ENVIRONMENTAL STEWARDSHIP PLAN
FOR THE CONSTRUCTION, OPERATION, AND MAINTENANCE OF VEHICLE FENCE AND RELATED TACTICAL INFRASTRUCTURE
U.S. Border Patrol Tucson Sector, Douglas Station, Arizona

U.S. Department of Homeland Security
U.S. Customs and Border Protection
U.S. Border Patrol

December 2008

ABBREVIATIONS AND ACRONYMS

°F	Fahrenheit
ADWR	Arizona Department of Water Resources
AHPA	Archaeological and Historic Preservation Act
AIRFA	American Indian Religious Freedom Act
amsl	above mean sea level
APE	Area of Potential Effect
ARPA	Archaeological Resources Protection Act
ASM	Arizona State Museum
BLM	Bureau of Land Management
BMP	Best Management Practice
BRP	Biological Resources Plan
CBP	U.S. Customs and Border Protection
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CM&R	Construction Mitigation and Restoration
CWA	Clean Water Act
CY	calendar year
dBA	A-weighted decibels
DHS	U.S. Department of Homeland Security
ESA	Endangered Species Act
ESP	Environmental Stewardship Plan
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FPPA	Farmland Protection Policy Act
FR	Federal Register
FY	fiscal year
IIRIRA	Illegal Immigration Reform and Immigrant Responsibility Act
MBTA	Migratory Bird Treaty Act
NAGPRA	Native American Graves Preservation and Repatriation Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NVCS	National Vegetation Classification System
NWR	National Wildlife Refuge
OHM	ordinary high water mark
OSHA	Occupational Safety and Health Administration
P.L.	Public Law
POE	Port of Entry
RCRA	Resource Conservation and Recovery Act
ROI	Region of Influence
SARA	Superfund Amendments and Reauthorization Act
SBNWR	San Bernardino National Wildlife Refuge
SHPO	State Historic Preservation Office
SPCC	Spill Prevention Control and Countermeasures
SWPPP	Storm Water Pollution Prevention Plan
TSCA	Toxic Substances Control Act
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USBP	U.S. Border Patrol
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USIBWC	United States Section, International Boundary and Water Commission

Cover Sheet

Environmental Stewardship Plan for the Construction, Operation, and Maintenance of Vehicle Fence and Related Tactical Infrastructure U.S. Border Patrol Tucson Sector, Douglas Station, Arizona

Responsible Agencies: U.S. Department of Homeland Security (DHS), U.S. Customs and Border Protection (CBP), U.S. Border Patrol (USBP).

Coordinating Agencies: United States Section, International Boundary and Water Commission (USIBWC), and U.S. Fish and Wildlife Service (USFWS).

Affected Location: U.S./Mexico border in Cochise County, Arizona.

Project Description: The Project includes the construction, operation, and maintenance of tactical infrastructure to include primary vehicle fence and associated access roads along approximately 16 miles of the U.S./Mexico border within the USBP Tucson Sector, Arizona. The Project will be implemented in two discrete sections with approximately 9 miles of post-on rail fence and 7 miles of Normandy-style fence.

Report Designation: Final Environmental Stewardship Plan (ESP).

Abstract: CBP plans to construct, operate, and maintain approximately 16 miles of tactical infrastructure to include approximately 9 miles of post-on rail fence and 7 miles of Normandy-style fence, and access roads along the U.S./Mexico border in the USBP Tucson Sector, Arizona. The tactical infrastructure will encroach on multiple privately owned land parcels and public lands managed by the Bureau of Land Management (BLM), USFWS, and Arizona State Lands.

This ESP analyzes and documents potential environmental consequences associated with the Project.

On April 1, 2008, the Secretary of the U.S. Department of Homeland Security (DHS), pursuant to his authority under Section 102(c) of the Illegal Immigration Reform and Immigrant Responsibility Act (IIRIRA) of 1996 as amended, exercised his authority to waive certain environmental and other laws in order to ensure the expeditious construction of tactical infrastructure along the U.S./Mexico international border. The tactical infrastructure described in this Environmental Stewardship Plan (ESP) is covered by the Secretary's April 1, 2008, waiver (see **Appendix A**). Although the Secretary's waiver means that U.S. Customs and Border Protection (CBP) no longer has any specific legal obligations under the laws that are included in the waiver, the Secretary has committed DHS to continue to protect valuable natural and cultural resources. CBP strongly supports the Secretary's commitment to responsible environmental stewardship. To that end, CBP has prepared this ESP, which analyzes the

potential environmental impacts associated with construction of tactical infrastructure in the USBP's Tucson Sector. The ESP also discusses CBP's plans as to how it can mitigate potential environmental impacts. The ESP will guide CBP's efforts going forward.

ENVIRONMENTAL STEWARDSHIP PLAN

FOR THE

CONSTRUCTION, OPERATION, AND MAINTENANCE OF VEHICLE FENCE AND RELATED TACTICAL INFRASTRUCTURE

U.S. BORDER PATROL TUCSON SECTOR, DOUGLAS STATION, ARIZONA

U.S. Department of Homeland Security
U.S. Customs and Border Protection
U.S. Border Patrol

DECEMBER 2008

This document printed on paper that contains at least 30 percent postconsumer fiber.

EXECUTIVE SUMMARY

Introduction

On April 1, 2008, the Secretary of the U.S. Department of Homeland Security (DHS), pursuant to his authority under Section 102(c) of Illegal Immigration Reform and Immigrant Responsibility Act (IIRIRA), exercised his authority to waive certain environmental and other laws in order to ensure the expeditious construction of tactical infrastructure along the U.S./Mexico border. The tactical infrastructure described in this Environmental Stewardship Plan (ESP) is covered by the Secretary's April 1, 2008, waiver (73 Federal Register [FR] 65, pp. 18293-24, **Appendix A**). Although the Secretary's waiver means that U.S. Customs and Border Protection (CBP) no longer has any specific legal obligations under the laws that are included in the waiver, the Secretary committed DHS to responsible environmental stewardship of our valuable natural and cultural resources. CBP strongly supports this objective and remains committed to being a good steward of the environment. CBP will continue to work in a collaborative manner with local governments, state, and Federal land managers, and the interested public to identify environmentally sensitive resources and develop appropriate Best Management Practices (BMPs) to avoid or minimize adverse impacts resulting from the installation of tactical infrastructure.

CBP and U.S. Border Patrol (USBP) will construct, operate, and maintain approximately 16 miles of vehicle fence (VF) and related tactical infrastructure (TI) along the U.S/Mexico border in Cochise County, Arizona. TI is a term used by USBP to describe physical structures that facilitate enforcement activities; these items typically include, but are not limited to, roads, fences, lights, gates, boat ramps, and barriers.

To that end, CBP has prepared the following ESP, which analyzes the potential environmental impacts associated with construction of tactical infrastructure in the USBP's Tucson Sector, Douglas Station. The ESP also discusses CBP plans to mitigate potential environmental impacts. The ESP further details the BMPs associated with the tactical infrastructure that CBP will implement during and after construction.

Goals and Objectives of the Project

The Project will provide U.S. Border Patrol (USBP) agents with the tools necessary to strengthen their control of the U.S. border between ports of entry (POEs) in the USBP Tucson Sector. The Project will help to deter illegal entries within the USBP Tucson Sector by improving enforcement efficiency, thus preventing terrorists and terrorist weapons, illegal aliens, drugs, and other cross-border violators and contraband from entering the United States, while providing a safer work environment for USBP agents. The USBP Tucson Sector has identified two discrete areas along the border that experience high levels of illegal entry. Illegal entry activity typically occurs in areas that are remote and not easily accessed by USBP agents, near POEs where concentrated populations might live on either side of the border, or in locations that have quick access to U.S. transportation routes.

The Project is being carried out pursuant to Section 102 of IIRIRA, 8 United States Code (U.S.C.) § 1103 note. In Section 102(b) of IIRIRA, Congress called for the installation of fencing, barriers, roads, lighting, cameras, and sensors on not less than 700 miles of the southwestern border. This total includes certain priority miles of fencing that are to be completed by December 2008. Section 102(b) further specifies that these priority miles are to be constructed in areas where they will be practical and effective in deterring smugglers and aliens attempting to gain illegal entry into the United States. Congress appropriated funds for this project in CBP's fiscal year (FY) 2007 and 2008 Border Security Fencing, Infrastructure, and Technology Appropriations (Public Law [P.L.] 109-295; P.L. 110-161).

Public Outreach and Coordination

To encourage public comment, CBP held a public open house in Sierra Vista, Arizona, to convey information on the project and other CBP projects in the Tucson Sector. This open house took place the evening of May 13, 2008. Comments were received by CBP and considered during the planning process. In addition, CBP notified relevant Federal, state, and local agencies of the Project and requested input on environmental concerns regarding the Project. CBP has coordinated with the U.S. Environmental Protection Agency (USEPA); U.S. Fish and Wildlife Service (USFWS); State Historic Preservation Office (SHPO); and other Federal, state, and local agencies. Meetings with interested agencies were conducted on May 21, 2008 and July 22, 2008.

Description of the Project

CBP plans to construct, operate, and maintain approximately 16 miles of tactical infrastructure in two discrete sections along the U.S./Mexico border near the City of Douglas, in the USBP Tucson Sector, Cochise County, Arizona. Tactical infrastructure will include approximately 9 miles of post-on rail and 7 miles of Normandy-style fence and access roads. The tactical infrastructure will be constructed in areas of the border that are not currently fenced. Locations are based on the USBP Tucson Sector's assessment of local operational requirements where such infrastructure will assist USBP agents in reducing illegal cross-border activities. The tactical infrastructure will encroach on multiple privately owned land parcels and public lands managed by the BLM and USFWS. Congress appropriated funds for this project in CBP's FY 2007 and 2008 Border Security Fencing, Infrastructure, and Technology Appropriations (P.L. 109-295, P.L. 110-161).

Summary of Environmental Impacts, Mitigation, and Best Management Practices

The following discussion elaborates on the nature of the characteristics that might relate to various impacts:

- *Short-term or long-term*. These characteristics are determined on a case-by-case basis and do not refer to any rigid time period. In general, short-term impacts are those that would occur only with respect to a particular activity or for a finite period or only during the time required for construction or installation activities. Long-term impacts are those that are more likely to be persistent and chronic.
- *Direct or indirect*. A direct impact is caused by an action and occurs contemporaneously at or near the location of the action. An indirect impact is caused by an action and might occur later in time or be farther removed in distance but still be a reasonably foreseeable outcome of the action.
- *Negligible, minor, moderate, or major*. These relative terms are used to characterize the magnitude or intensity of an impact. Negligible impacts are generally those that might be perceptible but are at the lower level of detection. A minor impact is slight, but detectable. A moderate impact is readily apparent. A major impact is one that is severely adverse or exceptionally beneficial.
- *Adverse or beneficial*. An adverse impact is one having adverse, unfavorable, or undesirable outcomes on the man-made or natural environment. A beneficial impact is one having positive outcomes on the man-made or natural environment. A single act might result in adverse impacts on one environmental resource and beneficial impacts on another resource.

Table ES-1 provides an overview of BMPs and mitigation measures by specific resource areas. **Chapter 3** and **4** of this ESP addresses impacts, BMPs, and mitigation in more detail.

CBP followed specially developed design criteria to reduce adverse environmental impacts and will implement best management practices and mitigation measures to further reduce or offset adverse environmental impacts. Design criteria to reduce adverse environmental impacts include selecting a route that will minimize impacts, consulting with Federal and state agencies and other stakeholders to avoid or minimize adverse environmental impacts, and developing appropriate BMPs to protect natural and cultural resources. Potential effects, including physical disturbance and construction of solid barriers on wetlands, riparian areas, streambeds, and floodplains, will be avoided or mitigated whenever possible. Construction contractor BMPs will include implementation of a Storm Water Pollution Prevention Plan (SWPPP), Construction Mitigation and Restoration (CM&R) Plan, Spill Prevention Control and Countermeasures (SPCC) Plan, Dust Control Plan, Fire Prevention and Suppression Plan, and Unanticipated Discovery Plan to protect natural and cultural resources.

Table ES-1. Summary of Anticipated Environmental Impacts

Resource Area	Impacts of the Project	BMPs/Mitigation
Air Quality	Emissions from the Project will not exceed the *de minimis* thresholds and will be less than 10 percent of the emissions inventory for Southeast Arizona Intrastate Air Quality Control Region (SEIAQCR).	Dust Control Plan.
Noise	Minor temporary increases to noise levels during construction activities will occur. There is one residence approximately 500 feet of the Project area. Noise effects to that residence are expected to be between approximately 65-72 dBA.	Equipment will be operated on an as-needed basis. A majority of the activities will occur away from population centers.
Land Use and Recreation	Approximately 3 miles of the San Bernardino National Wildlife Refuge, 2.0 miles of BLM land, 15 miles of the Roosevelt Reservation and 1 mile of private land will be impacted. The Project will result in indirect beneficial effects such as reduced habitat degradation.	None needed.
Aesthetics	There will be a minor permanent impact on aesthetics.	None needed.
Geology and Soils	Minor impacts to soils from a loss of biological production are expected as a result of new road construction. Construction of vehicle fence will have minor impacts.	Dust Control Plan and SWPPP.

Resource Area	Impacts of the Project	BMPs/Mitigation
Water Use and Quality		
Hydrology and Groundwater	Short-term, minor, direct, adverse construction-related impacts on groundwater resources is expected. Construction activities will require a temporary and one-time usage of 44.85 acre feet of water (14,625,000 gallons) for the entire length. Grading and contouring will result in short-term minor adverse impacts.	Revegetation of temporary staging areas, SWPPP, any applicable conservation methods as outlined by Arizona Department of Water Resources (ADWR).
Surface Waters and Waters of the United States	Construction will cause a minor and temporary impact on surface water resources from sedimentation and erosion. Impacts will be minimized through mitigation measures, as appropriate. Minor beneficial impacts on washes are expected from the reduction in cross-border traffic.	SWPPP, sediment and erosion control plans, wetlands mitigation and restoration plan.
Floodplains	The 100-year floodplains associated with the Black Draw and Hay Hollow Wash will be crossed by the tactical infrastructure, therefore negligible adverse impacts are expected. If possible, the floodplains will be avoided by limiting construction activities to beyond the reach of the floodplains along either side of Black Draw and Hay Hollow Wash.	Special fence design for stream crossings, planning guidance developed by the U.S. Army Corp of Engineers (USACE).
Biological Resources		
Vegetation	Permanent loss of 157.1 acres of vegetation communities, due to construction of tactical infrastructure. Approximately 49.7 acres of vegetation will be temporarily impacted via the staging area but will be rehabilitated upon completion of the construction activities.	Biological monitor on site to ensure all BMPs and mitigation plans are followed. Implementation of SWPPP, SPCC and CM&R plans, and Dust Control Plan.

Resource Area	Impacts of the Project	BMPs/Mitigation
Wildlife and Aquatic Species	Minor impacts on wildlife are expected from permanent loss of habitat. Potential loss of small mammals and reptiles during construction. Minor impacts on aquatic resources could result from increased sedimentation.	Construction start-date to consider migratory birds. Survey of nesting migratory birds. SWPPP, and sediment and erosion control plans.
Special Status Species	No direct effects to Federally listed species are expected. The Project may affect, but is not likely to adversely affect, the beautiful shiner, Yaqui chub, Yaqui catfish, Yaqui topminnow, Chiricahua leopard frog, yellow-billed cuckoo, jaguar, lesser long-nosed bat, Cochise pincushion cactus, and Huachuca water umbel.	Biological monitor on site to ensure all BMPs and mitigation plans are followed.
Cultural Resources	Adverse impacts to cultural resources.	The border monuments will be avoided and will not be impacted by construction activities. Mitigation for other cultural sites will include data recovery and the presence of archaeological monitors during construction to ensure recovery of data from unanticipated cultural resource finds.
Socioeconomic and Environmental Justice	Short-term minor beneficial impacts are expected from the procurement of construction materials and new employment opportunities.	None needed.
Hazardous Materials and Waste	Short- and long-term negligible to moderate adverse impacts will be expected.	SPCC and CM&R plans.

ENVIRONMENTAL STEWARDSHIP PLAN FOR THE CONSTRUCTION, OPERATION, AND MAINTENANCE OF VEHICLE FENCE AND RELATED TACTICAL INFRASTRUCTURE U.S. BORDER PATROL TUCSON SECTOR, DOUGLAS STATION, ARIZONA

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

APPENDICES

FIGURES

TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

1. INTRODUCTION

1.1 BACKGROUND

On April 1, 2008, the Secretary of the U.S. Department of Homeland Security (DHS), pursuant to his authority under Section 102(c) of the Illegal Immigration Reform and Immigrant Responsibility Act (IIRIRA), exercised his authority to waive certain environmental and other laws in order to ensure the expeditious construction of tactical infrastructure along the U.S./Mexico border. The tactical infrastructure described in this Environmental Stewardship Plan (ESP) is covered by the Secretary's April 1, 2008, waiver (73 Federal Register [FR] 65, pp. 18293-24, **Appendix A**). Although the Secretary's waiver means that U.S. Customs and Border Protection (CBP) no longer has any specific legal obligations under the laws that are included in the waiver, the Secretary committed DHS to responsible environmental stewardship of our valuable natural and cultural resources. CBP strongly supports this objective and remains committed to being a good steward of the environment. CBP will continue to work in a collaborative manner with local governments, state and Federal land managers, and the interested public to identify environmentally sensitive resources and develop appropriate Best Management Practices (BMPs) to avoid or minimize adverse impacts resulting from the installation of tactical infrastructure.

To that end, CBP has prepared this ESP, which analyzes the potential environmental impacts associated with construction of tactical infrastructure in the USBP's Tucson Sector. The ESP also discusses CBP plans to mitigate potential environmental impacts. The ESP further details the BMPs associated with the tactical infrastructure that CBP will implement during, and after construction.

1.2 GENERAL GOALS AND OBJECTIVES

The Project will provide U.S. Border Patrol (USBP) agents with the tools necessary to strengthen their control of the U.S. border between ports of entry (POEs) in the USBP Tucson Sector. The Project will help to deter illegal entries within the USBP Tucson Sector by improving enforcement efficiency, thus preventing terrorists and terrorist weapons, illegal aliens, drugs, and other cross-border violators and contraband from entering the United States, while providing a safer work environment for USBP agents. The USBP Tucson Sector has identified two discrete areas along the border that experience high levels of illegal entry. Illegal entry activity typically occurs in areas that are remote and not easily accessed by USBP agents, near POEs where concentrated populations might live on either side of the border, or in locations that have quick access to U.S. transportation routes.

The Project is being carried out pursuant to Section 102 of IIRIRA, 8 United States Code (U.S.C.) § 1103 note. In Section 102(b) of IIRIRA, Congress called for the installation of fencing, barriers, roads, lighting, cameras, and sensors on not less than 700 miles of the southwestern border. This total includes certain priority miles of fencing that are to be completed by December 2008. Section 102(b) further specifies that these priority miles are to be constructed in areas where it will be practical and effective in deterring smugglers and aliens attempting to gain illegal entry into the United States. Congress appropriated funds for this project in CBP's fiscal year (FY) 2007 and 2008 Border Security Fencing, Infrastructure, and Technology Appropriations (Public Law [P.L.] 109-295, P.L. 110-161).

1.3 INTRODUCTION TO THE ENVIRONMENTAL STEWARDSHIP PLAN

This ESP is divided in to six chapters plus appendices. The first chapter presents an overview of the ESP and the planned Project. **Chapter 2** presents a detailed description of the Project. Subsequent chapters present information on the resources present, and evaluate the direct, indirect, and cumulative effects of the Project. The ESP also describes measures CBP has identified—in consultation with Federal, state, and local agencies—to avoid, minimize, or mitigate impacts on the environment, whenever practicable. The following resource areas are presented in this ESP: air quality, noise, land use and recreation, aesthetics, geology and soils, water use and quality, biological resources (i.e., vegetation resources, wildlife and aquatic species, special status species); cultural resources, socioeconomics and environmental justice, and hazardous materials and wastes. Some environmental resources were not included in this ESP because they were not relevant to the analysis. These potential resource areas include utilities and infrastructure (omitted because the Project will not impact any utilities or similar infrastructure), roadways and traffic (omitted because the Project will not be accessible from public roadways), sustainability (omitted because the Project will use minimal amounts of resources during construction and maintenance), and human health and safety (omitted because construction workers will be subject to Occupational Safety and Health Administration [OSHA] standards and the Project will not introduce new or unusual safety risks).

CBP will follow specially developed criteria to reduce adverse environmental impacts and will implement mitigation measures to further reduce or offset adverse environmental impacts to the extent practicable. Mitigation measures to reduce adverse environmental impacts include avoiding physical disturbance and construction of barriers in wetlands/riparian areas and streambeds, where practicable. Consultation with Federal and state agencies and other stakeholders will augment efforts to avoid or minimize adverse environmental impacts. Appropriate BMPs to protect natural and cultural resources will be utilized to the extent practicable. BMPs will include implementation of a Storm Water Pollution Prevention Plan (SWPPP), Construction Mitigation and Restoration (CM&R) Plan, Spill Prevention Control and Countermeasures

(SPCC) Plan, Dust Control Plan, Fire Prevention and Suppression Plan, and Unanticipated Discovery Plan to protect natural and cultural resources.

1.4 PUBLIC OUTREACH AND AGENCY COORDINATION

Although the Secretary's waiver means that CBP no longer has any specific legal obligations under the laws that are included in the waiver, the Secretary committed DHS to responsible environmental stewardship of our valuable natural and cultural resources. CBP strongly supports this objective and remains committed to being a good steward of the environment. CBP will continue to work in a collaborative manner with local governments, state, and Federal land managers; and the interested public. CBP also continues to work closely with stakeholders and private landowners to address their concerns; this may also include compensation for land used for permanent border access, if required.

A public open house and 15-day public review and comment period were advertised in the *Arizona Daily Star* and *Sierra Vista Herald*. The public open house was held in Sierra Vista, Arizona, on May 13, 2008 and was attended by 25 people. CBP notified relevant Federal, state, and local agencies of the Project and requested input on environmental concerns regarding the Project. CBP has coordinated with the U.S. Environmental Protection Agency (USEPA); U.S. Fish and Wildlife Service (USFWS); State Historic Preservation Office (SHPO); and other Federal, state, and local agencies. Documents concerning public outreach and agency coordination can be found in **Appendix B**. Meetings with interested Federal and state agencies and Tribal Nations were held on May 21, 2008 and July 22, 2008. Agency comments have been considered and incorporated into the analysis of potential environmental impacts.

