).

Some general trends were apparent in the survey. Respondents highly valued the solitude and scenery of the refuge and felt that the presence of illegal traffic and military over flights detracted from both. Some respondents complained that the activities of border law enforcement personnel adversely affected their refuge visit, while other praised the high level law enforcement activity to address degradation of the refuge

by illegal traffic. Military flight training over the refuge, border law enforcement and illegal traffic through the refuge are beyond the control of refuge management, and are likely to remain largely unchanged, regardless of the management alternative implemented.

As the ultimate social consequences on refuge management actions are largely dependent on the individual's or group's values, each action has a variety of positive and negative social consequences. These are described for each alternative in the USGS report; only general consequences are summarized here. Implementing Alternatives 2 or 3 would positively affect individuals and groups who value limiting management actions in wilderness and adversely affect individuals and groups who value interventions to manage wildlife populations. The cessation of water hauling to desert bighorn sheep developed waters proposed in Alternative 2 or the reduction of such hauling proposed in Alternative 3 would adversely affect UDAs who depend upon those waters while traversing the refuge. Continued active management of habitat resources in wilderness, as proposed in Alternatives 4 (Preferred alternative) and 5, would adversely affect individuals and groups who value limiting management actions in wilderness and favorably affect groups who value increasing wildlife populations through active management.

4.7 ENVIRONMENTAL JUSTICE

Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or a socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. Meaningful involvement means that: (1) potentially affected community residents have an appropriate opportunity to participate in decisions about a proposed activity that will affect their environment and/or health; (2) the public's contribution can influence the regulatory agency's decision; (3) the concerns of all participants involved will be considered in the decision making process; and (4) the decision makers seek out and facilitate the involvement of those potentially affected (EPA 2004). No proposed action of any management alternative for the refuge should cause any group of people to bear a disproportionate share of negative environmental consequences. The refuge and the Service have sought meaningful involvement of all interested people through the scoping and other public involvement processes for this EIS, as described in Chapter 1.

4.8 SUMMARY OF CUMULATIVE IMPACTS OF PLAN ACTIONS AND OTHER, REASONABLY FORESEEABLE RELATED ACTIVITIES

Table 4.3: Cumulative Impacts

Resource Affected	Agent of Impact	Remarks	Reference
Soil surface	On-road vehicle use by Border Law Enforcement	Significant Impacts likely to continue under all management alternatives DHS construction of a vehicle barrier on or near the border would significantly mitigate soil disturbance from off-road driving	Page 182
Wilderness Character	UDAs, Border Law Enforcement vehicles and helicopter response, military overflights	Significant impacts to wilderness solitude, naturalness and undeveloped appearance likely to continue to under all management alternatives	Page 209
Endangered Species, Sonoran Pronghorn	Disturbance from UDAs (afoot and in vehicles) Border Law Enforcement vehicles, low altitude aircraft use (both military jets and helicopters, CBP-BP helicopters)	Potentially significant impacts to this rare species are ongoing and are likely to continue under any management alternative. DHS construction of a vehicle barrier on or near the border would significantly mitigate disturbance from off-road driving	Page 195