1.5 SUMMARY OF ENVIRONMENTAL IMPACTS, BMPS, AND MITIGATION

CBP applied various criteria to reduce adverse environmental impacts associated with the Project, including selecting alignments that will avoid or minimize effects on environmental and cultural resources. Nonetheless, CBP has determined that construction, operation, and maintenance of tactical infrastructure in USBP Tucson Sector will result in adverse environmental impacts. These impacts will be most adverse during construction. BMPs and mitigation actions planned are included in **Table 1-1**.

Table 1-1. Summary of Planned Mitigation and BMPs

Resource Area	Impacts of the Project	BMPs/Mitigation
Air Quality	Emissions from the Project will not exceed the *de minimis* thresholds and will be less than 10 percent of the emissions inventory for Southeast Arizona Intrastate Air Quality Control Region (SEIAQCR).	Dust Control Plan.
Noise	Minor temporary increases to noise levels during construction activities will occur. There is one residence approximately 500 feet of the Project area. Noise effects to that residence are expected to be between approximately 65-72 dBA.	Equipment will be operated on an as-needed basis. A majority of the activities will occur away from population centers.
Land Use and Recreation	Approximately 3 miles of the San Bernardino National Wildlife Refuge, 2.0 miles of BLM land, 15 miles of the Roosevelt Reservation and 1 mile of private land will be impacted. The Project will result in indirect beneficial effects such as reduced habitat degradation	None needed.
Aesthetics	There will be a minor permanent impact on aesthetics.	None needed.
Geology and Soils	Minor impacts to soils from a loss of biological production are expected as a result of new road construction. Construction of vehicle fence will have minor impacts.	Dust Control Plan and SWPPP.
Water Use and Quality		
Hydrology and Groundwater	Short-term, minor, direct, adverse construction-related impacts on groundwater resources is expected. Construction activities will require a temporary and one-time usage of 44.85 acre feet of water (14,625,000 gallons) for the entire length. Grading and contouring will result in short-term minor adverse impacts.	Revegetation of temporary staging areas, SWPPP, any applicable conservation methods as outlined by Arizona Department of Water Resources (ADWR).

Resource Area	Impacts of the Project	BMPs/Mitigation
Surface Waters and Waters of the United States	Construction will cause a minor and temporary impact on surface water resources from sedimentation and erosion. Impacts will be minimized through mitigation measures, as appropriate. Minor beneficial impacts on washes are expected from the reduction in cross-border traffic.	SWPPP, sediment and erosion control plans, wetlands mitigation and restoration plan.
Floodplains	The 100-year floodplains associated with the Black Draw and Hay Hollow Wash will be crossed by the tactical infrastructure, therefore negligible adverse impacts are expected. If possible, the floodplains will be avoided by limiting construction activities to beyond the reach of the floodplains along either side of Black Draw and Hay Hollow Wash.	Special fence design for stream crossings, planning guidance developed by the U.S. Army Corp of Engineers (USACE).
Biological Resources		
Vegetation	Permanent loss of 157.1 acres of vegetation communities, due to construction of tactical infrastructure. Approximately 49.7 acres of vegetation will be temporarily impacted via the staging area but will be rehabilitated upon completion of the construction activities.	Biological monitor on site to ensure all BMPs and mitigation plans are followed. Implementation of SWPPP, SPCC and CM&R plans, and Dust Control Plan.
Wildlife and Aquatic Species	Minor impacts on wildlife are expected from permanent loss of habitat. Potential loss of small mammals and reptiles during construction. Minor impacts on aquatic resources could result from increased sedimentation.	Construction start-date to consider migratory birds. Survey of nesting migratory birds. SWPPP, and sediment and erosion control plans.
Special Status Species	No direct effects to Federally listed species are expected. The Project may affect, but is not likely to adversely affect, the beautiful shiner, Yaqui chub, Yaqui catfish, Yaqui topminnow, Chiricahua leopard frog, yellow-billed cuckoo, jaguar, lesser long-nosed bat, Cochise pincushion cactus, and Huachuca water umbel.	Biological monitor on site to ensure all BMPs and mitigation plans are followed.

Resource Area	Impacts of the Project	BMPs/Mitigation
Cultural Resources	Adverse impacts to cultural resources.	The border monuments will be avoided and will not be impacted by construction activities. Mitigation for other cultural sites will include data recovery and the presence of archaeological monitors during construction to ensure recovery of data from unanticipated cultural resource finds.
Socioeconomic and Environmental Justice	Short-term minor beneficial impacts are expected from the procurement of construction materials and new employment opportunities.	None needed.
Hazardous Materials and Waste	Short- and long-term negligible to moderate adverse impacts will be expected.	SPCC and CM&R plans.

2. GENERAL PROJECT DESCRIPTION

CBP plans to construct, operate, and maintain approximately 16 miles of tactical infrastructure to include approximately 9 miles of post-on rail fence and 7 miles of Normandy-style fence, and access roads along the U.S./Mexico border in the USBP Tucson Sector, Arizona. Two sections of tactical infrastructure will be constructed. These two sections of tactical infrastructure are designated as Section FV-1B and consist of primary vehicle fence and construction access roads. **Table 2-1** presents general information for both sections. **Figures 2-1** through **2-3** show the location of the tactical infrastructure within the USBP Tucson Sector's Douglas Station area of responsibility.

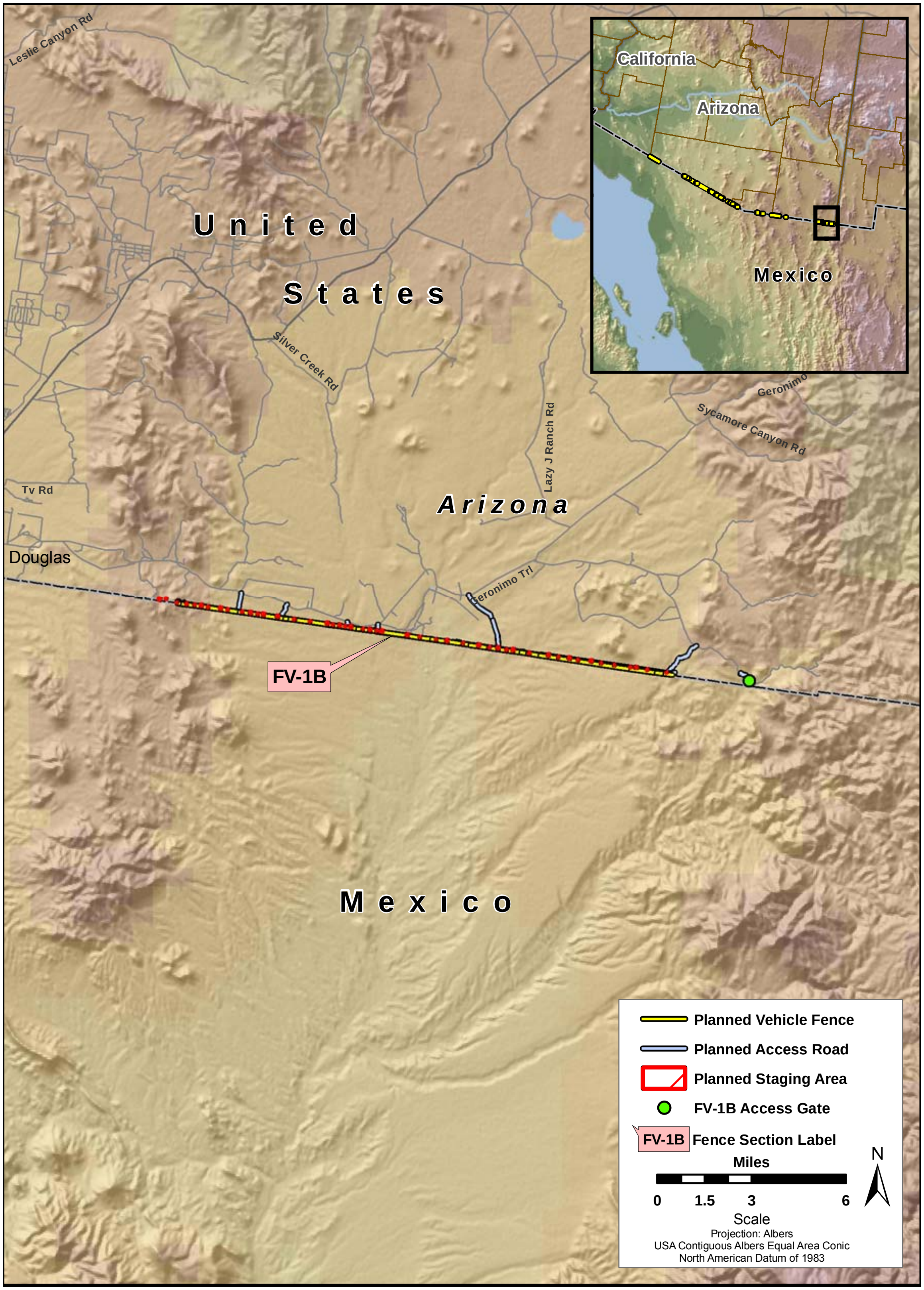
Table 2-1. Tactical Infrastructure for Section FV-1B, USBP Tucson Sector

General Location	Land Ownership	Type of Tactical Infrastructure	Length of New Fence Section/Length of Construction Access Roads
East of the City of Douglas	Private, Public, USWFS, BLM, Arizona State Lands	Primary vehicle fence, access roads	15.75/5.0miles
Near Guadalupe Canyon	Private, BLM	Primary vehicle fence, access roads	0.5/0.5 miles
		Total	**16.25/5.5 miles**

The tactical infrastructure will be constructed in areas of the border that are not currently fenced. The locations of tactical infrastructure are based on a USBP Tucson Sector assessment of local operational requirements where such infrastructure will assist USBP agents in reducing illegal cross-border activities. The 16 miles of vehicle fence will include approximately 9 miles of post-on rail fence (see **Figure 2-4**) and 7 miles of Normandy-style fence (see **Figure 2-5**). Individual sections of post-on rail and Normandy-style fence will range from approximately 0.06 miles to 2.93 miles in length. Normandy-style fence primarily will be used in washes and in steeper portions of the project corridor.

Design criteria that have been established based on USBP operational needs require that, at a minimum, any primary vehicle fencing must meet the following requirements:

- Built 4 to 6 feet high and extend below ground
- Capable of withstanding a crash of a 10,000-pound (gross weight) vehicle traveling at 40 miles per hour



Source: ESRI StreetMap USA 2005

Figure 2-1. Location of Tactical Infrastructure

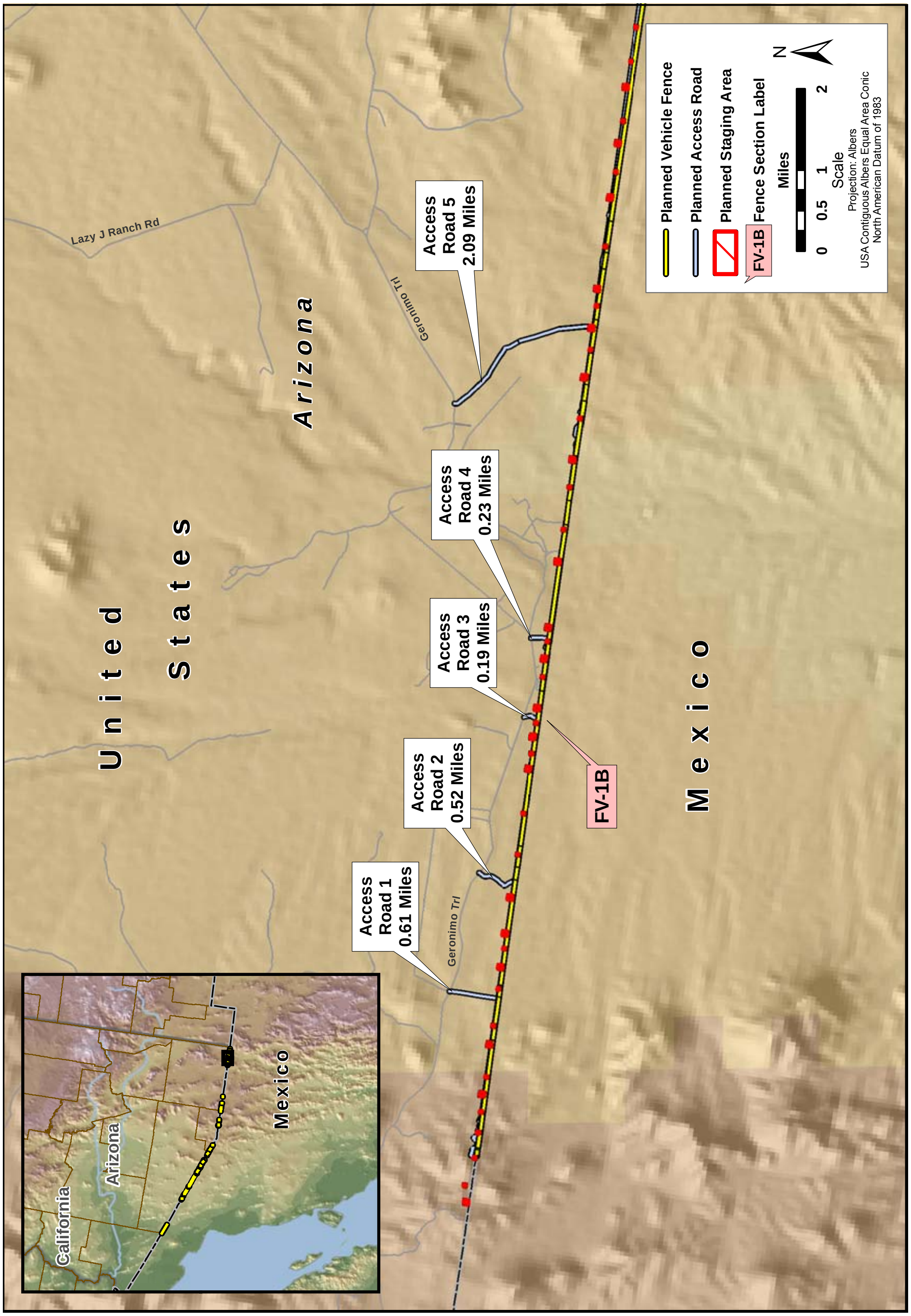
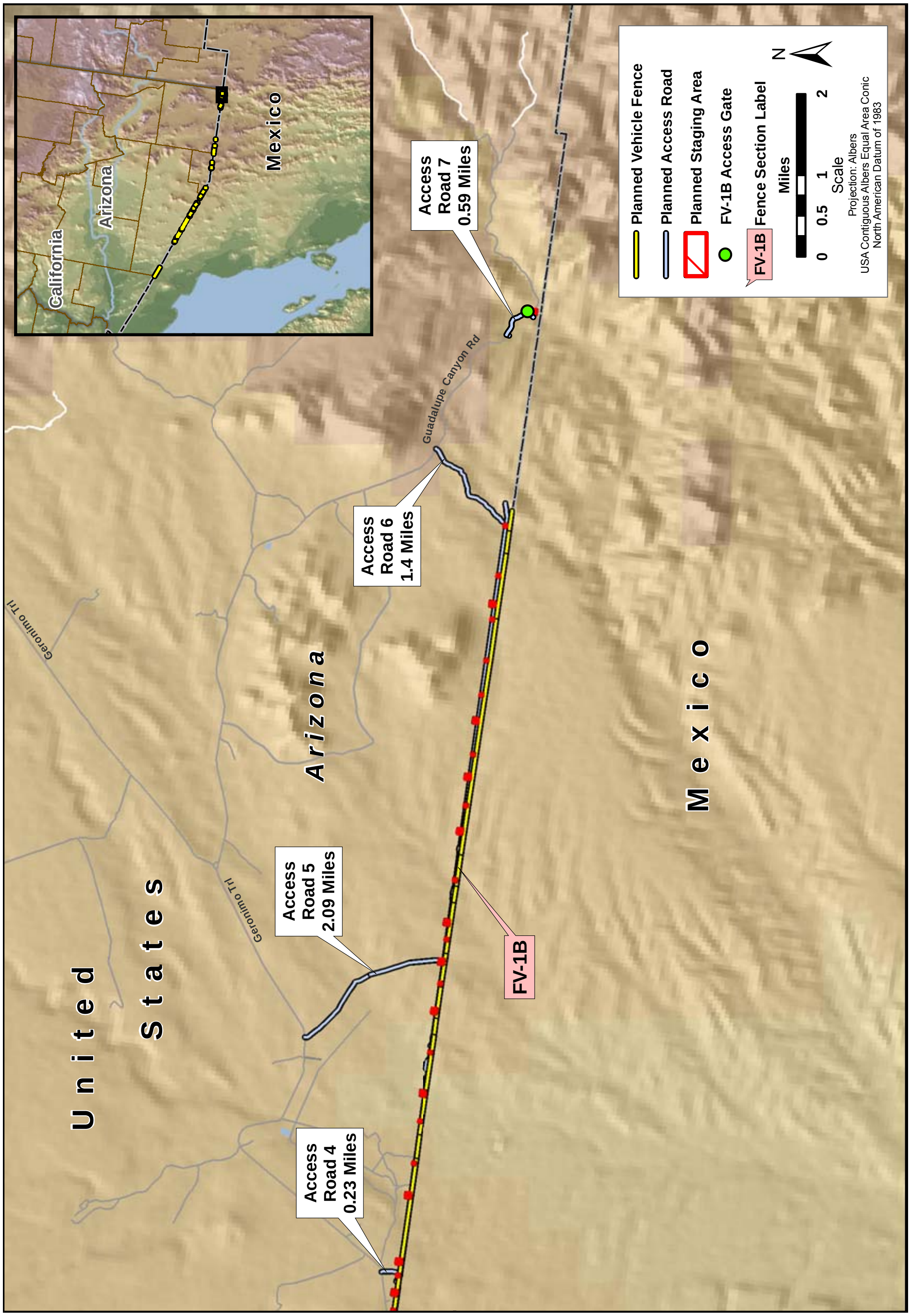


Figure 2-2. Western Section of Tactical Infrastructure



Source: ESRI StreetMap USA 2005

Figure 2-3. Eastern Section of Tactical Infrastructure

Figure 2-4. Photograph of Post-on Rail Fence

Figure 2-5. Photograph of Normandy-style Fence

- Capable of withstanding vandalism, cutting, or various types of penetration
- Designed to survive extreme climate changes
- Designed to reduce or minimize impacts on small animal movements
- Engineered to reduce the disturbance of the natural flow of surface water by utilizing Normandy-style vehicle barrier
- Aesthetically pleasing to the extent possible.

In addition, the United States Section, International Boundary and Water Commission (USIBWC) has design criteria for tactical infrastructure to avoid adverse impact on floodplains, levees, and flood control operations (IBWC 2007, IBWC 2008).

The tactical infrastructure will be installed approximately 3 feet north of the U.S./Mexico border within the Roosevelt Reservation[1] (see also **Section 3.4.2** and **Appendix C**). The tactical infrastructure will be constructed around USIBWC monuments. The tactical infrastructure will impact an approximate 60-foot-wide corridor along each fence section. Only the far eastern portion of the vehicle barrier will be constructed completely outside the Roosevelt Reservation. It will be constructed on BLM and private land under an agreement with the land owners.

Wherever possible, existing roads and previously disturbed areas will be used for construction access and staging areas. Any necessary aggregate or fill material will be clean material obtained by construction contractors from available sources that will not pose an adverse impact on biological or cultural resources.

The fence will be made from nonreflective steel. No painting will be required. Fence maintenance will include removing any accumulated debris on the fence after a rain event to avoid potential future flooding. It is anticipated that the Normandy-style fence placed within the washes will sufficiently allow storm water and debris through during rain events. Following storm events the washes will be patrolled for large storm debris and the debris will be removed. It is anticipated that the Normandy-style fence will be adequately anchored to the bottom and sides of washes.

Sand that builds up against the fence and brush will also be removed, as needed. Brush removal could include mowing, removal of small trees, and

[1] In 1907, President Roosevelt reserved from entry and set apart as a public reservation all public lands within 60 feet of the international boundary between the United States and Mexico within the State of California and the Territories of Arizona and New Mexico. Known as the "Roosevelt Reservation," this land withdrawal was found "necessary for the public welfare ... as a protection against the smuggling of goods." The proclamation excepted from the reservation all lands, which, as of its date, were (1) embraced in any legal entry; (2) covered by any lawful filing, selection, or rights of way duly recorded in the proper U.S. Land Office; (3) validly settled pursuant to law; or (4) within any withdrawal or reservation for any use or purpose inconsistent with its purposes (CRS 2006).

application of herbicide, if needed. Any destruction or breaches of the fence will be repaired, as needed.

Construction of other tactical infrastructure might be required in the future as mission and operational requirements are continually reassessed. To the extent that other current and future actions are known, they are discussed in **Chapter 5**, Related Projects and Potential Effects.

THIS PAGE INTENTIONALLY LEFT BLANK

3. ENVIRONMENTAL BASELINE AND EVALUATION

3.1 INTRODUCTION

CBP has compiled extensive information (summarized here) about the environmental resources that might be affected by the construction, operation, and maintenance of tactical infrastructure along the U.S./Mexico border. CBP used this information to establish the baseline against which it evaluated the impacts of the construction, operation, and maintenance of the vehicle fence and supporting infrastructure. CBP obtained baseline environmental information from many sources, including site visits, field work, personal communications, and data from reputable sources such as Federal and state agencies.

The following resource areas are presented in this ESP: air quality, noise, land use and recreation, aesthetics, geology and soils, water use and quality, biological resources (i.e., vegetation resources, wildlife and aquatic species, special status species), cultural resources, socioeconomics and environmental justice, and hazardous materials and wastes. Some environmental resources were not included in this ESP because they were not relevant to the analysis. These potential resource areas include utilities and infrastructure (omitted because the Project will not impact any utilities or similar infrastructure), roadways and traffic (omitted because the Project will not be accessible from heavily traveled public roadways), sustainability (omitted because the Project will use minimal amounts of resources during construction and maintenance), and human health and safety (omitted because construction workers will be subject to OSHA standards and the Project will not introduce new or unusual safety risks).

3.2 AIR QUALITY

3.2.1 Definition of the Resource

Although the Secretary's waiver means that CBP no longer has any specific legal obligations under the Clean Air Act (CAA) for the tactical infrastructure segments addressed in this ESP, the Secretary committed CBP to continue to protect valuable natural and cultural resources. CBP supports this objective and has applied the appropriate standards and guidelines associated with the CAA as the basis for evaluating potential environmental impacts and appropriate mitigations.

The air quality in a given region or area is measured by the concentration of various pollutants in the atmosphere. The measurements of these "criteria pollutants" in ambient air are expressed in units of parts per million (ppm), micrograms per cubic meter ($\mu g/m^3$), or milligrams per cubic meter (mg/m^3).

The CAA directed USEPA to develop National Ambient Air Quality Standards (NAAQS) for pollutants that have been determined to affect human health and the environment. NAAQS are currently established for six criteria air pollutants:

ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), respirable particulate matter (including particulates equal to or less than 10 microns in diameter [PM_{10}] and particulates equal to or less than 2.5 microns in diameter [$PM_{2.5}$]), and lead (Pb). The primary NAAQS are ambient air quality standards to protect the public health; secondary NAAQS specify levels of air quality to protect the public welfare such as effects on vegetation, crops, wildlife, economic values, and visibility.

States designate any area that does not meet the national primary or secondary ambient air quality standard for a criteria pollutant as a nonattainment area. For O_3, each designated nonattainment area is classified as marginal, moderate, serious, severe, or extreme, based on ambient O_3 concentrations. The Arizona Department of Environmental Quality (ADEQ) has responsibility for implementation of the Federal CAA.

The State of Arizona adopted the NAAQS for criteria pollutants. No additional State Ambient Air Quality Standards (SAAQS) have been promulgated by the State of Arizona. **Table 3-1** presents the primary and secondary USEPA NAAQS.

These programs are detailed in State Implementation Plans (SIPs), which are required to be developed by each state or local regulatory agency and approved by USEPA. A SIP is a compilation of regulations, strategies, schedules, and enforcement actions designed to move the state into compliance with all NAAQS. Any changes to the compliance schedule or plan (e.g., new regulations, emissions budgets, controls) must be incorporated into the SIP and approved by USEPA. USEPA has delegated the authority for ensuring compliance with the NAAQS to ADEQ. USEPA classifies the air quality in an air quality control region (AQCR), or in subareas of an AQCR, according to whether the concentrations of criteria pollutants in ambient air exceed the NAAQS. All areas within each AQCR are therefore designated as either “attainment,” “nonattainment,” “maintenance,” or “unclassified” for each of the six criteria pollutants. Attainment means that the air quality within an AQCR is better than the NAAQS, nonattainment indicates that criteria pollutant levels exceed NAAQS, maintenance indicates that an area was previously designated nonattainment but is now attainment, and unclassified means that there is not enough information to appropriately classify an AQCR, so the area is considered attainment.

Prior to approval of any Federal action, the General Conformity Rule (GCR) (Title 40 CFR Part 51.853) states that a “a conformity determination is required for each criteria pollutant or precursor where the total of direct and indirect emissions of the criteria pollutant or precursor in a nonattainment or maintenance area caused by a Federal action would equal or exceed” (40 CFR 51.853 b) any of the threshold screening rates specified in the GCR. This requires the responsible Federal agency of a Federal action to determine the following:

Table 3-1. National Ambient Air Quality Standards

Pollutant	Averaging Time	National Standard	
		Primary	Secondary
O_3	1 Hour [c]	0.12 ppm	Same as Primary Standard
	8 Hours [b]	0.08 ppm (157 μg/m^3)	
	8 Hours	0.075 ppm[g]	
PM_{10}	24 Hours [a]	150 μg/m^3	Same as Primary Standard
$PM_{2.5}$	24 Hours [f]	35 μg/m^3	Same as Primary Standard
	Annual Arithmetic Mean [e]	15 μg/m^3	
CO	8 Hours [a]	9.0 ppm (10 mg/m^3)	None
	1 Hour [a]	35 ppm (40 mg/m^3)	
NO_2	Annual Arithmetic Mean	0.053 ppm (100 μg/m^3)	Same as Primary Standard
SO_2	Annual Arithmetic Mean	0.030 ppm (80 μg/m^3)	----
	24 Hours [a]	0.14 ppm (365 μg/m^3)	----
	3 Hours [a]	----	0.5 ppm (1,300 μg/m^3)
Pb	Quarterly Average	1.5 μg/m^3	Same as Primary Standard

Sources: USEPA 2008

Notes: Parenthetical values are approximate equivalent concentrations.

[a] Not to be exceeded more than once per year.

[b] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

[c] (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1. (b) As of June 15, 2005, USEPA revoked the 1-hour ozone standard in all areas except the 14 8-hour ozone nonattainment Early Action Compact Areas.

[d] To attain this standard, the expected annual arithmetic mean PM_{10} concentration at each monitor within an area must not exceed 50 μg/m^3.

[e] To attain this standard, the 3-year average of the annual arithmetic mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 μg/m^3.

[f] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 μg/m^3.

[g] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008).

- Does the project generate emissions of criteria pollutants or their precursors?
- Does the project generate emissions of criteria pollutants or their precursors in a federally designated nonattainment or a federally designated maintenance area for each pollutant?
- Is the project exempt based on criteria listed in the GCR?
- Are emissions of criteria pollutants or their precursors resulting from the project below applicable screening threshold rates (and therefore, exempt from conformity determination requirements)?
- Are emissions of criteria pollutants or their precursors resulting from the project above applicable screening threshold rates (therefore, conformity determination requirements apply and a formal conformity determination would be needed for the project)?

Many chemical compounds found in the Earth's atmosphere act as "greenhouse gases." These gases allow sunlight to enter the atmosphere freely. When sunlight strikes the Earth's surface, some of it is reflected back towards space as infrared radiation (heat). Greenhouse gases absorb this infrared radiation and trap the heat in the atmosphere. Over time, barring other influences, the trapped heat results in the phenomenon known as global warming.

In Massachusetts v. EPA, the Supreme Court ruled that the CAA authorizes regulation of greenhouse gases (GHGs) because they meet the definition of air pollutant under the CAA (Massachusetts v. EPA, 127 S. Ct. 1438 [2007]). The Court ruled that the USEPA has the authority to regulate emissions from new cars and trucks under the CAA.

Many gases exhibit these "greenhouse" properties. The sources of the majority of greenhouse gases come mostly from natural sources but are also contributed to by human activity.

3.2.2 Environmental Setting

The Project is within Cochise County, Arizona. Cochise County is within the Southeast Arizona Intrastate Air Quality Control Region (SEIAQCR). The SEIAQCR encompasses Cochise, Graham, Greenlee and Santa Cruz counties, Arizona. Cochise County has been designated as a Federal moderate nonattainment area for PM_{10} and attainment/unclassified for all other criteria pollutants. Air quality in this region is monitored by the ADEQ.

3.2.3 Effects of the Project

The Federal *de minimis* threshold emissions rates were established by USEPA in the General Conformity Rule to focus analysis requirements on those Federal actions with the potential to substantially affect air quality. **Table 3-2** presents these thresholds, by regulated pollutant. As shown in **Table 3-2**, *de minimis* thresholds vary depending on the severity of the nonattainment area classification.

Table 3-2. Conformity *de minimis* Emissions Thresholds

Pollutant	Status	Classification	*de minimis* Limit (tpy)
O_3 (measured as NO_x or VOCs)	Nonattainment	Extreme Severe Serious Moderate/marginal (inside ozone transport region) All others	10 25 50 50 (VOCs)/100 (NO_x) 100
	Maintenance	Inside ozone transport region Outside ozone transport region	50 (VOCs)/100 (NO_x) 100
CO	Nonattainment/ maintenance	All	100
PM_{10}	Nonattainment/ maintenance	Serious Moderate Not Applicable	70 100 100
$PM_{2.5}$ (measured directly, as SO_2, or as NO_x)	Nonattainment/ maintenance	All	100
SO_2	Nonattainment/ maintenance	All	100
NO_x	Nonattainment/ maintenance	All	100

Source: 40 Code of Federal Regulations (CFR) 93.153

According to 40 CFR 93.153, a conformity determination is required for each pollutant where the total of direct and indirect emissions in a nonattainment or maintenance area caused by a Federal action would equal or exceed any of the limits shown in **Table 3-2**. Since Cochise County has been designated as a Federal moderate nonattainment area for PM_{10}, direct or indirect PM_{10} emissions above 100 tpy would require a conformity determination.

The USEPA has not promulgated an ambient standard or *de minimis* level for CO_2 emissions for Federal actions, so there is no standard value to compare an action against in terms of meeting or violating the standard.

Regulated pollutant emissions associated with the Proposed Project will not contribute to or affect local or regional attainment status with the NAAQS. The

Proposed Project will generate minor air pollutant emissions from the proposed construction projects, the operation of an emergency generator, and a slight increase in maintenance activities.

Construction Actions. The construction actions will generate total suspended particulate and PM_{10} emissions as fugitive dust from ground-disturbing activities (e.g., minor grading and trenching) and from combustion of fuels in construction equipment. Fugitive dust emissions will be greatest during the initial site-preparation activities and will vary from day to day depending on the construction phase, level of activity, and prevailing weather conditions. The quantity of uncontrolled fugitive dust emissions from a construction site is proportional to the area of land being worked and the level of construction activity. Estimated ground disturbance associated with the Project will total approximately 175 acres and will occur in stages as fence is constructed. CBP will develop a Dust Control Plan and implement best available control measures for PM_{10} during construction and earthmoving activities.

Construction actions will also result in emissions of criteria pollutants as combustion products from construction equipment. These emissions will be of a temporary nature. For purposes of this analysis, the project duration and affected project site area that will be disturbed was used to estimate fugitive dust and all other criteria pollutant emissions. The construction emissions presented in **Table 3-3** include the estimated annual construction PM_{10} emissions associated with the Project. **Appendix F** contains the detailed spreadsheets for calculation of air emissions. These emissions will produce elevated short-term PM_{10} ambient air concentrations. However, the effects will be temporary, and will fall off rapidly with distance from the construction sites. Uncontrolled fugitive dust emissions (PM_{10} and $PM_{2.5}$) from the Project might exceed *de minimis* threshold levels (100 tpy) for Cochise County. However, CBP will develop a Dust Control Plan and implement best available control measures for PM_{10} and $PM_{2.5}$ during construction and earthmoving activities such as frequent watering and covering exposed dust piles to reduce fugitive dust emissions by 50 percent. With the implementation of the Dust Control Plan and best available control measures, construction fugitive dust emissions resulting from the Project will not exceed the *de minimis* threshold limits and will not exceed 10 percent of the regional air emissions values.

Specific information describing the types of construction equipment required for a specific task, the hours the equipment is operated, and the operating conditions vary widely from project to project. For purposes of analysis, these parameters were estimated using established methodologies for construction and experience with similar types of construction projects. Combustion by-product emissions from construction equipment exhausts were estimated using USEPA's NONROAD Model emissions factors for construction equipment. As with fugitive dust emissions, combustion emissions will produce slightly elevated air pollutant concentrations. Early phases of construction projects involve heavier diesel

Table 3-3. Total Construction Emissions Estimates

Description	NO_x (tpy)	VOC (tpy)	CO (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)
Construction Combustion Emissions	2.12	0.13	0.80	0.04	0.13	0.13
Construction Fugitive Emissions	--	--	--	--	73.16	7.32
Construction Generator Emissions	6.03	0.49	1.30	0.40	0.42	0.40
Maintenance Emissions	0.31	0.04	0.29	0.0003	0.01	0.01
Total Project Emissions	**8.46**	**0.66**	**2.39**	**0.44**	**73.72**	**7.85**
Federal *de minimis* Threshold	NA	NA	NA	NA	100	NA
SEIAQCR Regional Emissions	22,249	14,846	103,502	6,942	26,944	8,271
Percent of SEIAQCR Regional Emissions	**0.038%**	**0.004%**	**0.002%**	**0.006%**	**0.27%**	**0.095%**

Source: USEPA 2007

Note: Total $PM_{10/2.5}$ fugitive dust emissions assume a 50 percent control efficiency (EPA 2006).

equipment and earthmoving, resulting in higher NO_x and PM_{10} emissions. Later phases of construction projects involve more light gasoline equipment, resulting in more CO and VOC emissions. However, the effects will be temporary, fall off rapidly with distance from the construction site, and will not result in any long-term effects.

The Project is projected to require six diesel-powered generators to power construction equipment. These generators are estimated to be approximately 75 horsepower each and operated approximately 8 hours per day for 60 working days. In addition, approximately 30 portable light units are projected to be required for construction activities. The portable lights are powered by 8 horsepower diesel generators and operate approximately 12 hours per day for 60 working days. Operational emissions of construction generators associated with the Project are shown in **Table 3-3**. The emissions factors and estimates were generated based on guidance provided in USEPA AP-42, Volume I, *Stationary Internal Combustion Sources*.

Maintenance Activities. Minor long-term adverse impacts on air quality will be expected from maintenance activities. Minor, long-term adverse effects will be expected from increased maintenance. The estimated annual air emissions from long-term maintenance activities are shown in **Table 3-4**.

Table 3-4. Total Maintenance Vehicle Emissions Estimates from the Project

NO_x (tpy)	VOC (tpy)	CO (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	CO_2 (tpy)
0.31	0.04	0.29	0.0003	0.01	0.01	35.35

The construction of new tactical infrastructure will increase infrastructure maintenance activities within the USBP Tucson Sector. It is anticipated that future maintenance of tactical infrastructure will be conducted by contractors, and will primarily consist of welding and fence section replacements, as needed. In addition some maintenance activities will require the use of a bulldozer to clear sand as needed from fencing. Air emissions from maintenance activities are not expected to exceed *de minimis* levels for criteria pollutants and will have a negligible contribution to the overall air quality in the SEIAQCR, as shown in **Table 3-3** (USEPA 2007).

Greenhouse Gases. The Project will result in short-term CO_2 emissions from the operation of construction vehicles and generators. Operation of construction vehicles will result in an estimated 252 tons of CO_2, and operation of generators will result in an estimated 224 tons of CO_2. Therefore, short-term greenhouse gas emissions associated with construction activities will total approximately 476 tons of CO_2.

The USEPA has estimated that the total greenhouse emissions for Arizona were 89 million metric tons of CO_2 equivalent (MMTCE) in 1990 (Eredux.com 2008). The short-term CO_2 emissions associated with construction (476 tons) represent less than 0.001 percent of the estimated Arizona CO_2 inventory. Long-term increases in CO_2 emissions will result from maintenance activities (35 tpy) representing negligible fractions of the estimated Arizona CO_2 inventory. The Project will be expected to have a negligible contribution to CO_2 and greenhouse gases.

Summary. As shown in **Tables 3-3** and **3-4**, emissions from the Project will not exceed the *de minimis* thresholds for the SEIAQCR and will be less than 10 percent of the emissions inventory for SEIAQCR (USEPA 2008). Minor adverse impacts on local air quality will be anticipated from implementation of the Project.

A conformity determination in accordance with 40 CFR 93-153(1) is not required, as the total of direct and indirect emissions from the Project will not be regionally significant (e.g., the emissions are not greater than 10 percent of the SEIAQCR emissions inventory). Emissions factors, calculations, and estimates of emissions for the Project are shown in detail in **Appendix F**.

3.3 NOISE

3.3.1 Definition of the Resource

Although the Secretary's waiver means that CBP no longer has any specific legal obligations under the laws included in the waiver, the Secretary committed CBP to responsible environmental stewardship of our valuable natural and cultural resources. CBP supports this objective and has applied the appropriate standards and guidelines for evaluating environmental impacts and mitigations with respect to noise.

Noise and sound share the same physical aspects, but noise is considered a disturbance while sound is defined as an auditory effect. Noise is defined as any sound that is undesirable because it interferes with communication, is intense enough to damage hearing, or is otherwise annoying. Noise can be intermittent or continuous, steady or impulsive, and can involve any number of sources and frequencies. It can be readily identifiable or generally nondescript. Human response to increased sound levels varies according to the source type, characteristics of the sound source, distance between source and receptor, receptor sensitivity, and time of day. How an individual responds to the sound source will determine if the sound is viewed as music to one's ears or as annoying noise. Affected receptors are specific (i.e., schools, churches, or hospitals) or broad (e.g., nature preserves or designated districts) areas in which occasional or persistent sensitivity to noise above ambient levels exists. Predictors of wildlife response to noise include noise type (i.e., continuous or intermittent), prior experience with noise, proximity to a noise source, stage in the breeding cycle, activity, and age. Potential impacts of noise on wildlife are discussed in **Chapter 3.8.2.3**.

Sound is defined as a particular auditory effect produced by a given source, for example the sound of rain on a rooftop. Sound is measured with instruments that record instantaneous sound levels in decibels. A-weighted sound level measurement is used to characterize sound levels that can be sensed by the human ear. "A-weighted" denotes the adjustment of the frequency range for what the average human ear can sense when experiencing an audible event.

Most people are exposed to sound levels of 50 to 55 A-weighted decibels (dBA) or higher on a daily basis. Studies specifically conducted to determine noise impacts on various human activities show that about 90 percent of the population is not significantly bothered by outdoor sound levels below 65 dBA (USEPA 1974).

Ambient Sound Levels. Noise levels in residential areas vary depending on the housing density and location. As shown in **Figure 3-1**, a suburban residential area is about 55 dBA, which increases to 60 dBA for an urban residential area, and 80 dBA in the downtown section of a city.

Construction Sound Levels. Building construction, modification, and demolition work can cause an increase in sound that is well above the ambient level. A variety of sounds come from graders, pavers, trucks, welders, and other work processes. **Table 3-5** lists noise levels associated with common types of construction equipment that are likely to be used during the construction of the Project. Construction equipment usually exceeds the ambient sound levels by 20 to 25 dBA in an urban environment and up to 30 to 35 dBA in a quiet suburban area.

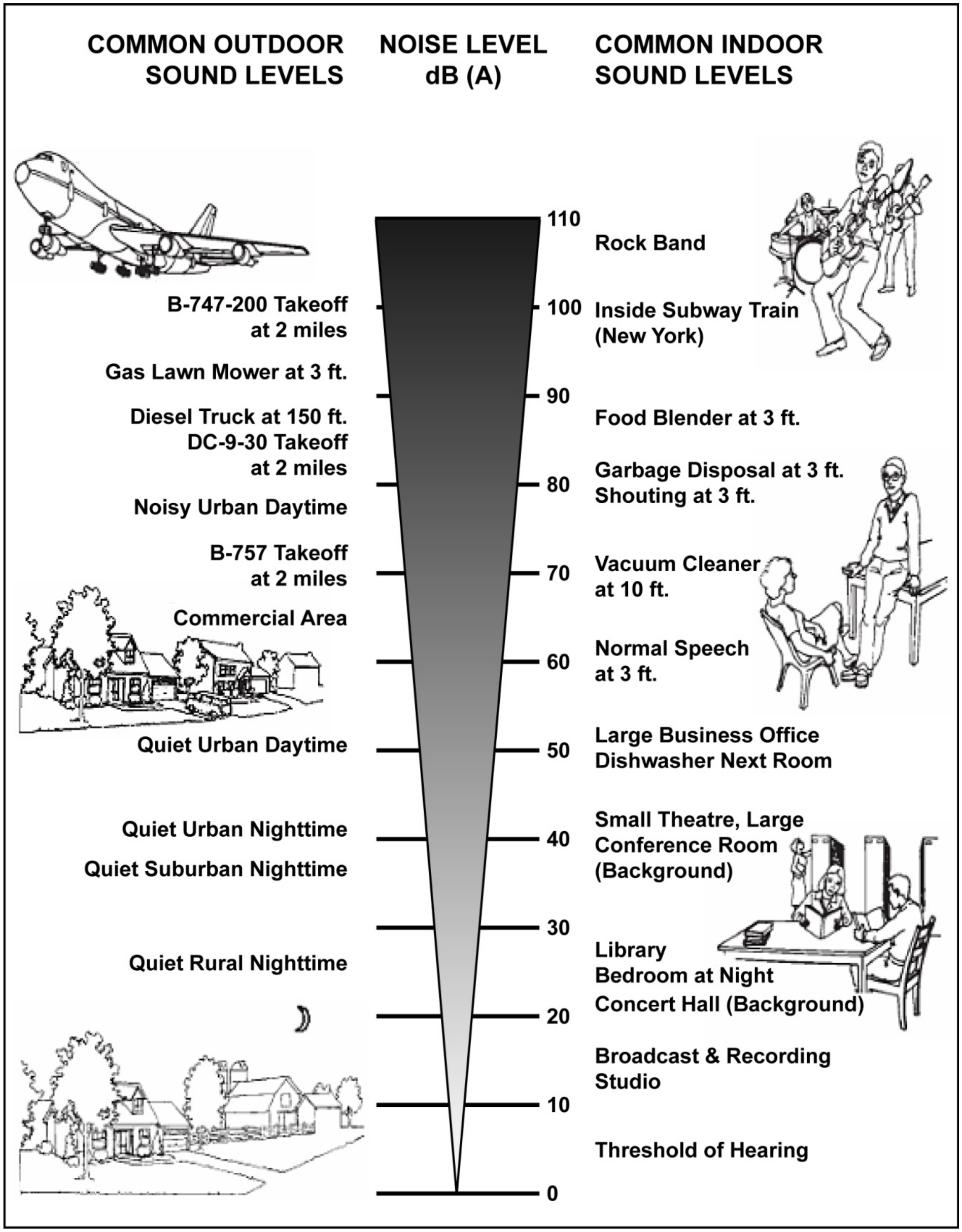
3.3.2 Affected Environment

While most of the land in the vicinity of the Project is open land, there are a few farms and ranches in the area. The ambient acoustical environment in the USBP Tucson Sector is primarily vehicular traffic, agricultural equipment, and natural noise sources, such as birds, wind, and wildlife. Along the western end of the Project area, the ambient acoustical environment is activities in Douglas, Arizona, including Douglas Municipal Airport.

The closest community to the impact corridor is the City of Douglas, Arizona, which is approximately 4 miles west. Noise from this community is not likely to have any significant noise impacts on the ambient acoustical environment at the western end of the Project area because of the distance and the mountain range acts like a buffer. Any noise impacts from Douglas will lessen along the impact corridor heading east along the border due to the increased distance from noise-generating activities in Douglas.

Douglas Municipal Airport is approximately 2.5 miles west of the western end of Section FV-1B. Used primarily by single-engine piston aircraft, Douglas Municipal Airport averages 31 operations per day (AirNav 2008). Operations from the airport are likely to contribute to the ambient acoustical environment along the western end of the Project area.

Agricultural areas are scattered along the Project area along the U.S./Mexico border in the USBP Tucson Sector. Agricultural equipment used in these areas can produce noise levels up to 100 dBA (OSU 2007). While the farms are generally spread out, noise from agricultural activities is likely to extend past the farm boundaries. Agricultural activities contribute to the ambient acoustical environment in the USBP Tucson Sector. These areas and the USBP Tucson Sector in general are ambient noise levels that are comparable to rural or suburban areas (25 to 55 dBA) (see **Figure 3-1**).



Source: Landrum & Brown 2002

Figure 3-1. Common Noise Levels

Table 3-5. Predicted Noise Levels for Construction Equipment

Construction Category and Equipment	Predicted Noise Level at 50 feet (dBA)
Clearing and Grading	
Bulldozer	80
Grader	80–93
Truck	83–94
Roller	73–75
Excavation	
Backhoe	72–93
Jackhammer	81–98
Building Construction	
Concrete mixer	74–88
Welding generator	71–82
Pile driver	91–105
Crane	75–87
Paver	86–88

Source: USEPA 1971

3.3.3 Effects of the Project

Short-term moderate adverse impacts are expected from the Project. Sources of noise from the implementation of the Project include operation of construction equipment and noise from construction vehicles utilizing public roads. Noise from construction activities and vehicle traffic can impact wildlife, as well as humans. Impacts on nesting, feeding, and migration could occur on various species due to construction noise. For specific information regarding impacts on wildlife from noise, see **Chapter 3.8.2.3**.

Construction Noise. The construction of the tactical infrastructure will result in temporary noise impacts on populations in the vicinity of the Project. Construction of the fence sections and access roads will result in noise from grading and construction activities. Grading refers to the act of leveling an area or road to a degree of inclination that vehicles can use it. In this case, several areas will need to be graded so that construction vehicles can traverse the difficult terrain between current roads and the border. Construction activities will include driving the posts into the ground and assembly of the rail.

Populations that could be impacted by construction noise include adjacent residents and personnel. Noise from construction activities was estimated from USEPA construction equipment noise levels (USEPA 1971). The noise levels were estimated from several different pieces of construction equipment operating simultaneously (see **Table 3-1**). Because noise attenuates over distance, a gradual decrease in noise levels occurs the farther a receptor is away from the source of noise. Consequently, noise levels from construction equipment will decrease as the distance increases from the source. At 50 feet the noise level will be approximately 85 dBA, at 300 feet the noise level will be approximately 70 dBA, and at 5,280 feet (i.e., 1 mile) the noise level will be approximately 45 dBA. The closest permanent residence that could be identified from aerial photography is approximately 500 feet from the Project area. At this distance, temporary noise from grading activities is expected to be approximately 72 dBA, and temporary noise from construction activities is expected to be approximately 65 dBA.

Implementation of the Project is expected to have temporary impacts on the noise environment from the use of heavy equipment during construction activities. Therefore, it is anticipated that implementation of the Project will have moderate short-term adverse impacts as a result of the construction activities.

Vehicular Noise. Noise impacts from increased construction traffic will be temporary. Although the access roads do not pass by many residential areas, construction vehicles from Douglas will traverse on main roads that pass by residential areas. Geronimo Trail, the major road utilized for access to the Project areas, becomes East 15th Street within the City of Douglas. East 15th Street passes by several residential areas throughout the city. Traffic along this road is likely to have adverse impacts on the populations nearby. However, construction activities will be temporary, and construction traffic along these roads will return to pre-Project levels when construction is complete. Therefore, it is anticipated that the Project will have short-term minor adverse noise impacts as a result of the increase in traffic, most notably in the areas east of the City of Douglas.

Equipment will be operated on an as-needed basis. A majority of the activities will occur away from population centers.

3.4 LAND USE AND RECREATION

3.4.1 Definition of the Resource

Although the Secretary's waiver means that CBP no longer has any specific legal obligations under the laws included in the waiver, the Secretary committed CBP to responsible environmental stewardship of our valuable natural and cultural resources. CBP supports this objective and has applied the appropriate standards and guidelines for evaluating environmental impacts and mitigations associated with land use. The term "land use" refers to real property classifications that indicate either natural conditions or the types of human activity occurring on a parcel. In many cases, land use descriptions are codified in local zoning laws. There is, however, no nationally recognized convention or uniform terminology for describing land use categories. As a result, the meanings of various land use descriptions, "labels," and definitions vary among jurisdictions.

Two main objectives of land use planning are to ensure orderly growth and compatible uses among adjacent property parcels or areas. Tools supporting land use planning include master plans/management plans and zoning regulations. The Project will be within Zoning District RU-4. RU-4 is designated as a rural area with a minimum lot size of 4 acres. Rural districts allow residential uses on large acreage, as well as some other uses typically found in rural areas. In addition, a wide range of commercial and industrial activities are also possible as Special Uses, which require, on a case-by-case basis, a public hearing and approval by the Planning and Zoning Commission (CCAPD 2008).

3.4.2 Environmental Setting

The two sections of vehicle fence will be on a mix of private and public lands. The western vehicle fence section will be wholly contained within Roosevelt Reservation and the eastern fence section will cross private land outside of the Roosevelt Reservation. Public lands are managed by the San Bernardino National Wildlife Refuge (SBNWR) and the Bureau of Land Management (BLM). Access to the construction area will require the improvement or construction of eight access roads totaling 5.25 miles on SBNWR, BLM, and private lands.

San Bernardino National Wildlife Refuge

National Wildlife Refuges (NWRs) are a designation for certain protected areas of the United States managed by the USFWS. The NWR system is a national network of lands and waters managed for the conservation, management, and restoration of wildlife and plant resources and their habitats within the United States. The system consists of more than 500 refuges across the nation. The primary land use of the SBNWR is for the protection of wildlife and habitat within the refuge. The SBNWR was a previous 2,309-acre ranch that was acquired by the USFWS in 1982 to protect the water resources and provide habitat for endangered native fishes of the Yaqui River. The SBNWR is open to visitors for activities such as bird watching; photography, hiking; and dove, quail, and cottontail rabbit hunting in season (USFWS 2008). The Project will traverse approximately 3.0 miles of the SBNWR.

Bureau of Land Management

The BLM is responsible for managing public lands and resources for multiple uses. The BLM balances recreational, commercial, scientific and cultural interests, and it strives for long-term protection of renewable and nonrenewable resources, including range; timber; minerals; recreation; watershed; fish and wildlife; wilderness and natural, scenic, scientific and cultural values. The BLM's mission is to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations. The area of the impact corridor is under the management of the Safford field office (BLM 2008). The BLM land within and around the Project area is primarily used for permitted cattle grazing. BLM lands in the area are also used for recreational purposes, particularly for hunting and hiking (Cooke 2008). The Project will traverse approximately 2.0 miles of BLM land.

Roosevelt Reservation

This is an area of land President Roosevelt set aside in 1907 as a public reservation and constitutes all public lands within 60 feet of the international boundary between the United States and Mexico within the State of California and the Territories of Arizona and New Mexico. Known as the "Roosevelt Reservation," this land withdrawal was found "necessary for the public welfare ... as a protection against the smuggling of goods." The proclamation excepted from the reservation all lands, which, as of its date, were (1) embraced in any legal entry; (2) covered by any lawful filing, selection, or rights-of-way duly recorded in the proper U.S. Land Office; (3) validly settled pursuant to law; or (4) within any withdrawal or reservation for any use or purpose inconsistent with its purposes (CRS 2006).

Private Lands

The private lands within the impact corridor are primarily undeveloped desert and used for cattle grazing. The Project traverses approximately 1 mile of private property.

3.4.3 Effects of the Project

The installation of the vehicle fence, staging areas, and access roads will result in short-term and long-term minor to moderate adverse and beneficial impacts on land use. The severity of the impact will vary depending on the amount of changed land use, degree of incompatibility of the tactical infrastructure with existing land use, or the degree to which access to various land use types is restricted or limited by the Project. The expected effects of the Project for each land use are discussed below.

San Bernardino National Wildlife Refuge

Protection of Wildlife and Habitat. Short-term, minor, adverse, direct impacts on wildlife are expected due to disturbance from construction activities. Temporary impacts from construction activities will be localized and short-term. Vegetation removal and grading activities could occur where necessary, thereby removing or altering wildlife habitat. This will result in minor adverse short-term impacts due to a temporary loss of habitat and long-term minor adverse impacts due to loss of vegetation species that take years to mature. Wherever possible, existing roads will be used for construction access; therefore, the loss of habitat due to access road construction and improvement is expected to be minor.

Long-term, moderate, direct beneficial impacts on wildlife species and habitat are expected due to a reduction in roads created by illegal vehicular traffic, vandalism, and trash. Additionally, illegal grazing of cattle herded into the area by Mexican farmers will also be prevented; thereby reducing the potential for the introduction of invasive species and disease.

Visitor Recreational Use. Short-term, minor, adverse direct impacts on refuge visitors will be expected due to construction activities. A relatively minimal amount of area within the refuge will be off-limits during the construction process. Construction activity and related noise will have a minor short-term adverse impact on the nature experience that many visitors come to the refuge to experience. Long-term moderate beneficial impacts on recreational areas could occur as a result of decreased illegal vehicular traffic crossing the border into the SBNWR and a subsequent increase in visitor safety and aesthetic appeal of the preserve.

Bureau of Land Management

Short-term, minor, adverse direct effects on recreational uses are expected due to construction activities. A relatively minimal amount of area within BLM land will be off-limits during the construction process. Long-term moderate beneficial impacts on recreational areas could occur as a result of decreased illegal vehicular traffic crossing the border into BLM land and a subsequent increase in visitor safety and aesthetic appeal of the area. Long-term, minor, direct beneficial impacts are expected for grazing land use due to added fencing along property and decreased illegal vehicular traffic. In addition, long-term, minor to moderate beneficial impacts on grazing land use could occur due to a reduction in the spread of disease from illegally grazed cattle herds from Mexico to the cattle herds in the United States.

Roosevelt Reservation

Long-term, minor to moderate, beneficial direct impacts are expected for land use associated with the Roosevelt Reservation. Since the Reservation was created to prevent the smuggling of goods, the presence of the vehicle fence will assist in this land use purpose.

Private Lands

Long-term minor direct adverse impacts on land use on private lands are expected due to construction or improvement of access roads. Newly constructed roads will remove a minimal amount of private land from owner usage. Since the majority of the fence will be wholly contained within the Roosevelt Reservation and very close to the U.S./Mexico border, the division or loss of private land due to vehicle fencing will be minimal and impacts are expected to be minor. Approximately 0.6 miles of the vehicle fencing will be outside of the Roosevelt Reservation and will cross and effectively divide a private landowner's property in the eastern end of FV-1B. However, the property owner is agreeable to this division and will have a gate for access to the southern portion of his property. The majority of fencing on this 0.6 mile portion will follow along an existing county road, thereby minimizing the effects of access road and vehicle fence construction to the private land.

Long-term, moderate, beneficial direct effects on private land use are expected due to a decrease in illegal vehicular traffic and illegal roadways. Long-term minor beneficial impacts could be experienced by private landowners for cattle grazing purposes due to added fencing on property lines along the U.S./Mexico border. Additionally, illegal grazing of cattle herded into the area by Mexican farmers will also be prevented; thereby reducing the potential for the introduction of disease to private landowners' cattle herds.

3.5 AESTHETICS

3.5.1 Definition of the Resource

Although the Secretary's waiver means that CBP no longer has any specific legal obligations under the laws included in the waiver, the Secretary committed CBP to responsible environmental stewardship of our valuable natural and cultural resources. CBP supports this objective and has applied the appropriate standards and guidelines for evaluating environmental impacts and mitigations associated with visual resources.

Visual resources include both natural and man-made features that influence the visual appeal of an area for residents and visitors. Visual resources can be defined as the visible physical features on a landscape (e.g., land, water, vegetation, animals, structures, and other features).

CBP does not currently have a standard methodology for the analysis and assessment of effects on visual resources. Accordingly, a standard methodology developed by another Federal agency was adopted for the analysis and assessment of effects on visual resources for this ESP. Within the Department of the Interior, which has overarching responsibility for several land management agencies, including the Bureau of Land Management (BLM), National Park Service, and the U.S. Fish and Wildlife Service (USFWS), CBP has determined that the most appropriate visual management system to analyze impacts from the Project has been developed by BLM. It was determined that the BLM methodology was the most applicable for this analysis due to its consideration of the management goals of public land. Publically owned land parcels typically have specific management goals and the assessment of effects on visual resources within a given parcel is tied to the management priorities for those parcels.

In order to meet its responsibility to maintain the scenic values of public lands, BLM has developed a Visual Resources Management (VRM) system based on human perceptions and expectations in the context of the existing landscape. Different levels of scenic values require different levels of management. Determining how an area should be managed first requires an assessment of the area's scenic values. For management purposes, BLM has developed Visual Resource Classes.

Class I Objective. The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes but also allows very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.

Class II Objective. The objective of this class is to preserve the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities are allowed, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape. New projects can be approved if they blend in with the existing surroundings and don't attract attention.

Class III Objective. The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities might attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape. New projects can be approved that are not large-scale, dominating features.

Class IV Objective. The objective of this class is to provide for management activities which require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities can dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements of predominant natural features (BLM 1986a).

3.5.2 Environmental Setting

As discussed in **Chapter 3.4**, the Project will primarily be on public lands managed by the USFWS San Bernardino National Wildlife Refure (SBNWR), the BLM, and the state of Arizona. The BLM land in the eastern portion of the Project area is classified as a Class IV Visual Resource, while BLM's Guadalupe Canyon Outstanding Natural Area/Area of Enviornmental Concern in the eastern portion of the Project area is classified as Class II Visual Resources (Willbanks 2008). The SBNWR, which is in the central portion of the Project, will be designated as a Class I Visual Resource. Due to its similar landforms, water features, vegetation, land uses, and viewer exposure and sensitivity, the other public land and private property in the Project area will likely be designated as a Class IV Visual Resource under the BLM VRM system.

The impact corridor and the surrounding area are primarily in a rural undeveloped area consisting of open land; however, there are a few farms and ranches in the area. The area has a basin and range topography with valleys, canyons, and washes as well as rugged terrain and upland mountainous areas. Land surface elevations range from approximately 3,700 feet to over 8,000 feet in the immediate Project region. The area is a desert environment with vegetation ranging from upland mixed desert scrub and thorn-scrub throughout the alignment to riparian woodland and forest stands within San Bernardino National Wildlife Refuge and Guadalupe Canyon. Plants in the area are widely dispersed and provide negligible groundcover in some areas and more dense growth occurs in others. Development consists of one irrigated pasture and existing roads and trails; rangeland is the prominent land use of the region.

To properly assess the contrasts between the existing conditions and the Project, it is necessary to break each down into the basic features (i.e., landform/water, vegetation, and structures) and basic elements (i.e., form, line, color, and texture) so that the specific features and elements that cause contrast can be accurately identified.

General criteria and factors used when rating the degree of contrast are as follows:

- *None.* The element contrast is not visible or perceived.
- *Weak.* The element contrast can be seen but does not attract attention.
- *Moderate.* The element contrast begins to attract attention and dominate the characteristic landscape.
- *Strong.* The element contrast demands attention, cannot be overlooked, and is dominant in the landscape.

When applying the contrast criteria, the following factors are considered:

1. *Distance*. The contrast created by a Project usually is less as viewing distance increases.
2. *Angle of Observation*. The apparent size of a Project is directly related to the angle between the viewer's line-of-sight and the slope upon which the Project is to take place. As this angle nears 90 degrees (vertical and horizontal), the maximum area is viewable.
3. *Length of Time the Project Is In View*. If the viewer can only view the Project for a short period of time, the contrast might not be of great concern. If the Project can be viewed for a long period of time, the contrast could be very significant.

4. *Relative Size or Scale*. The contrast created by the Project is directly related to its size and scale as compared to the immediate surroundings.
5. *Season of Use.* Contrast ratings should consider the physical conditions that exist during the heaviest or most critical visitor-use season, such as snow cover and tree defoliation during the winter, leaf color in the fall, and lush vegetation and flowering in the spring.
6. *Light Conditions*. The amount of contrast could be substantially affected by the light conditions. The direction and angle of light can affect color intensity, reflection, shadow, form, texture, and many other visual aspects of the landscape. Light conditions during heavy periods must be a consideration in contrast ratings.
7. *Recovery Time*. The amount of time required for successful revegetation should be considered. Few projects meet the VRM management objectives during construction activities. Recovery usually takes several years and goes through several phases (e.g., bare ground to grasses, to shrubs, to trees).
8. *Spatial Relationships*. The spatial relationship within a landscape is a major factor in determining the degree of contrast.
9. *Atmospheric Conditions.* The visibility of a Project due to atmospheric conditions such as air pollution or natural haze should be considered.
10. *Motion.* Movements such as waterfalls, vehicles, or plumes draw attention to a Project (BLM 1986b).

3.5.3 Effects of the Project

The Project will adversely impact visual resources both directly and indirectly. Construction of tactical infrastructure will result in the introduction of new temporary (e.g., presence of heavy equipment and supplies) and permanent (e.g., fencing and access roads) visual elements into existing viewsheds, which constitutes low to strong contrasts to Class I, II and IV Visual Resources. Clearing and grading of the landscape during construction will result in the removal of visual elements from existing viewsheds.

Impacts on aesthetic and visual resources will include short-term impacts associated with the construction phase of the Project and use of staging areas, recurring impacts associated with monitoring and maintenance, and long-term impacts associated with permanent placement of tactical infrastructure. Impacts can range from weak, such as the impacts on visual resources adjacent to the Project area when seen from a distance or when views of fences are obstructed by the terrain, to strong, such as the intrusion of fence sections into high-quality views of the SBNWR and Guadalupe Canyon. **Figure 3-2** displays the degree to which the tactical infrastructure is visible from various distances in areas of uninterrupted vistas.

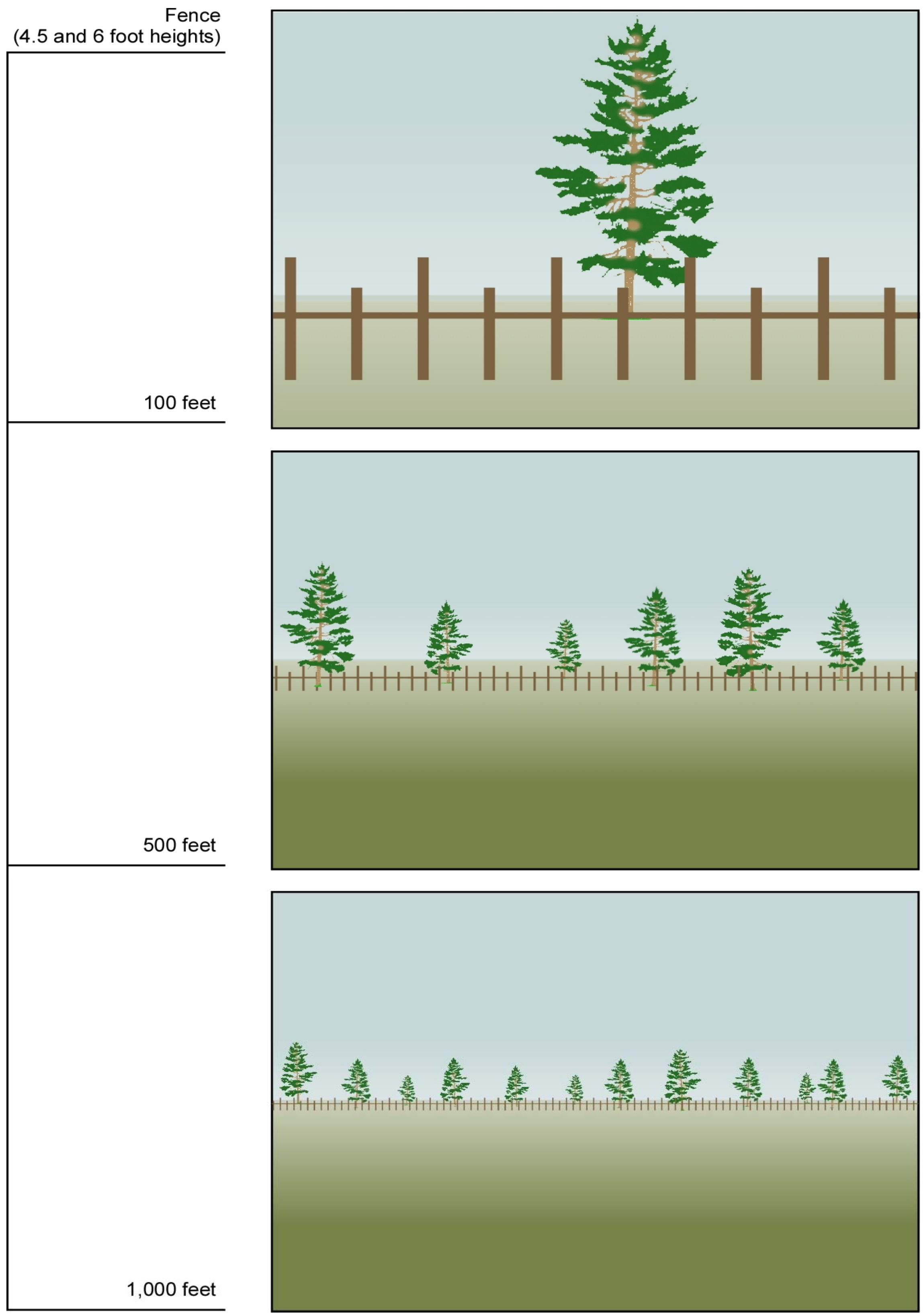


Figure 3-2. Schematic Showing Visibility of Fencing at Various Distances

The construction and presence of access roads and fences in and adjacent to a Class I and II Visual Resource areas (SBNWR and Guadalupe Canyon, respectively) will represent a strong contrast. The Slaughter Ranch Pueblo is a National Historic Landmark and a museum within the SBNWR, and is approximately 0.5 miles north of the project area. Visibility from the Slaughter Ranch will be low to moderate due to distance and intervening topography; however, the contrast will be strong. Construction activities and the presence of tactical infrastructure in a Class IV Visual Resource area is a low contrast to the other public and private lands in the project area due to low viewer exposure and sensitivity.

In many areas the fence will be screened from view by elevation and undulating terrain. Public viewing is also limited in the project area because of the lack of public trails and roadways. Except for the Slaughter Ranch Pueblo (as shown in **Appendix C**), most of the SBNWR along the Project corridor has low visitation frequency due to the restriction of camping, small number of official hiking and off-road vehicle trails, and the general lack of access and rough topographic conditions. In some areas, the fence will connect to an existing fence and patrol roads, which greatly reduces the overall contrast created by the Project.

Over time, the changes to the landscape caused by construction and repair of access roads will dissipate substantially, therefore reducing the contrast of viewable sections. Construction of tactical infrastructure will increase border security in the project corridor and may result in a change to illegal traffic patterns. However, changes to illegal traffic patterns result from a myriad of factors and therefore are considered unpredictable and beyond the scope of this ESP. Beneficial indirect impacts will be expected, as the vehicle fence will substantially reduce or eliminate illegal cross-border vehicle traffic and associated trash and illegal roads in the project corridor.

3.6 GEOLOGY AND SOILS

3.6.1 Definition of the Resource

Although the Secretary's waiver means that CBP no longer has any specific legal obligations under the laws included in the waiver, the Secretary committed CBP to responsible environmental stewardship of our valuable natural and cultural resources. CBP supports this objective and has applied the appropriate standards and guidelines for evaluating environmental impacts and mitigations associated with geological and soils resources.

Geology and soils resources include the surface and subsurface materials of the earth. Within a given physiographic province, these resources typically are described in terms of topography, soils, geology, minerals, and paleontology, where applicable.

Topography is defined as the relative positions and elevations of the natural or human-made features of an area that describe the configuration of its surface. Regional topography is influenced by many factors, including human activity, seismic activity of the underlying geological material, climatic conditions, and erosion. Information describing topography typically encompasses surface elevations, slope, and physiographic features (i.e., mountains, ravines, or depressions).

Site-specific geological resources typically consist of surface and subsurface materials and their inherent properties. Principal factors influencing the ability of geological resources to support structural development are seismic properties (i.e., potential for subsurface shifting, faulting, or crustal disturbance), topography, and soil stability. Soils are the unconsolidated materials overlying bedrock or other parent material. They develop from weathering processes on mineral and organic materials and are typically described in terms of their landscape position, slope, and physical and chemical characteristics. Soil types differ in structure, elasticity, strength, shrink-swell potential, drainage characteristics, and erosion potential, which can affect their ability to support certain applications or uses. In appropriate cases, soil properties must be examined for compatibility with particular construction activities or types of land use.

Prime and unique farmland is protected under the Farmland Protection Policy Act (FPPA) of 1981. Prime farmland is defined as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses. Unique farmland is defined as land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of a specific crop when treated and managed according to acceptable farming methods. Soil qualities, growing season, and moisture supply are needed for well-managed soil to produce a sustained high yield of crops in an economic manner. The land could be cropland, pasture, rangeland, or other land, but not urban built-up land or water. The intent of the FPPA is to minimize the extent that Federal programs contribute to the unnecessary conversion of farmland to nonagricultural uses. The FPPA also ensures that Federal programs are administered in a manner that, to the extent practicable, will be compatible with private, state, and local government programs and policies to protect farmland.

The provisions of the FPPA administered by the Natural Resources Conservation Service (NRCS) pertain to activities on prime and unique farmland, as well as farmland of statewide and local importance (see 7 Code of Federal Regulations [CFR] Part 658, 5 July 1984). Determination of whether an area is considered prime or unique farmland and potential impacts associated with a project are based on preparation of the Farmland Conversion Impact Rating Form AD-1006 for areas where prime farmland soils occur and by applying criteria established at Section 658.5 of the FPPA (7 CFR 658).

3.6.2 Environmental Setting

Physiography and Topography. The physiography of southeastern Arizona is classified as Mexican Highlands, with a basin and range topography. The basin and range is composed of multiple northwest-to-southeast trending mountain ranges and alternating valleys. The basin and range is expansive, extending from western Texas through southern New Mexico and the southwestern half of Arizona and into the Mojave Desert. From east to west, numerous southeast-trending mountain ranges are present, including Patagonia, Perilla, Mule, Dragoon, Peloncillo, and the Chiricahua Mountains (University of Arizona 2000).

Elevation in the Project corridor range from approximately 3,700 feet above mean sea level (amsl) to elevations of about 8,000 feet amsl in the Chiricahua Mountains (NRC undated). The San Bernardino Valley lies in the middle of the impact corridor, and supports a surface water drainage basin. The San Bernardino Valley floor slopes gently to the south along the stream valleys, and the margins of the valley rise through rugged terrain to the uplands of the Pedregosa and Perilla Mountains on the west, the Chiricahua Mountains to the north, and the Peloncillo Mountains to the east (NRC undated).

Valleys, canyons, and washes compose the basins running parallel to the mountain ranges. Washes are shallow to deep, flat-floored channels or gullies of an intermittent or ephemeral stream. Perennial streams within the Project area include Black Draw, and large ephemeral washes include Silver Creek and Hay Hollow Wash. In addition, numerous small unnamed washes occur within the Project area. Please see **Chapter 3.7.1** for a discussion on hydrology. **Appendix C** contains detailed maps showing hydrologic and geologic features.

The SBNWR is along the U.S./Mexico border in Cochise County, Arizona. The 2,309-acre refuge sits in the bottom of a wide valley at an elevation of 3,920 feet, encompassing a portion of the headwaters of the Yaqui River, and draining western Chihuahua and eastern Sonora, Mexico (USFWS undated a).

Geology. The regional geology is varied, with volcanic and sedimentary rocks present. The geologic history of the region is characterized by multiple episodes of tectonic activity and marine transgressions and regressions (USFWS 2006b). During the Mesozoic Era (146 million years to 65 million years before present), the Pacific tectonic plate was subducting underneath the North American tectonic plate, resulting in mountain-building and volcanic activity known as the Laramide Orogeny (NPS undated). As mountains were uplifted, faulting created geologic basins, which subsequently filled with sediment. Within the Project area, sedimentary rocks from the Mesozoic Era consist of Early Cretaceous Amole Arkose and the underlying Jurassic Recreation Red Beds (Hirschberg and Pitts 2000).

During the Tertiary and Quaternary periods of the Cenozoic Era (65 million years before present to Recent), volcanic eruptions deposited basalts, tuffs, breccias, and agglomerates in southeastern Arizona. Sedimentary deposits from the Quaternary period are also present, and are composed of alluvial gravel, sand, and silt. Cenozoic sediments were deposited by streams and an inland sea. During this time, crustal uplift and volcanic activity continued and were augmented by thrust and normal faulting and igneous intrusions. Cenozoic-aged rocks include igneous intrusions, basalts, conglomerates, and unconsolidated sediments.

Currently, land subsidence is becoming an issue of concern in south-central Arizona, and is likely caused by compaction of aquifers due to groundwater depletion (University of Arizona 1992). Differential compaction of an aquifer can cause the creation of fissures or cracks in the earth's surface, leading to land subsidence. Groundwater is discussed further in **Chapter 3.7.1**.

Soils. Soils in the Project area have formed on mountainsides, valley slopes, and within alluvial fans. In general, soils that formed on mountainsides are thinner and therefore can contain less organic nutrients than those formed in valley slopes or within alluvial fans. A total of 20 surface soil associations have been mapped in the Project area and are characterized as having slopes varying from 0 to 65 percent grade and are well-drained clayey sandy loams (NRCS 2008). Additionally, some bedrock is apparent in the area. Approximately 60 percent of the soil associations mapped have engineering hazards considered very limiting due to a number of factors including slope, shrink-swell capability, shallow depth to bedrock, low strength, and flood potential. Approximately 36 percent of the mapped soil associations are classified as having characteristics that are considered somewhat limiting to construction of roads (NRCS 2008). Two soil associations, the Graham-Lampshire-Ustollic and Mabray have severe erosion potential. The Blakeney-Luckyhills complex, Chorro-Guest complex, and Kahn-Zapolote complex exhibit the least constraint on construction, and compose 40 percent of the impact corridor (NRCS 2008). Composition of these soils is a sandy loam, clay loam, and clay, respectively. These soils have formed in alluvial fans, are well-drained, and have slopes ranging from 0 to 15 percent.

3.6.3 Effects of the Project

Physiography and Topography. The tactical infrastructure will be constructed to the west of the Perilla Mountains and extend into the San Bernardino Valley, crossing the SBNWR and towards the Peloncillo Mountains in the Coronado National Forest to the east. Because of the varied topography in the impact corridor, short- and long-term minor adverse impacts on the natural topography are expected. Grading, contouring, and trenching associated with the installation of the tactical infrastructure could result in minor alterations of the existing microtopography. The impact corridor will be regraded, contoured, and revegetated following tactical infrastructure installation. This will minimize modifications to existing flood-flow characteristics.

The Project will disturb greater than 5 acres of land and therefore will develop an SWPPP consistent with USEPA National Pollutant Discharge Elimination System (NPDES), Arizona Pollutant Discharge Elimination System, and Arizona Department of Environmental Quality guidelines. SWPPPs will be developed and implemented as a part of Project development. The SWPPPs must list BMPs that the discharger will use to protect storm water runoff along with the locations of those BMPs. Minor adverse impacts due to potential increased sheet flow as a result of grading, contouring, and trenching is expected to be temporary and mitigated by the implementation of the BMPs developed during preparation of the SWPPP.

Geology. The 60-foot wide Project corridor overlies granitic mountains, sediments, and volcanic rocks. The soils are primarily composed of sandy loam and clayey loam. The predominant rock types are basalts, breccias, arkose, and alluvium. The landforms reflect the different rock types with volcanics forming hills and mountain ranges and the sediments forming valleys.

Short- and long-term minor to moderate adverse impacts on geologic resources could occur at locations where rugged terrain or bedrock is present at the surface. Geologic resources could affect the placement of the primary vehicle fence due to the occurrence of bedrock at the surface, or as a result of structural instability due to steep grades. Site-specific geotechnical surveys will be conducted prior to construction to determine depth to bedrock. In most cases, it is expected that Project design and engineering practices could be implemented to mitigate geologic limitations to site development.

Soils. It is anticipated that the tactical infrastructure will cross over 20 soil units. The soil units are derived from alluvium and have varying degrees of slope. The least limiting soil associations for construction can be found in three locations: southeast of George’s Canyon; within the SBNWR, especially east of Hay Hollow Wash; and north of Mesa la Nopalera in Mexico.

Short-term minor direct adverse impacts on soils are expected. Soil disturbance and compaction due to grading, contouring, and trenching associated with the installation of the tactical infrastructure sections are expected. The volume of soil disturbance cannot be determined due to the operational sensitivity of disclosing the exact depth of soil disturbance. However, displaced soil will be properly stockpiled to prevent erosion and sedimentation and excess soils will be disposed of properly if not utilized during regrading and recontouring activities following installation of the fence. In areas where soils have not been previously disturbed by development and other land uses prior to this Project, minor adverse effects on natural soil structure and soil organisms will be expected.

Increased soil erosion as a result of the construction activities will be minimized with the implementation of BMPs established during the development of the SWPPP. Implementing these BMPs will minimize adverse effects associated with sediments that could potentially be transported from construction sites and deposited in adjacent washes. Construction activities are expected to directly impact the existing soils as a result of grading, excavating, placement of fill, compaction, and mixing or augmentation necessary to prepare the sites for development of the fence sections and associated utility lines. These impacts along with potential associated erosion and sedimentation will be minimized by the proper implementation of the BMPs established in the SWPPP. Due to the semi-arid climate of the region, wind erosion could potentially impact disturbed soils in areas where vegetation has been removed. However, following construction activities, the areas disturbed will be revegetated with native species to the maximum extent practicable to reestablish native plant communities and help stabilize soils.

No impacts on prime farmland will occur as a result of project implementation. There are no prime farmland soils mapped within the impact corridor.

Soils in open areas between the tactical infrastructure sections could be adversely impacted by cross-border violators in the areas where there will be no fence. However, changes to cross-border violator traffic patterns result from a myriad of factors and therefore are considered unpredictable and beyond the scope of this ESP.

Long-term, minor to moderate direct beneficial impacts on soils are expected as a result of an expected decrease in illegal vehicle off road traffic and the associated soil erosion and compaction within the Project area. In addition, the increased security of the vehicle fence will likely reduce the need for current USBP off-road traffic within the Project area, as illegal traffic across the border will be reduced.

3.7 WATER USE AND QUALITY

3.7.1 Hydrology and Groundwater

3.7.1.1 Definition of the Resource

Although the Secretary's waiver means that CBP no longer has any specific legal obligations under the Clean Water Act (CWA), the Secretary committed CBP to responsible environmental stewardship of our valuable natural and cultural resources. CBP supports this objective and has applied the appropriate standards and guidelines associated with the CWA as the basis for evaluating potential environmental impacts and developing appropriate mitigations for hydrology and groundwater.

Hydrology addresses the redistribution of water through the processes of evapotranspiration, surface runoff, and subsurface flow. Hydrology results primarily from temperature and total precipitation that determine evapotranspiration rates, topography which determines rate and direction of surface flow, and soil properties that determine the rate of subsurface flow and recharge to the groundwater reservoir. Groundwater consists of subsurface hydrologic resources. It is an essential resource that functions to recharge surface water and is used for drinking, irrigation, and industrial processes. Groundwater typically can be described in terms of depth from the surface, aquifer or well capacity, water quality, recharge rate, and surrounding geologic formations.

3.7.1.2 Environmental Setting

***Hydrology*.** Hydrologic features occurring in the region of the Project include Black Draw, Cottonwood Draw, Silver Creek, and the Hay Hollow Wash. The area within which the project lies is the San Bernardino Valley Basin (ADWR undated a). A portion of the Yaqui River headwaters exists in the basin and drains the Chiricahua Mountains and eastern Sonora, Mexico. In general, the drainage of the impact corridor flows to the south into Mexico, draining 421 square miles within the United States (ADWR undated b). Overall, the impact corridor is on an extensive plain of arid desert valleys and mountain ranges. The climate is continental desert, is of extreme aridity, and results in high air and soil temperatures. The average annual precipitation in the area is approximately 15 inches, with 52 percent of precipitation occurring in July through September (ADWR undated a).

The SBNWR is in the south-central portion of the basin. This refuge was established in 1982 to protect water resources and provide habitat for endangered fish (ADWR undated a). Please see **Chapter 3.8** for a discussion on biological resources. Dwindling water resources have altered this region so that only one perennial stream, Black Draw, exists and wetlands have greatly diminished in size.

The biotic community in the area is classified as the Chihuahuan desert scrub and desert grassland in the uplands and mesquite bosque and fallow fields in bottomlands (USFWS undated a). Plants in the area are widely dispersed and provide negligible groundcover in some areas and more dense growth occurs in others. In areas where plant dispersion is wide, reduced groundcover along with steep slopes due to local topography can lead to heavy runoff and high erosion potential during precipitation events.

Groundwater. The Project area is in the San Bernardino Valley Basin, which has a total surface area of 421 square miles and lies in southeastern Arizona along the U.S./Mexico border. Groundwater is discharged in the central axis of the basin into Mexico. Recharge occurs through mountain front recharge, stream infiltration, and some underflow from upgradient basins. Recharge is estimated at 9,000 acre-feet per year (ADWR undated a). Aquifers are composed of volcanic rocks and recent stream alluvium, with lower basin fill composed of fine-grained sediments more than 1,000 feet thick. Upper basin fill is 300 feet thick and contains sand, gravel, clay, and some limestone (ADWR undated a). The groundwater basin extends across the U.S./Mexico border. Several major and minor faults dissect the basin, but water flow is primarily impacted by basin fill. Basin fill is sedimentary in the northern part of the basin and rhyolitic and basaltic in the southern part. Lacustrine clays are present in the center of the basin at depth (USFWS undated b).

The San Bernardino Valley Basin has one aquifer, which has both a shallow unconfined and a deep confined component. The aquifer splits into two aquifers when it comes into contact with lacustrine clays (USFWS 2006). The shallow water-bearing unit is composed of basalts, with water levels varying from 30 to 612 feet below ground level (ADWR undated a). Heavy groundwater pumping from Mexico, water diversion, and springhead modification could decrease groundwater levels at artesian wells within the refuge (USFWS 2006). Groundwater samples obtained for analysis in 1986 and 1992 indicated total dissolved solids values of 180 to 1,080 milligrams per liter and fluoride concentrations from 0.1 to 3.0 milligrams per liter (ADWR undated b).

Groundwater recharge is primarily from mountain front recharge from the Chiricahua Mountains, with well recharge estimated to range from approximately 100 to 1,000 gallons per minute (USFWS 2006). Approximately 1.6 million acre-feet of groundwater is estimated to exist in storage at a depth of 1,200 feet (ADWR undated a). The Arizona Department of Water Resources (ADWR) lists more than 300 registered wells within the San Bernardino Valley (USFWS 2006). Nearby ranches use pesticides during operations, and as such two wells have reported drinking water standard exceedances of nitrate (ADWR undated a, USFWS 2006). The only instance of drinking water standard exceedances in the basins is due to the presence of nitrate.

3.7.1.3 Effects of the Project

Hydrology. Minor adverse impacts on the hydrology of the Black Draw will be expected to occur as a result of grading and contouring in the impact corridor. Grading and contouring will be expected to alter the topography and remove vegetation, which could in turn increase erosion potential and increase runoff during heavy precipitation events. Revegetating the area with native vegetation following construction along with other BMPs to abate runoff and wind erosion could reduce the impacts of erosion and runoff. Additionally, the small increase in impervious surface within the floodplain will result in negligible increases in the quantity and velocity of storm water flows to the Black Draw, as well as the ephemeral Silver Creek. BMPs will be developed as part of the SWPPPs to manage storm water both during and after construction. Therefore, effects will be negligible.

Groundwater. Short-term, minor, direct, adverse construction-related impacts on groundwater resources is expected. During construction, approximately 44.85 acre feet (14,625,000 gallons) of water will be required for pouring concrete, watering of road and ground surfaces for dust suppression during construction, and for washing construction vehicles. Water use for construction will be temporary and the volume of water used will be minor when compared to the amount used annually in developed areas within the San Bernardino Valley Basin for municipal purposes. Water not lost to evaporation from watering of surfaces during construction will potentially contribute to aquifer recharge through downward seepage.

The potential for short-term negligible adverse effects on groundwater related to an increase in storm water runoff is expected. In addition, leakage of fluids from construction equipment or washdown, or spill-related runoff could adversely affect groundwater resources. Implementation of storm water and spill prevention BMPs developed consistent with the SWPPPs and other applicable plans and regulations will minimize potential runoff or spill-related impacts on groundwater quality during construction.

Long-term, negligible to minor, beneficial impacts associated with groundwater supply in the Project area are expected as a result of a reduction of cross-border violators, who often utilize the stock tanks as a water source. Groundwater in proximity to the Project area will not be expected to be used as a source of water needed to conduct patrol activities. Site-specific analysis would be necessary to determine the affect of cross-border violators and USBP operations on regional water supplies.

3.7.2 Surface Waters and Waters of the United States

3.7.2.1 Definition of the Resource

Surface water resources generally consist of wetlands, lakes, rivers, and streams. Surface water is important for its contributions to the economic, ecological, recreational, and human health of a community or locale.

Waters of the United States are defined within the CWA, as amended, and jurisdiction is addressed by the USEPA and the USACE. These agencies assert jurisdiction over (1) traditional navigable waters, (2) wetlands adjacent to navigable waters, (3) nonnavigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically flow year-around or have continuous flow at least seasonally (e.g., typically 3 months), and (4) wetlands that directly abut such tributaries (USDOJ 2007).

Wetlands and riparian habitats represent some of the most ecologically important and rare vegetation communities on desert landscapes. They provide keystone habitat for a wide array of plant and animal species including resident and migrating birds, amphibian and fish species, mammals, and insects. Vegetation production and diversity are usually very high in and around these mesic to aquatic sites, with many plant species adapted only to these unique environments. In addition, wetlands and riparian zones provide a variety of hydrologic functions vital to ecosystem integrity. These include water filtration of sediment, groundwater recharge, and nutrient/chemical capture (USFS 1995). Development and conversion of wetlands and riparian zones affects wildlife diversity, carrying capacity, and hydrologic regime. Changes to and removal of wetlands can cause effects that are proportionally greater than elsewhere in an ecosystem (Graber 1996).

Wetlands have been defined by agencies responsible for their management. The term "wetland" used herein, is defined using USACE conventions. The USACE has jurisdiction to protect wetlands under Section 404 of the CWA using the following definition:

> . . . areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (33 CFR 328.3[b]). Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands have three diagnostic characteristics that include: (1) over 50 percent of the dominant species present must be classified as obligate, facultative wetland, or facultative, (2) the soils must be classified as hydric, and (3) the area is either permanently or seasonally inundated, or saturated to the surface at some time during the growing season of the prevalent vegetation (USACE 1987).

Wetlands are protected as a subset of "the waters of the United States" under Section 404 of the CWA. The term "waters of the United States" has a broad meaning under the CWA and incorporates deepwater aquatic habitats and special aquatic habitats (including wetlands).

3.7.2.2 Environmental Setting

Surface Water

Black Draw, Silver Creek, and the Hay Hollow Wash are all within the Project corridor in the San Bernardino Valley basin. In addition, numerous unnamed ephemeral washes occur within the impact corridor. Of these, the only perennial stream is Black Draw, which becomes perennial just north of the U.S./Mexico border as it captures water from nearby ephemeral streams flowing towards Mexico (ADWR undated a). All other water sources recharge in response to precipitation events. In addition to these hydrologic features, minor wetlands exist and are supported by artesian wells and springs. Two vegetated wetlands are within the impact corridor in the SBNWR. No major springs exist in the basin, but 6 to 10 minor springs are present. Of the minor springs, House Spring emits 3 gallons per minute (ADWR undated a). The annual outflow of surface waters draining the San Bernardino Valley is estimated at approximately 5,000 acre-feet per year (ADWR undated c).

Jurisdictional Wetlands and Other Waters of the United States

An initial field survey was conducted in Section FV-1B from June 10 through 13, 2008. A field survey for a fence alignment amendment to Section FV-1B was conducted on August 13, 2008, to delineate jurisdictional wetlands and other waters of the United States within the Project areas. Delineations were also conducted along access roads and staging areas associated with the fence alignments. Formal delineations were conducted within a 150-foot corridor associated with the fence alignments, 60 feet to either side of the center line of access roads, and within staging areas.

Determination of the occurrence and extent of jurisdictional wetlands and other waters of the United States was based on the application of procedures established in the USACE *Wetlands Delineation Manual*, Technical Report Y-87-1 (USACE 1987) and the *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region,* Technical Report ERDC/EL TR-06-16 (USACE 2006). Determination of the occurrence of jurisdictional wetlands was based on the presence or absence of hydrophytic (wetland) vegetation, hydric (wetland) soils, and wetland hydrology. The presence of all three of the criteria is necessary for an area to be designated as a jurisdictional wetland under normal conditions.

Determination of the extent of jurisdictional washes and other waters of the United States in the Project areas was based on characterization of the landward extent of the ordinary high water mark (OHM). Indicators used to determine the occurrence and extent of jurisdictional washes included the presence of developed channels, typically 2 feet or greater in width; the occurrence of an OHM; the absence of fine sediments along flow paths; distinct changes in the vegetative assemblage or larger or more dense vegetation than surrounding areas; the presence of cut banks; the presence of litter, debris, or wrack lines; occurrence of desiccation cracks or other indicators of hydrology; and other indicators of the occurrence of intermittent water flow regimes.

All wetlands and other waters of the United States within the Project areas were delineated.

Table 3-6 provides the section locations, wetland or other waters of the United States types, delineated acreages within a 150-foot corridor associated with the initial and amended fence alignments, 60 feet to either side of the center line of access roads, or within proposed staging areas and potential impact acreages in Douglas, Arizona, Section FV-1B. A 60-foot impact corridor to the north of the fence alignment, or adjacent to access roads is considered the maximum width of potential impact associated with implementing the Project. All wetland or other waters of the United States acreages within proposed staging areas are included

Table 3-6. Delineated Acreages and Potential Impact Acreage of Wetlands and Other Waters of the United States

WL ID	Wetland or Other Waters of the United States Type	General Location	Delineated Area (acres)	Potential Impacts (acres)
W1N	Wash	Near west end of FV-1B	5.14	1.75
W1S	Wash	Near west end of FV-1B		
W2	Wash	First access road east of the west end of FV-1B	0.27	0.07
W3	Wash	First access road east of the west end of FV-1B	0.18	0.07
W4	Wash	First access road east of the west end of FV-1B	0.28	0.09
W5	Wash	Second access road east of the west end of FV-1B	0.26	0.07
W6	Wash	Second access road east of the west end of FV-1B	0.98	0.31
W7	Wash	Approximately 1,900 feet east of W6 at the border	0.43	0.20
W8	Wash	Tributary draining to the east along the border and into the west side of Silver Creek at the border	4.88	1.66
W9	Wash	Tributary to W8	0.17	0.08
W10	Wash	Tributary to W8	0.29	0.17
W11	Wash	Tributary to W8	0.46	0.15
W12	Wash	Tributary to W8	0.25	0.01
W13	Wash	Silver Creek	6.07	0.42
W14	Wash	South of Slaughter Ranch in the SBNWR	0.55	0.29
W15	Emergent Wetland	On the Border in the SBNWR	0.11	0.01
W16	Riverine and Palustrine Forested Wetland	Black Wash in the SBNWR	1.74	0.35
W17	Wash	Hay Hollow in the SBNWR	1.92	1.31
W18	Wash	Approximately 2,200 feet west of the eastern SBNWR boundary on the border	1.33	0.36
W19	Wash	Approximately 0.45 miles east of the western boundary of the SBNWR on the border	1.07	0.25

WL ID	Wetland or Other Waters of the United States Type	General Location	Delineated Area (acres)	Potential Impacts (acres)
W20	Wash	Approximately 0.7 miles east of W19 on the border	0.27	0.11
W21	Wash	Approximately 0.2 miles east of W20 on the border	0.44	0.15
W22	Wash	Approximately 0.4 miles east of W21 on the border	0.61	0.18
W23	Wash	Approximately 0.25 miles east of W22 on the border	0.30	0.15
W24	Wash	Approximately 0.18 miles east of W23 on the border	0.21	0.12
W25	Wash	Approximately 0.41 miles east of W24 on the border	0.43	0.19
W26	Wash	Approximately 0.18 miles east of W25 on the border	0.49	0.12
W27	Wash	Approximately 0.36 miles east of W26 on the border	3.68	2.54
W28	Wash	Approximately 0.15 miles east of W27 on the border	0.26	0.10
W29	Wash	Approximately 0.23 miles east of W28 on the border	0.45	0.22
W30	Wash	Approximately 0.24 miles east of W29 on the border	0.31	0.14
W31	Wash	Approximately 0.27 miles east of W30 on the border	0.32	0.16
W32	Wash	Approximately 0.22 miles east of W31 on the border	0.17	0.09
W33	Wash	Approximately 600 feet east of W32 on the border	0.19	0.08
W34	Wash	Approximately 800 feet east of W33 on the border	0.14	0.07
W35	Wash	Approximately 0.48 miles east of W34 on the border	0.43	0.10
W36	Wash	Approximately 0.49 miles east of W34 on the border	0.31	0.07
W37	Wash	Guadalupe Canyon	0.69	0*
W38	Wash	Guadalupe Canyon	1.24	0.06
W39	Wash	Guadalupe Canyon	0.13	0.1
W40	Wash	Approximately 300 feet north of Guadalupe Canyon	0.147	0.09
		Totals	**37.607**	**12.5**

Note: *Indicates that the area was removed from the project and will not be impacted.

as potential impact areas. Maps showing the locations and boundaries of delineated wetlands and other waters of the United States in the Project assessment areas along with general descriptions of the delineated areas are provided in **Appendix C**.

Based on the field surveys, 38 ephemeral wash channels and 2 vegetated wetlands occur within the 150-foot corridor associated with the fence alignments, 60 feet to either side of the center line of access roads, or within proposed staging areas. Wetlands and other waters of the United States delineated in Section FV-1B were designated as W1 through W40.

3.7.2.3 Effects of the Project

***Surface Waters, Wetlands, and Other Waters of the United States*.** Minor short- and long-term impacts on wetlands and washes in the impact corridor will be expected. The tactical infrastructure will consist of a primary vehicle fence, access roads, and staging areas. Development of staging areas and the placement of permanent primary vehicle fence across wash channels will result in short-term adverse impacts associated with land disturbance and potential erosion and sedimentation. CBP will require the construction contractor to prepare an SWPPP, sediment and erosion control plans, and other mitigation measures for the Project which will minimize potential for adverse effects on the wetlands and washes. Minor, long-term, beneficial effects on washes will be expected as a result of a reduction in cross-border traffic in washes. Development of culverted crossing at washes will be expected to reduce damage to wash channels and their banks associated with traffic along access roads. Implementation of the Project will be expected to have minor short-term, adverse effects on surface water quality as a result of potential erosion and associated transport of sediments into adjacent surface waters. Implementation of BMPs, as discussed above, will reduce potential for these adverse effects.

Adverse effects on jurisdictional wetlands, washes, and other waters of the United States will be avoided or minimized to the maximum extent practicable. Based on the delineations of wetlands and other waters of the United States conducted on June 10 through 13, and August 13, 2008, there are 0.36 acres of vegetated wetlands and 11.89 acres of washes within the potential impact areas. Based on the acres impacted, a wetlands mitigation and restoration plan will be developed to compensate for unavoidable impacts on wetlands and washes within the project areas.

3.7.3 Floodplains

3.7.3.1 Definition of the Resource

Floodplains are areas of low-level ground present along rivers, stream channels, or coastal waters. The living and nonliving parts of natural floodplains interact with each other to create dynamic systems in which each component helps to maintain the characteristics of the environment that supports it. Floodplain ecosystem functions include natural moderation of floods, flood storage and conveyance, groundwater recharge, nutrient cycling, water quality maintenance, and a diversity of plants and animals. Floodplains provide a broad area to spread out and temporarily store floodwaters. This reduces flood peaks and velocities and the potential for erosion. In their natural vegetated state, floodplains slow the rate at which the incoming overland flow reaches the main water body (FEMA 1986).

Floodplains are subject to periodic or infrequent inundation due to rain or melting snow. Risk of flooding typically hinges on local topography, the frequency of precipitation events, and the size of the watershed above the floodplain. Flood potential is evaluated by Federal Emergency Management Agency (FEMA), which defines the 100-year floodplain. The 100-year floodplain is the area that has a 1 percent chance of inundation by a flood event in a given year. Certain facilities inherently pose too great a risk to be in either the 100- or 500-year floodplain, such as hospitals, schools, or storage buildings for irreplaceable records. Federal, state, and local regulations often limit floodplain development to passive uses, such as recreational and preservation activities, to reduce the risks to human health and safety.

3.7.3.2 Environmental Setting

According to the December 4, 1984, FEMA Flood Insurance Rate Map (FIRM) Panel No. 0400121550B for Cochise County, Arizona, two small sections of the impact corridor are within the 100-year floodplains associated with the banks of Black Draw and Hay Hollow Wash. The 100-year floodplain for Black Draw will cross the impact corridor where it flows south into Mexico (FEMA 1984). The floodplain associated with Hay Hollow Wash is approximately 2,000 feet to the east of Black Draw along the U.S./Mexico border.

3.7.3.3 Effects of the Project

Negligible adverse impacts on floodplain resources will occur as a result of the Project. According to the FEMA FIRM Panel No. 0400121550B, the 100-year floodplains associated with the Black Draw and Hay Hollow Wash will be crossed by the tactical infrastructure. If possible, the floodplains will be avoided by limiting construction activities to beyond the reach of the floodplains along either side of Black Draw and Hay Hollow Wash. CBP will mitigate unavoidable impacts associated with floodplains using planning guidance developed by the USACE.

Erosion and sediment control and storm water management practices will be implemented during and after construction. Adverse effects on floodplain resources will be minimized.

3.8 BIOLOGICAL RESOURCES

3.8.1 Vegetation Resources

3.8.1.1 Definition of the Resource

Although the Secretary's waiver means CBP no longer has any specific legal obligations for the tactical infrastructure segments addressed in this ESP, the Secretary committed CBP to responsible environmental stewardship of our valuable natural and cultural resources. CBP supports this objective and has applied the appropriate standards and guidelines for evaluating environmental impacts and mitigations associated with vegetation resources.

Vegetation distribution and character within the Project area is strongly defined by the environmental variables including physiography, climate, geology, soils, and topography. This section of the ESP identifies and briefly describes the important environmental drivers, the floristic classification and vegetation types that occur throughout the Project area, and the effects related to use/widening of existing access roads and staging areas and the construction of new access roads, staging areas, and the vehicle barrier. More detailed and extensive biological information and characteristic ground photographs are presented in the Biological Survey Report (see **Appendix D**).

3.8.1.2 Environmental Setting

Physiography. This region is characterized by deep, northwest-trending, alluvium-filled basins separated by linear mountain ranges (basin and range lowlands). Relatively recent volcanic activity was evident with many slopes covered by gravel and cobble of volcanic origin. Land surface elevations range from approximately 3,720 feet to more than 5,000 feet in the immediate Project region. Rangeland is the prominent land use of the region.

Plant Community Classification and Description

General Vegetation Classification. The vegetation of the basin and range lowlands of southeastern Arizona has generally been classified under the Dry Domain (Map Unit 300), Tropical/Subtropical Desert Division (Map Unit 320) of Bailey (1995). The Project area is more finely classified by Bailey (1995) as the Chihuahuan Desert Province (Map Unit 321).

Douglas Station Site Vegetation Classification. The Arizona Gap Analysis Program Project (Bennett et al. 2004) provided discussion and described plant geography to vegetation series using topographic features, climate, vegetation types, and terrestrial vertebrates. This system placed the Project area generally in the Nearctic Upland, Warm Temperate Desertland, Chihuahuan Desertscrub classification. Vegetation series that were described and are applicable to the impact corridor include (1) Creosotebush-Tarbush Series, (2) Mesquite Series,

(3) Whitethorn Series, (4) Mixed Scrub Series, and (5) Scrub Grassland Series (Bennett et al. 2004).

The U.S. Geological Survey (USGS) (Bennett et al. 2004) recognized nine Nearctic Upland and Nearctic Wetland vegetation mapping units in the Douglas, Arizona, vicinity using a combination of plant species dominance, wildlife use, topography, hydrology, and geology. The vegetation series that could be associated with the Project region include (1) Warm Temperate Grassland, Scrub-Grassland (Semidesert), Tobosa Grass-Scrub Series; (2) Warm Temperate Scrub-Grassland (Semidesert), Sacaton-Scrub Series; (3) Warm Temperate Desertland, Chihuahuan Desertscrub, Creosotebush-Tarbush Series; (4) Warm Temperate Desertland, Chihuahuan Desertscrub, Whitethorn Series; (5) Warm Temperate Desertland, Chihuahuan Desertscrub, Mesquite Series; (6) Warm Temperate Desertland, Chihuahuan Desertscrub, Mixed Scrub Series; (7) Tropical-Subtropical Swamp Riparian and Oasis Forests, Sonoran Riparian and Oasis Forest, Cottonwood-Willow Series; (8) Tropical-Subtropical Swamp and Riparian Scrub, Sonoran Deciduous Swamp and Riparian Scrub, Mixed Scrub Series; and (9) Tropical-Subtropical Marshland, Sonoran Interior Marshland, Cattail Series. The entire corridor was predominantly characterized by Chihuahuan Desertscrub vegetation series.

NatureServe (2008) has defined ecological systems to represent recurring groups of biological communities that are found in similar physical environments and are influenced by similar dynamic ecological processes such as fire or flooding. Ecological systems represent classification units that are readily identifiable by conservation and resource managers in the field. The ensuing vegetation description for the Project area was prepared in the framework of ecological systems that include (1) North American Warm Desert Riparian Woodland and Shrubland (CES302.753), (2) Apacherian-Chihuahuan Mesquite Upland Scrub (CES302.733), (3) Chihuahuan Mixed Desert and Thorn Scrub (CES302.734), (4) Apacherian-Chihuahuan Mesquite Upland Scrub (CES302.733), (5) North American Warm Desert Riparian Mesquite Bosque (CES302.752), (6) North American Warm Desert Wash (CES302.755), (7) Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (CES 302.735), (8) North American Warm Desert Cienega (CES302.747), and (9) North American Warm Desert Playa (CES302.751).

Field Methods. Classification of existing vegetation within this corridor was achieved by accessing the impact corridor and staging areas as proposed, sampling observation points in the plant communities encountered, and relating them to the NatureServe Explorer classification database (2008). At the coarsest level, the nine above-named ecological systems were determined and local vegetation types described using the national system. A finer level of classification equaling or approximating the vegetation alliance level of the National Vegetation Classification System (NVCS) (NatureServe 2008) was used to prepare the plant community discussions under each ecological system. Vegetation stands and patches that are generally unclassified in the current system and sampled within the proposed corridor typically consisted of nonnative species including Bermuda Grass Herbaceous Vegetation, Russian-thistle Herbaceous Vegetation, and Common Cocklebur Herbaceous Vegetation.

Vegetation Overview. Habitats observed, sampled, and photographed within the impact corridor range from upland mixed-desert scrub and thorn-scrub throughout the alignment to riparian woodland and forest stands within SBNWR and Guadalupe Canyon. Much of the vegetation cover along the vehicle fence section consists of native shrublands characterized by honey mesquite, creosotebush, tarbush, whitethorn, shrubby coldenia, mortonia, and ocotillo.

A detailed description of each plant community observed within the proposed section (FV-1B) is provided in **Appendix D**. Each of these communities is illustrated and supported by representative ground photographs within the attached Biological Survey Report (see **Appendix D**). Following each description is a statement of the measured impact of project construction to the individual vegetation type.

3.8.1.3 Effects of the Project

Direct impacts include blading, scraping, drilling, trenching, berming, and crushing vegetation and are calculated from the vegetation map created for this Project versus the designed corridors of construction. Indirect impacts include dust generation, nonnative species introductions, diversion of flows, and incidental or random vehicle and equipment turning and parking that causes rutting and compaction of soils, but might not kill the vascular flora. Vegetation impacts related to vehicle barrier fence construction will be direct and indirect and are summarized in **Table 3-7** using the notes identified in the lists below.

<u>Direct Impact Types</u>

The construction of the vehicle fence, construction access roads and staging areas will impact the vegetation directly. Vegetation will be removed by blading, grubbing, trenching, filling, and drilling. This will result in a loss of the current vegetation. A total of 206.8 acres of vegetation is expected to be removed.

<u>Indirect Impact Types</u>

In addition to the direct impacts of construction there will be indirect effects from the construction process. There will be short-term effects such as increased dust covering plants along roads and near construction areas, and areas downwind of construction. Increased siltation from runoff during storm events and accidental spills could also affect the vegetation. There will also be potential long-term impacts including increased erosion, introduction or spread of nonnative plant species, and potential soil compaction to the rooting zones.

Table 3-7. Project Impacts on Vegetation by Plant Community

Plant Community Impacted	Approximate Impact Type and Acreage	Indirect Impact Type	Location and Comments
One-seed Juniper/Whitethorn Wooded Shrubland	Acreage Direct Impacts: 0.2 A-2, B-2	a, b, c, e, g, h	Located on ridges and slopes along access roads within Guadalupe Canyon.
Fremont Cottonwood – Goodding Willow Forest	Acreage Direct Impacts: 0.2 A-1, B-1	a, b, c, d, e, f, g, h	Located in Black Draw on the international border within SBNWR. A fish barrier design will be created for a low water crossing. There is a post-on rail barrier fence in place.
Fremont Cottonwood – Honey Mesquite Forest	Acreage Direct Impacts: 0.78Staging Areas: 1.5 A-1, B-1	a, b, c, d, e, f, g, h	Located in Hay Hollow Wash on the international border within SBNWR.
Arizona Sycamore – Fremont Cottonwood/Honey Mesquite Woodland	Acreage Direct Imacts: 1.2 Staging Areas: 2.0 A-1, A-2, B-1, B-2	a, b, c, d, e, f, g, h	Located in Guadalupe Canyon along access roads and on the international border.
Ocotillo – Tarbush Shrubland	Acreage: Direct Impacts : 7.6 Staging Areas: 2.4 A-1, A-2, B-1, B-2, C-1, C-2	a, b, c, d, e, f, g, h	Located on the slopes of the Perilla Mountains along access roads and on the international border.
Mortonia – Mariola Shrubland	Acreage: Direct Ipacts 6.4 A-2, B-2, C-2	a, b, c, e, g, h	Located on limestone outcrops along the eastern access road.
Creosotebush – Mariola Shrubland	Acreage: Direct Impacts: 68.8 Staging Areas: 21.7 A-1, A-2, A-3, B-1, B-2, B-3	a, b, c, d, e, f, g, h	Located on alluvium and gravelly slopes on the central Project portion along access roads, in staging areas, and on the international border.
Mariola Dwarf-shrubland	AcreageDirect Impacts 1.3 A-1, B-1	a, b, c, d, e, f, g, h	Located west of Slaughter Ranch on a slope of volcanic cobble on the international border.

Plant Community Impacted	Approximate Impact Type and Acreage	Indirect Impact Type	Location and Comments
Creosotebush – Honey Mesquite/Tobosa Shrubland	Acreage Direct Impacts: 18.3 Staging Areas: 2.2 A-1, A-2, A-3, B-1, B-2, B-3	a, b, c, d, e, f, g, h	Located on gravelly slopes and plains in the central and eastern Project portion along access roads, on staging areas, and on the international border.
Creosotebush – Tarbush Shrubland	Acreage Direct Impacts: 15.3 Staging Areas: 5.6 A-1, A-2, A-3, B-1, B-2, B-3	a, b, c, d, e, f, g, h	Located on gravelly plains in the western and central Project portion along access roads, on staging areas, and on the international border.
Tarbush Shrubland	Acreage: Direct Impacts: < 0.1 Staging Area: 0.4 A-1, B-1	a, b, c, d, e, f, g, h	Located in the central Project portion on the international border.
Shrubby Coldenia – Engelmann Prickly-pear Dwarf-shrubland	Acreage Direct Impacts 0.4 A-2, B-2	a, b, c, e, g, h	Located on a ridge and slopes along an access road in the central Project portion.
Honey Mesquite – Whitethorn Bajada Shrubland	Acreage Direct Impacts: 1.4 Staging Area: 0.1 A-1, B-1	a, b, c, d, e, f, g, h	Located in SBNWR on the international border.
Honey Mesquite – Hook Threeawn Shrubland	Acreage: Direct Impacts:1.7 A-1, B-1	a, b, c, d, e, f, g, h	Located in the central Project portion on the international border.
Honey Mesquite – Tarbush Shrubland	Acreage: Direct Impacts1.7 A-1, B-1	a, b, c, d, e, f, g, h	Located on the Slaughter Ranch in a braided drainage on the international border.
Honey Mesquite – Four-wing Saltbush Shrubland	Acreage Direct Impacts: 12.1 Staging Areas: 1.1 A-1, A-2, A-3, B-1, B-2, B-3	a, b, c, d, e, f, g, h	Located on gravelly and cobbly volcanic slopes and alluvial plains in the central and eastern Project portion including SBNWR and Slaughter Ranch along access roads, on staging areas, and on the international border.

Plant Community Impacted	Approximate Impact Type and Acreage	Indirect Impact Type	Location and Comments
Honey Mesquite – Alkali Sacaton Woodland and Shrubland	Acreage: Direct Impacts: 9.3 Staging Area: 3.1 A-1, A-2, B-1, B-2	a, b, c, d, e, f, g, h	Located in SBNWR and on the eastern Project portion in swales and desert washes along access roads and on the international border.
Honey Mesquite – Sparse Understory Woodland and Shrubland	Acreage Direct Impacts: 6.0 Staging Area: 3.6 A-1, A-2, A-3, B-1, B-2, B-3	a, b, c, d, e, f, g, h	Located in upper Hay Hollow Wash, Silver Creek, and on Slaughter Ranch on the eastern Project portion along access roads and on the international border.
Honey Mesquite – Littleleaf Sumac Shrubland	Acreage Direct Impacts 2.0 A-1, A-2, B-1, B-2	a, b, c, d, e, f, g, h	Located in SBNWR and on the eastern Project portion in swales and desert washes along access roads and on the international border.
Alkali Sacaton Herbaceous Vegetation	Acreage Direct Impacts: 1.3 Staging Areas: 1.4 A-1, A-2, A-3, B-1, B-2, B-3	a, b, c, d, e, f, g, h	Located in SBNWR and on the eastern Project portion in swales and desert washes along access roads, on staging areas, and on the international border.
Wild Barley – Honey Mesquite Shrub Herbaceous Vegetation	Acreage Direct Impacts: 0.1 Staging Areas:0.1 A-1, B-1	a, b, c, d, e, f, g, h	Located on the Slaughter Ranch on the international border. There is a post-on rail barrier fence in place.
Hook Three-awn Herbaceous Vegetation	Acreage Direct Impacts: 0.8 A-2, B-2	a, c, d, e, f, g, h	Located near the eastern Project portion on fine soils along an access road.
Desert Marigold Herbaceous Vegetation	Acreage Staging Areas: 0.6 A-2, A-3, B-2, B-3	a, b, c, d, e, f, h	Located near the eastern Project portion on a disturbed site along an access road and staging area.
Russian-thistle Semi-natural Herbaceous Vegetation	Acreage Staging Area: 1.6 A-1, B-1	a, c, e, f, g, h	Located on the Slaughter Ranch on the international border. There is a post-on rail barrier fence in place.

Plant Community Impacted	Approximate Impact Type and Acreage	Indirect Impact Type	Location and Comments
Common Cocklebur Semi-natural Herbaceous Vegetation	Acreage Direct Impacts:-0.1 A-2, B-2	a, c, e, h	Located near the eastern Project portion in an excavation along an access road.
Total Long-term Vegetation Impact/Total Temporary Vegetation Impact (likely will have long-term implications in terms of restoration)	**157.1 acres 49.7 acres**		

Portions of the Project area subject to construction and future maintenance will result in permanent impacts on vegetation; this area totals 157.1 acres. Some areas will receive indirect impacts that range from short-term to long-term in duration. For example, dust deposition during construction will be considered short-term and will largely be removed from vegetation during an adequate rainfall event. Temporary staging areas and vehicle or equipment tracks outside the construction and access zones will result in long-term impacts due to vegetation crushing, nonnative species invasion, and increased erosion potential. Restoration of these sites will likely require several decades in this semiarid environment. Effects on Chihuahuan Desert vegetation communities due to elimination of most illegal vehicle access and possibly some human foot traffic following construction of the vehicle barrier will be beneficial and will allow restoration of the landscape to proceed in the short- and long-terms.

Mitigation used to lessen the impacts of the Project includes providing onsite biological monitors to assist in avoiding sensitive or protected plant species and habitats when possible (see **Appendix E**) and the implementation of a SWPPP, SPCC and CM&R plans, and Dust Control Plan to reduce siltation, pollutant runoff, and dust covering of plants, respectively. Vegetation will be replanted in temporarily impacted areas.

Construction of tactical infrastructure will increase border security in the project corridor and may result in a change to illegal traffic patterns. However, changes to illegal traffic patterns result from a myriad of factors and therefore are considered unpredictable and beyond the scope of this ESP. Beneficial indirect impacts will be expected, as the vehicle fence will substantially reduce or eliminate illegal cross-border vehicle traffic and associated trash and illegal roads in the project corridor.

3.8.2 Wildlife and Aquatic Resources

3.8.2.1 Definition of the Resource

Although the Secretary's waiver means CBP no longer has any specific legal obligations for the tactical infrastructure segments addressed in this ESP, the Secretary committed CBP to responsible environmental stewardship of our valuable natural and cultural resources. CBP supports this objective and has applied the appropriate standards and guidelines for evaluating environmental impacts and mitigations associated with wildlife and aquatic resources.

Wildlife and aquatic resources include native or naturalized animals and the habitats in which they exist. Identification of the species potentially occurring in the Project area was accomplished through literature reviews, coordination with appropriate Federal and state resource managers, other knowledgeable experts, and field surveys.

The Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703–712) as amended, implements various treaties for the protection of migratory birds. Under the Act, taking, killing, or possessing migratory birds is unlawful without a valid permit. Under Executive Order (EO) 13186, the USFWS has the responsibility to administer, oversee, and enforce the conservation provisions of the MBTA, which include responsibility for population management (e.g., monitoring), habitat protection (e.g., acquisition, enhancement, and modification), international coordination, and regulations development and enforcement. The MBTA defines a migratory bird as any bird listed in 50 CFR 10.13, which includes nearly every native bird in North America.

The MBTA and EO 13186 require Federal agencies to minimize or avoid impacts on migratory birds listed in 50 CFR 10.13. If design and implementation of a Federal action cannot avoid measurable negative impact on migratory birds, EO 13186 requires the responsible agency to consult with the USFWS and obtain a Migratory Bird Depredation permit.

The Secretary's waiver means that CBP no longer has any specific legal obligations under the MBTA, for the FV-1B segments addressed in this ESP, the Secretary committed the DHS to responsible environmental stewardship of our valuable natural and cultural resources. CBP supports this objective and has applied the appropriate standards and guidelines associated with the MBTA as the basis for evaluating potential environmental impacts and appropriate mitigations.

3.8.2.2 Environmental Setting

Wildlife. Cochise County is in southeastern Arizona. Surveys were conducted in the impact corridor from April 28, 2008, to May 2, 2008. Detailed results are provided in the Biological Survey Report (see **Appendix D**). The wildlife habitats in the impact corridor are predominately Chihuahuan Desert shrublands. Higher elevations are characterized by ocotillo, tarbush, and mortonia, while middle elevations have developed a shrubland canopy composed of creosotebush, tarbush, and honey mesquite. The lowest elevations are predominately honey mesquite shrublands and woodlands with a gallery forest of Fremont cottonwood and Goodding willow, small stands of grasslands, and forb-dominated agricultural fields. The entire impact corridor occurs within the Rio Yaqui Basin. Historically this watershed's basin was a large cienega (marshy wetland) that supported a number of herbaceous species with only a few honey mesquite trees and shrubs. However groundwater pumping, surface water diversion, and farming and ranching pursuits have converted the basin bottom into an extensive stand of honey mesquite trees and shrubs. Riparian and wetland plant communities have been established along washes, on seeps, and adjacent to springs that provide adequate surface and groundwater. There is limited open water and aquatic habitat.

Thirty-nine reptiles and amphibians are known from SBNWR habitats. During the wildlife surveys of the impact corridor western diamondback rattlesnakes, coachwhips, Sonoran toads, and lizard species were observed. Other species that could occur include the black-tailed rattlesnake, desert kingsnake, ringneck snake, Gila monster, Madrean alligator lizard, collared lizard, and horned toad in uplands and rock outcrops, while the wetland habitats support the Chiracahua leopard frog, Sonoran mud turtle, and checkered and Mexican garter snakes (USFWS 2008).

Fifty-five species of mammals have been recorded in the SBNWR habitats and also use adjacent landscapes of the impact corridor. The largest species groups include bats (14) and mice, including pocket mice (10). Most of the mammals are nocturnal (night-active) or crepuscular (dusk- and dawn-active) and with the exception of the bat species are year-round residents. Black bear can traverse the Project area in search of forage. The rugged mountains that surround the San Bernardino Valley can support the very rare and federally endangered jaguar and ocelot, which have been recorded southeast and west of the Project area.

SBNWR and the adjacent impact corridor support at least 268 bird species (USFWS 2008). Raptors that commonly utilize area habitats include American kestrel, peregrine falcon, red-tailed hawk, sharp-shinned hawk, Swainson's hawk, gray hawk, zone-tailed hawk, golden eagle, turkey vulture, and Chihuahuan raven (USFWS 2008). Aquatic birds and shorebirds that have been observed in the SBNWR include American coot, great blue heron, green-backed heron, Virginia rail, ringneck duck, Mexican duck, and sandhill crane. Other species and groups of birds common to the impact corridor include doves, greater roadrunner, owls, nighthawks, hummingbirds, flycatchers, loggerhead shrike, vireos, swallows, verdin, wrens, northern mockingbird, thrashers, warblers, tanagers, towhees, sparrows, grosbeaks, eastern meadowlark, and Bullock's oriole.

Aquatic Resources. There are eight native fish species found in the SBNWR including the Yaqui chub *(Gila purpea)*, Yaqui topminnow (Poeciliopsis occidentalis sonoriensis), Yaqui catfish (*Ictalurus pricei)*, and the beautiful shiner *(Cyprinella Formosa).* The SBNWR was created specifically to protect native fish. Prior to drainage of wetlands and loss of permanent surface flows, the SBNWR drainages and cienega supported approximately one-fourth of the fish species native to Arizona (USFWS 2008). Three of the remaining eight native fish species in the refuge are listed as endangered.

Southeastern Arizona has a diverse and unique invertebrate population due to the intersection of the Sonoran and Chihuahuan deserts. Cochise County supports more than 100 butterfly species as well as an abundance of damselflies and several unique tropical species. The SBNWR has been documented as supporting species of invertebrates that occur in the United States only on the refuge (USFWS 2008).

3.8.2.3 Effects of the Project

The Project will potentially have impacts on wildlife on approximately 16.85 miles of public and private lands. The fence will be constructed in two sections along the U.S./Mexico border. In addition, improvements to or construction of seven access roads are required and will impact 5.25 miles of the SBNWR, BLM, and private lands. It is anticipated that the post-on rail style vehicle fence will be constructed for the majority of the segment, with Normandy-style barrier used for desert wash crossings and steeper grades. As part of the criteria the fence was designed to reduce or minimize impacts on small animal movements and to not impede the natural flow of surface water. However, it is anticipated the wildlife and aquatic resources could be impacted, as discussed below.

***Wildlife*.** Permanent impacts on wildlife from habitat loss will occur from the installation of the vehicle fence, construction of new access roads, and improvement of existing access roads. Temporary impacts on wildlife could result from increased human activity, noise, security lighting, and physical disturbances associated with construction and maintenance.

Impacts on migratory birds are dependent upon timing of fence construction. The SBNWR; and state, Federal, and private lands in the Tucson Sector are extremely important to migratory bird management. Any nesting birds found within the Project footprint will be avoided or relocated by a qualified biologist prior to construction activities. There could also be a beneficial effect on migratory birds from the Project by the reduction in foot and vehicular traffic through the habitats.

Temporary construction lighting along the border fence could behaviorally impact nocturnal wildlife both by attracting them or displacing them around the illuminated zones. The Project proposes minimizing impacts by only using security lighting around the staging areas. If construction or maintenance activities require continuing into the night in areas occupied by listed animal species, all lights will be shielded to direct light only onto the work site and the area necessary to ensure worker safety and productivity. The minimum foot-candles needed will be used and the number of lights will be minimized.

Aquatic Resources. Minor direct and indirect increases in sedimentation could result due to construction and installation of new vehicle barrier and creation or improvement of the access roads and construction staging areas. The soils found in the former cienega are extremely fine silt and clay and are highly erodible by water and wind action. Sedimentation impacts could impact the aquatic resources during construction by increased siltation of waters, reducing water (habitat) quality. Indirect impacts could result from increased erosion after construction due to destabilization of the ground surface during clearing and construction activities. Such increased erosion could result in changes to the surface hydrology of the area. Implementation of the standard BMPs for water quality provided in **Chapter 3.7** will minimize impacts on aquatic resources from sedimentation.

3.8.3 Special Status Species

3.8.3.1 Definition of the Resource

Although the Secretary's waiver means CBP no longer has any specific legal obligations under the Endangered Species Act (ESA) for the tactical infrastructure segments addressed in this ESP, the Secretary committed CBP to responsible environmental stewardship of our valuable natural and cultural resources. CBP supports this objective and has applied the appropriate standards and guidelines associated with the ESA as the basis for evaluating potential environmental impacts and appropriate mitigations associated with special status species.

This section of the ESP addresses the species and their habitats that have been designated by the USFWS to fall under the category of Threatened or Endangered under the ESA, as amended (16 U.S.C. §§ 1531–1544 et seq.). The ESA provides broad protection for species of fish, wildlife, and plants that are listed as threatened or endangered in the United States or elsewhere. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species.

CBP, in partnership with other Federal and state agencies, developed a set of species-specific BMPs that would attenuate, or mitigate in some instances, potentially adverse effects on species and their habitats normally protected by provisions of the ESA and the procedural requirements of the National Environmental Policy Act (NEPA).

3.8.3.2 Environmental Setting

Habitats within the Project area range from upland mixed-desert scrub and thorn-scrub throughout the alignment to riparian woodland and forest stands within SBNWR and Guadalupe Canyon. Much of the vegetation cover along the vehicle fence section consists of native shrublands characterized by honey mesquite, creosotebush, tarbush, whitethorn, shrubby coldenia, mortonia, and ocotillo. Development is limited to one irrigated pasture and existing roads and trails. Most of the affected habitat for the species listed in **Table 3-8** is within the Yaqui drainage, which includes the headwaters at Leslie Canyon and continues south through the Leslie Canyon NWR and the SBNWR. The refuges operate under guidelines established by the National Wildlife Refuge System Improvement Act of 1997, the ESA as amended, the Fish and Wildlife Coordination Act, and as a preserve for the restoration of fish and invertebrates that had been previously extirpated from the upper Yaqui River drainage within the United States.

Table 3-8 presents the federally listed species for Cochise County, Arizona. The state status is provided for these species; however, this section addresses only the federally listed species.

The construction of vehicle fence for the Tucson Sector will consist of post-on rail and Normandy-style fence sections ranging from 0.06 to 2.93 miles in length for a total of approximately 16 miles. Employment for federally listed species with potential to occur within the Project area and be affected by construction activities will minimize impacts on federally listed species and their habitats.

Fish and Invertebrates

The following fish and invertebrate species occur within Cochise County, Arizona, and are listed as threatened or endangered under the ESA: beautiful shiner *(Cyprinella formosa),* desert pupfish *(Cyprinodon macularius),* Gila chub, (*Gila intermedia),* Yaqui chub, (*Gila purpurea),* Yaqui catfish (*Ictalurus pricei),* spikedace (*Meda fulgida*), Gila topminnow, *(Poeciliopsis occidentalis occidentalis),* Yaqui topminnow, (*Poeciliopsis occidentalis sonoriensis),* loach minnow (*Tiaroga cobitis*), and Huachuca springsnail, (*Pyrgulopsis thompsonii*) (candidate). Of these, beautiful shiner, Yaqui chub, Yaqui catfish, and Yaqui topminnow have the potential to occur within or near the Project area.

Amphibians and Reptiles

The following amphibian and reptile species occur within Cochise County, Arizona, and are listed as threatened or endangered under the ESA: Sonora tiger salamander (*Ambystoma tigrinum stebbinsi),* Ramsey Canyon leopard frog (*Lithobates subaquavocalis)* (listed under a Conservation Agreement),

Table 3-8. Federal- and State-Listed Species Potentially Occurring Within Cochise County

Common Name	Scientific Name	Federal Status	State Status
Fish and Invertebrates			
Beautiful shiner	*Cyprinella formosa*	LT	WSC
Desert pupfish	*Cyprinodon macularius*	LE	---
Gila chub	*Gila intermedia*	LE	WSC
Yaqui chub	*Gila purpurea*	LE	WSC
Yaqui catfish	*Ictalurus pricei*	LT	WSC
Spikedace	*Meda fulgida*	LT	---
Gila topminnow	*Poeciliopsis occidentalis occidentalis*	LE	---
Yaqui topminnow	*Poeciliopsis occidentalis sonoriensis*	LE	WSC
Loach minnow	*Tiaroga cobitis*	LT	---
Huachuca springsnail	*Pyrgulopsis thompsonii*	C	---
Amphibians			
Sonora tiger salamander	*Ambystoma tigrinum stebbinsi*	LE	---
Ramsey Canyon leopard frog	*Lithobates subaquavocalis*	CA	---
Chiricahua leopard frog	*Rana chiricahuensis*	LT	WSC
Reptiles			
New Mexico ridge-nosed rattlesnake	*Crotalus willardi obscurus*	LT	---
Birds			
Yellow-billed cuckoo	*Coccyzus americanus*	C	WSC
Southwestern willow flycatcher	*Empidonax traillii extimus*	LE	WSC
California brown pelican	*Pelecanus occidentalis californicus*	LE, PDL	---
Mexican spotted owl	*Strix occidentalis lucida*	LT	WSC
Mammals			
Ocelot	*Leopardus pardalis*	LE	---
Lesser long-nosed bat	*Leptonycteris curasoae*	LE	WSC
Jaguar	*Panthera onca*	LE	WSC

Common Name	Scientific Name	Federal Status	State Status
Plants			
Cochise pincushion cactus	*Coryphantha robbinsorum*	LT	HS
Huachuca water umbel	*Lilaeopsis schaffneriana* var. *recurva*	LE	HS
Canelo Hills ladies'-tresses	*Spiranthes delitescens*	LE	HS

Source: AZGFD 2008b, USFWS 2008
Notes:
C = Candidate; CA = Conservation Agreement; LE = Listed Endangered;
LT = Listed Threatened; PDL = Proposed for Delisting;
HS = Highly Safeguarded (no collection allowed); WSC = Wildlife of Special Concern in Arizona

Chiricahua leopard frog (*Rana chiricahuensis),* and New Mexico ridge-nosed rattlesnake (*Crotalus willardi obscures).* Of these, Chiricahua leopard frog has the potential to occur within or near the Project area.

Avian Sensitive Species

The following avian species occur within Cochise County, Arizona, and are listed as threatened or endangered under the ESA: yellow-billed cuckoo (*Coccyzus americanus*), southwestern willow flycatcher (*Empidonax traillii extimus*), California brown pelican (*Pelecanus occidentalis californicus*), and Mexican spotted owl (*Strix occidentalis lucida*). Of these, yellow-billed cuckoo, a candidate species, has the potential to occur within or near the Project area.

Mammal Species

The following mammal species have potential to occur within Cochise County, Arizona, and are listed as endangered under the ESA: ocelot, (*Leopardus pardalis*), lesser long-nosed bat (*Leptonycteris curasoae*), and jaguar (*Panthera onoca*). Of these, lesser long-nosed bat and jaguar have the potential to occur in or near the Project area.

Plant Species

The following plant species occur within Cochise County, Arizona, and are listed as threatened or endangered under the ESA: Cochise pincushion cactus (*Coryphantha robbinsorum*), Huachuca water umbel (*Lilaeopsis schaffneriana* var. *recurva)*, Lemmon fleabane *(Erigeron lemmonii*) (candidate), and Canelo Hills ladies'-tresses *(Spiranthes delitescens)*. Of these, Cochise pincushion cactus and Huachuca water umbel have the potential to occur in or near the impact area.

3.8.3.3 Effects of the Project

Effects on listed species are addressed in detail in the Biological Resources Plan developed for this Project (see **Appendix E**). The following provides a general evaluation of potential impacts on those listed species potentially occurring within the Project area. No threatened or endangered species were observed in the Project area during biological surveys conducted during spring and early summer of 2008.

Fish and Invertebrates

The 60-foot-wide Project corridor and temporary construction staging areas will directly impact mixed-desert scrub and thorn-scrub communities throughout the alignment, as well as riparian woodland and forest stands. However, construction within the Project area and associated vegetation removal and land clearing/grading activities will have only a minor impact on the springs, cienegas, and other aquatic habitats where these species occur. The fence design does not affect the natural flow of the Yaqui River drainage into Mexico.

With the employment of BMPs, to include design signatures of the fence itself, the planned Project will not impact natural drainages of the Yaqui River. Therefore, it is not expected that construction of the fence will directly impact the beautiful shiner, Yaqui chub, Yaqui catfish, or Yaqui topminnow. It is also likely that an effective vehicle barrier will prevent incursions by illegal vehicles that would otherwise destroy sensitive habitat and displace or destroy sensitive species.

Amphibians and Reptiles

Chiricahua Leopard Frog. The 60-foot-wide Project corridor and temporary construction staging areas will directly impact mixed-desert scrub and thorn-scrub communities throughout the alignment, as well as riparian woodland and forest stands. However, construction within the Project area and associated vegetation removal and land clearing/grading activities will have only a minor impact on the natural movement of amphibians in the use of springs, cienegas, and other aquatic habitats. With the employment of BMPs, the planned Project will not obstruct the natural movement of amphibians and reptiles across the U.S./Mexico border. Project activity will not impact natural drainages of the Yaqui River. Therefore, it is not expected that construction of the fence will directly impact the Chiricahua leopard frog. It is also likely that an effective vehicle barrier will prevent incursions by illegal vehicles that would otherwise destroy sensitive habitat and displace or destroy sensitive species.

Avian Sensitive Species

Yellow Billed-Cuckoo. The 60-foot-wide Project corridor and temporary construction staging areas will directly impact mixed-desert scrub and thorn-scrub communities throughout the alignment, as well as riparian woodland and forest stands. The employment of BMPs will minimize the amount of vegetation cleared along drainages and in riparian areas, streambeds, and floodplains within the Project area. Therefore the impacts on habitat and natural movement of avian species, including yellow-billed cuckoo, will be minimized. It is also likely that an effective vehicle barrier will prevent incursions by illegal vehicles that would otherwise destroy sensitive habitat and displace or destroy suitable habitat for sensitive avian species.

Mammal Species

Jaguar and Lesser Long-nosed Bat. The 60-foot-wide Project corridor and temporary construction staging areas will directly impact mixed-desert scrub and thorn-scrub communities throughout the alignment, as well as riparian woodland and forest stands. The employment of BMPs will minimize the amount of vegetation cleared along drainages and in riparian areas, streambeds, and floodplains within the Project area. Therefore, the impacts on existing habitat potentially utilized by jaguar will be minimized. The fence design will not impede jaguar transmigration across the U.S./Mexico border. The lesser long-nosed bat is not expected to be directly impacted by the planned Project because BMPs minimize nighttime lighting and limit the removal of agave plants. It is also likely that an effective vehicle barrier will prevent incursions by illegal vehicles that would otherwise destroy sensitive habitat and displace or destroy suitable habitat for sensitive mammal species.

Plant Species

Cochise Pincushion Cactus and Huachuca Water Umbel. The 60-foot-wide Project corridor and temporary construction staging areas will directly impact mixed desert scrub and thorn-scrub communities throughout the alignment, as well as riparian woodland and forest stands. The employment of BMPs and the use of biological monitors to identify and remove any sensitive plants prior to construction will reduce impacts on Cochise pincushion and Huachuca water umbel. Clearing activities will, to the degree practicable, allow for monitors to identify the existence of these species at least 48 hours prior to construction activities taking place. Biological monitors will minimize and document permanent effects directly associated with Project activities. It is also likely that an effective vehicle barrier will prevent incursions by illegal vehicles that would otherwise destroy sensitive plants and their habitat.

3.9 CULTURAL RESOURCES

3.9.1 Definition of the Resource

Although the Secretary's waiver means CBP no longer has any specific legal obligations under the National Historic Preservation Act (NHPA), Archaeological Resources Protection Act (ARPA) of 1979 (as amended), American Indian

Religious Freedom Act (AIRFA) of 1978, and the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990, EO 11593: Protection and Enhancement of the Cultural Environment of 1971, American Antiquities Act of 1906, and Executive Order 13007: Indian Sacred Sites of 1996 for the tactical infrastructure segments addressed in this ESP, the Secretary committed CBP to responsible environmental stewardship of our valuable natural and cultural resources. CBP supports this objective and has applied the appropriate standards and guidelines associated with the NHPA as the basis for evaluating potential environmental impacts and appropriate mitigations for cultural resources.

Cultural resources are defined by the NHPA of 1966 (as amended) as prehistoric and historic sites, structures, districts, or any other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or other reasons. Depending on the condition and historic use, such resources can provide insight into living conditions in previous civilizations and can retain cultural and religious significance to modern groups.

Typically, cultural resources are subdivided into *archaeological resources* (prehistoric or historic sites where human activity has left physical evidence of activities but no standing structures remain) or *architectural resources* (buildings or other structures or groups of structures that are of historic or aesthetic significance). Archaeological resources comprise areas where human activity has measurably altered the earth or deposits of physical remains, such as arrowheads or bottles, are found.

Architectural resources include standing buildings, bridges, dams and other structures of historic or aesthetic significance. Generally, architectural resources must be more than 50 years old to be considered for nomination to the National Register of Historic Places (NRHP). More recent structures, such as Cold War-era resources, might warrant protection if they have the potential to gain significance in the future or if they meet “exceptional” significance criteria.

Traditional cultural properties or sacred sites are a special category of cultural resources. These site types can encompass archaeological resources, structures, neighborhoods, prominent topographic features, habitat, plants, animals, and minerals that Native Americans or other groups consider essential for the preservation of traditional culture.

The evaluation and consultation processes promulgated in Section 106 of the NHPA require assessment of the undertaking’s potential impact on historic properties that are within the proposed Project’s Area of Potential Effect (APE). The APE is defined as the geographic area(s) “within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist.” In accordance with EO 12372, *Intergovernmental Review of Federal Programs*, determinations regarding the potential effects of an undertaking on historic properties are presented to the SHPO.

3.9.2 Environmental Setting

A search of existing archaeological and historical site records within one mile of the U.S./Mexico border along the current APE was conducted through Arizona State Museum (ASM) AZSites online database, U.S. Department of the Interior, BLM, and USFWS. Pedestrian inventory of the APE west of Guadalupe Canyon was conducted between April 30 and May 12, 2008. The Guadalupe Canyon section was inventoried on June 13, 2008, and again on August 13, 2008, pursuant to a modification of the original design.

File search results indicated 62 previously recorded archaeological sites within one mile of the U.S./Mexico border along the Project area. Nearly one third of the previously recorded sites represent prehistoric occupations of unknown temporal or cultural affiliation. Five previously recorded sites (8 percent) are ascribed to the prehistoric Archaic period without further specification; two (3 percent) are noted as general Archaic and unspecified later ceramic period occupations, and one (2 percent) is described as containing both unspecified Archaic and unspecified historic components. Two prehistoric sites are attributed to the Animus phase and two are attributed to Mogollon occupations. The only prehistoric site within the file search area that has been reliably ascribed a temporal affiliation is AZ FF:11:21[ASM], which was partially excavated in the late 1960s (Mills and Mills 1971). This site is affiliated with the Salado phase and is cross-dated via temporally diagnostic ceramics to the period A.D. 1300 to 1500. This temporal range is partially corroborated by two archaeomagnetic samples that provided an average date of approximately A.D. 1380 with a standard deviation of less than 25 years (Fish et al. 2006). It will not be impacted by the proposed undertaking.

Among 19 previously recorded historic occupations for which dates of occupation have been estimated based on manufacturing ranges of associated artifacts, the temporal range is from 1880 to 1950. The majority of historic sites cluster in a temporal range of approximately 1900 to 1920.

Among the 62 previously recorded sites within one mile of the APE, summarized above, seven (sites AZ FF:11:81[ASM], AZ FF:11:23[ASM], AZ FF:11:48[ASM], SB-11, SB-12, SB14, and SB-19) were within the Project's APE. Five previously unrecorded archaeological sites (AZ FF:12:59[ASM], AZ FF:10:71–74[ASM]) were also documented, recorded, and evaluated during the Project pedestrian inventory. Two of the newly recorded sites were within the APE for vehicle barrier fence construction and three were within the APE of proposed access roads. All previously recorded sites reevaluated during the pedestrian inventory were within the vehicle barrier fence APE.

In addition to the above archaeological sites, Border Monuments 74 to 80 were recorded as historic structures AZ FF:10:61(ASM) through AZ FF:10:67(ASM). Sites SB-12 and SB-19 were re-recorded as a single site (AZ FF:10:69 [ASM]); site AZ FF:11:23(ASM), a small lithic scatter recommended not eligible for NRHP inclusion by the recorders, could not be relocated and is considered destroyed. A total of 18 archaeological sites (including site AZ FF:11:23[ASM] which is no longer evident) or border monuments have been recorded or reevaluated within the Project's APE.

All of the border monuments are recommended eligible for listing on the NRHP due to their significant association with the historical pattern of U.S.-Mexican political and economic relations during the period 1848 to 1896. All but one of the monuments were erected between 1892 and 1896; Border Monument 77 was erected in 1855. The monuments' period of historical significance, however, extends to the 1848 Treaty of Guadalupe Hidalgo and subsequent treaties and agreements between 1852 and 1896 that modified and amended various previous agreements and which required the establishment of joint U.S./Mexican border surveys and demarcations. CBP will implement procedures to ensure that these monuments are not impacted by construction and maintenance activities.

Among the five newly recorded archaeological sites within the APE, sites AZ FF:12:59(ASM), AZ FF:10:70(ASM), AZ FF:10:71(ASM), and AZ FF:10:72(ASM) are assessed as lacking integrity of association and location and do not retain good potential for buried deposits. Further archaeological work at these locations cannot be expected to produce additional information that would be important to the study of prehistory or history. These sites are therefore recommended not eligible for inclusion in the NRHP under any criteria. No further management actions are recommended for these sites.

Newly recorded site AZ FF:12:59(ASM) is a large artifact scatter that contains high frequencies of lithic debitage, flaked stone tools, and ceramic sherds. The ceramic assemblage consists of indeterminate buffware and corrugated sherds, and Mimbres black-on-white specimens (AD 1100–1350). The site is in good condition and is recommended for listing on the NRHP.

Site AZ FF:11:81(ASM) was determined eligible for NRHP under Criterion D by Arizona State Historic Preservation Office (AZ SHPO log 2000-1904). The site has been impacted by road grading. However, the remaining portion is in good condition.

Sites AZ FF:11:48(ASM) and AZ FF:10:74(ASM) contain temporally diagnostic artifacts indicative of an Early Agricultural period occupation and occur in settings conducive to the burial and preservation of intact archaeological materials. Both of these sites are recommended eligible for the NRHP under Criterion D.

AZ FF:10:68(ASM) and AZ FF:10:69(ASM) are unique historic sites associated with Mormon settlement and Chinese immigrant settlement, respectively. These sites are recommended for NRHP listing under Criterion A for their association with broad patterns in our history, Criterion C as the only known examples of specific cross-border sites used by Mormons and Chinese, and under Criterion D for information content. Controlled test excavations are recommended for both sites to determine the depth and lateral extent of cultural deposits and to identify how the Project might impact cultural deposits. Archival research is also recommended for both sites.

3.9.3 Effects of the Project

Analysis of potential impacts on cultural resources considers various agents. Adverse impacts can include physically altering, damaging, or destroying all or part of a resource; altering characteristics of the surrounding environment that contribute to the resource's significance; introducing visual or audible elements that are out of character with the property or alter its setting; or neglecting the resource to the extent that it deteriorates or is destroyed. The sale, transfer, or lease of a historic property out of agency ownership (or control) without adequate legally enforceable restrictions or conditions to ensure preservation of the property's historic significance is also considered an adverse impact.

The Project along the international border east of Douglas, Arizona, includes excavation, grading, road improvement, fence construction, construction equipment storage, and increased human presence during the construction phase. The alignment is planned to cross or be immediately adjacent to the border monuments, and the five sites will be partially or completely destroyed by construction activities and installation of the infrastructure within the 60-foot alignment. In summary, the border monuments and five archaeological sites will incur long-term moderate to major adverse effects, as the Project is currently designed.

To address these adverse effects on historic properties, the border monuments will be avoided by specially designing 2 x 2 m (6 x 6 foot) rectangular offsets into the vehicle fence to accommodate the monuments. Archaeological monitors will be present during construction to ensure that no impacts occur to them. Mitigation of adverse impacts on the five significant archaeological sites will entail archaeological data recovery. Specific data recovery actions and associated research themes are detailed in a historic properties treatment plan (Hokanson and Grant 2008). The five sites would be subjected to controlled surface collection, exploratory mechanical trenching, hand excavation, and archival research. In total, the five prehistoric and two historical sites that are recommended or determined eligible for listing in the NRHP or in need of further evaluation, will receive up to 540 m of mechanical trenching, hand excavation of up to 215 m^2 (2,316 ft^2), and complete surface collection and detailed instrument mapping of the 18.28-m-(60-foot) wide APE within site boundaries. The affected sites will incur long-term, moderate to major adverse effects that will be completely or partially mitigated through the archaeological data recovery.

3.10 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

3.10.1 Definition of the Resource

Although the Secretary's waiver means CBP no longer has any specific legal obligations under the laws included in the waiver, the Secretary committed CBP to responsible environmental stewardship of our valuable natural and cultural resources. CBP supports this objective and has applied the appropriate standards and guidelines for evaluating environmental impacts associated with socioeconomic resources.

Socioeconomics. Socioeconomics is defined as the basic attributes and resources associated with the human environment, particularly characteristics of population and economic activity. Regional birth and death rates and immigration and emigration affect population levels. Economic activity typically encompasses employment, personal income, and industrial or commercial growth. Changes in these two fundamental socioeconomic indicators are typically accompanied by changes in other components, such as housing availability and the provision of public services. Socioeconomic data at county, state, and national levels permit characterization of baseline conditions in the context of regional, state, and national trends.

Data in three areas provide key insights into socioeconomic conditions that might be affected by a project. Data on employment identify gross numbers of employees, employment by industry or trade, and unemployment trends. Data on personal income in a region can be used to compare the "before" and "after" effects of any jobs created or lost as a result of a project, and whether Environmental Justice issues are present. Data on industrial or commercial growth or growth in other sectors provide baseline and trend line information about the economic health of a region.

Demographics identify the population levels and changes to population levels of a region. Demographics data might also be obtained to identify, as appropriate to the evaluation of a project, a region's characteristics in terms of race, ethnicity, poverty status, educational attainment level, and other broad indicators.

Socioeconomic data shown in this chapter are presented at the county level (which is referred to as the Region of Influence [ROI]), and state level to characterize baseline socioeconomic conditions in the context of regional and state trends. Data have been collected from previously published documents issued by Federal, state, and local agencies; and from state and national databases (e.g., U.S. Census Bureau).

Environmental Justice and Protection of Children. EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* February 11, 1994, addresses the Federal policy of Federal agencies' actions substantially affecting human health or the environment not to exclude persons, deny persons benefits, or subject persons to discrimination because of their race, color, or national origin. The purpose of the EO is to ensure 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 groups of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the adverse environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, tribal, and local programs and policies. Consideration of environmental justice concerns includes race, ethnicity, and the poverty status of populations in the vicinity of a Project. Such information aids in evaluating whether a project will render vulnerable any of the groups targeted for protection in the EO.

EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, addresses the Federal policy of protection of children from exposure to disproportionate environmental health and safety risks. This EO established that each agency has a responsibility to ensure that its policies, programs, activities, and standards address risk to children that results from environmental health risks or safety risks.

3.10.2 Environmental Setting

Socioeconomics. The Project includes the construction of primary pedestrian and vehicle fence along the U.S./Mexico border southeast of Douglas, Arizona, in Cochise County, Arizona. The Project will occur in a rural/undeveloped area in the United States. For the purposes of this ESP, the ROI will be Cochise County, Arizona. The Project will be constructed on its southern border, and the economic effects of the Project will be felt predominantly within this area. As a baseline, the ROI will be measured against the State of Arizona as a whole. The most current census data are from Census 2000.

Employment types in the ROI vary (see **Table 3-9**). The largest employment type in the ROI and Arizona are educational, health, and social services (20.3, and 18.0 percent, respectively). A substantially larger portion of residents in the ROI (14.3 percent) were employed in the public administration sector as compared to Arizona as a whole (5.4 percent). Arizona has a higher percentage of manufacturing (10.2 percent) compared to the ROI (3.9 percent). Other employment types in the ROI resemble the percentages of Arizona (U.S. Census Bureau 2002). The ROI has a 3.4 percent unemployment rate, which is the exact same as the unemployment rate for Arizona (U.S. Census Bureau 2002).

Environmental Justice. For the purposes of the environmental justice analysis for this ESP, the residents of the ROI and the State of Arizona were evaluated. The ROI is considered to have a disproportionately high percentage of low-income or minority residents under either of two conditions: (1) the percentage of

Table 3-9. Employment Type of Residents in ROI (Cochise County) and the State of Arizona

Economic and Social Indicators	ROI (Cochise County)	Arizona
Employed Persons in Armed Forces	0.3%	0.5%
Civilian Labor Force by Industry Type		
Agriculture, forestry, fishing and hunting, and mining	3.3%	1.5%
Construction	7.4%	8.7%
Manufacturing	3.9%	10.2%
Wholesale trade	1.4%	3.3%
Retail trade	14.7%	12.3%
Transportation and warehousing, and utilities	4.9%	5.0%
Information	2.4%	2.8%
Finance, insurance, real estate, and rental and leasing	4.0%	7.9%
Professional, scientific, management, administrative, and waste management services	7.9%	10.3%
Educational, health and social services	20.3%	18.0%
Arts, entertainment, recreation, accommodation and food services	9.9%	10.1%
Other services (except public administration)	5.6%	4.6%
Public administration	14.3%	5.4%

Source: U.S Census Bureau 2000

low-income or minority populations within the ROI is greater than Arizona's minority percentage or low-income percentage, or (2) the percentage of persons in low-income or minority populations within the ROI is greater than 50 percent. Based on these two conditions, the ROI is not considered to have a disproportionately high percentage of low-income or minority residents according to Census 2000 data.

Table 3-10 shows demographic data and economic indicators of the ROI, and Arizona. The ROI has a lower percentage of minority populations than Arizona. Approximately 12.1 percent of the population in the ROI and 11.6 percent of the population in Arizona are reported as "Some other race" (see **Table 3-10**). As stated earlier, the ROI has a 3.4 percent unemployment rate, which is the exact same as the unemployment rate for Arizona (U.S. Census Bureau 2002).

However, the economic characteristics of the ROI are slightly lower than Arizona (see **Table 3-10**). Residents living in the ROI have lower median household incomes than the State of Arizona (see **Table 3-10**). In the ROI, 17.7 percent of the residents are living below the poverty level, as compared to 9.9 percent in the State of Arizona (see **Table 3-10**).

Table 3-10. Demographic and Economic Characteristics of the ROI (Cochise County) and the State of Arizona

	ROI (Cochise County)	Arizona
Total Population	117,755	5,130, 632
Percent White	76.7%	75.5 %
Percent Black or African American	4.5%	3.1%
Percent American Indian Alaska Native	1.1%	5.0%
Percent Asian	1.6%	3.6%
Percent Native Hawaiian and Other Pacific Islander	0.1%	0.1%
Percent “Some other race”	12.1%	11.6%
Percent Reporting 2 or more races	3.7%	2.9%
Hispanic or Latino (of any race)	30.7%	25.3%
Percent Unemployment	3.4%	3.4%
Percent of Individuals Below Poverty Level	17.7%	9.9%
Median Household Income	$32,105	$40,558

Source: U.S Census Bureau 2000

3.10.3 Effects of the Project

Construction expenditure impacts are assessed in terms of direct effects on the local economy and related effects on other socioeconomic resources (e.g., housing). The magnitude of potential impacts can vary greatly, depending on the location of a Project. For example, implementation of an action that creates 10 employment positions might go unnoticed in an urban area, but could have considerable impacts in a rural region. If potential socioeconomic changes were to result in substantial shifts in population trends or a decrease in regional spending or earning patterns, they will be considered adverse. Analysis of Project impacts focused on the following:

- Change the local business volume, employment, personal income, or population that exceeds the ROI’s historical annual change
- Adverse impacts on social services or social conditions, including property values, school enrollment, county or municipal expenditures, or crime rates.

Socioeconomics. Short-term minor direct beneficial effects will be expected as a result of construction associated with the Project. The construction activities will occur over calendar year (CY) 2008. It is assumed that local materials, supplies, and contractors will be used. However, the limited nature of the construction and new employment associated with the Project will not substantially affect personal income, poverty levels, or other demographic employment indicators in the ROI.

The Cochise County community will benefit from more effective and efficient operations across the Project area. Implementation of the Project will reduce adverse impacts that currently exist on law enforcement, both local and Federal. The reduction of adverse impacts will have a beneficial impact on the emergency response and emergency medical community within the ROI and the surrounding area as well. The Project will provide additional protection from illegal vehicle and foot traffic. Beneficial impacts like a lower crime rate and an improvement in the quality of life in the ROI and the surrounding area will be expected as a result of the decrease in illegal vehicle and foot traffic.

Of the approximately 16 miles of tactical infrastructure, 0.4 miles of it will be built on private ranch land. There might be a slight positive economic impact, as the potential for cattle diseases spreading from Mexico to the United States will decrease as a result of the tactical infrastructure. It is not anticipated that the tactical infrastructure will alter existing grazing patterns, as grazing animals should not be crossing the U.S./Mexico border.

Environmental Justice. Environmental justice concerns and special risks to the populations in Mexico living closest to the Project include safety, noise, pollutants, and hazardous materials. There is not a significant risk to children in the project area because there is not a large population of children in the project area. Safety precautions to protect children and other populations in areas surrounding work sites will include adequate measures to restrict access, minimization of hazards associated with construction activities, and proper handling and disposal of hazardous materials (see **Chapter 3.11**). These BMPs will reduce the potential for impacts on any populations or age groups, including children. Noise associated with construction will be intermittent and short in duration (described in **Chapter 3.3**).

3.11 HAZARDOUS MATERIALS AND WASTE

3.11.1 Definition of the Resource

Although the Secretary's waiver means that CBP no longer has any specific obligation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), the Toxic Substances Control Act (TSCA), and the Superfund Amendments and Reauthorization Act (SARA), the Secretary committed CBP to responsible environmental stewardship of our valuable natural and cultural resources. CBP supports this objective and has applied the appropriate standards and guidelines associated with CERCLA, RCRA, TSCA, and SARA as the basis for evaluating potential environmental impacts and developing appropriate mitigations for hazardous materials and wastes.

In general, hazardous materials, hazardous substances, and hazardous wastes include elements, compounds, mixtures, solutions, and substances which, when released into the environment or otherwise improperly managed, could present substantial danger to the public health, welfare, or the environment.

Evaluation of hazardous materials and wastes focuses on underground storage tanks, aboveground storage tanks, and the storage, transport, handling, and use of pesticides, herbicides, fuels, solvents, oils, lubricants, asbestos-containing material, and lead-based paint. Evaluation might also extend to generation, storage, transportation, and disposal of hazardous wastes when such activity occurs at or near the Project area. In addition to being a threat to humans, the improper release of hazardous materials and wastes can threaten the health and well-being of wildlife species, botanical habitats, soil systems, and water resources. In the event of release of hazardous materials or wastes, the extent of contamination varies based on the type of soil, topography, and water resources.

3.11.2 Environmental Setting

The area surrounding the Project area is predominantly within public (SBNWR and BLM land) and private undeveloped land. Therefore, the potential of the presence of hazardous materials within or near the vehicle fence sections is highly unlikely. There are no known waste storage sites, waste disposal sites, or known releases of hazardous substances or petroleum products within the Project area (USAF 2008, CRS 2006).

3.11.3 Effects of the Project

Short-term negligible adverse impacts will be expected. Products containing hazardous materials (e.g., fuels, oils, lubricants, pesticides, and herbicides) will be procured and used during construction. It is anticipated that the quantity of products containing hazardous materials used will be minimal and their use will be of short duration. It is anticipated that the quantity of hazardous and petroleum wastes generated from construction will be negligible.

Accidental spills could occur as a result of the construction. Spills could result from such activities as refueling of heavy equipment, loss of hydraulic oil through ruptured or leaking hoses, and possible gasoline or diesel fuel spills resulting from the unlikely event of a ruptured fuel tank. A spill could potentially result in short-term or long-term, minor to moderate adverse impacts on wildlife, soils, water, and vegetation. However, the amount of hazardous materials at the construction site will be limited and the equipment necessary to quickly contain any spill will be present when refueling. Contractors will be responsible for the management of hazardous materials and wastes. CBP will require that the contractor keep any necessary materials and equipment onsite to quickly contain any spill or leak. The management of hazardous materials and wastes will include the use of BMPs and adherence to a refueling standard operating procedures, a pollution prevention plan, an SPCC Plan, and a storm water management plan. CBP will also require the construction contractor to manage all hazardous materials and wastes in accordance with applicable Federal, state, and local regulations.

THIS PAGE INTENTIONALLY LEFT BLANK

4. BEST MANAGEMENT PRACTICES AND MITIGATION MEASURES

CBP will continue to work in a collaborative manner with local government, state and Federal land managers, and the interested public to identify environmentally sensitive resources and develop appropriate BMPs to avoid or minimize adverse impacts resulting from the installation of tactical infrastructure.

Design criteria to reduce adverse environmental impacts include selecting a route that will minimize impacts, consulting with Federal and state agencies and other stakeholders to avoid or minimize adverse environmental impacts, and developing appropriate BMPs to protect natural and cultural resources (see **Table 4-1**). Potential effects, including physical disturbance and construction of solid barriers on wetlands, riparian areas, streambeds, and floodplains, will be avoided or mitigated whenever possible. BMPs will include implementation of a SWPPP, CM&R Plan, SPCC Plan, Dust Control Plan, Fire Prevention and Suppression Plan, and Unanticipated Discovery Plan to protect natural and cultural resources.

Environmental monitors will be present to enforce BMPs and mitigation measures during construction. In many instances, monitors have been present to enforce BMPs during pre-construction activities such as placing targets for aerial photography.

Table 4-1. BMPs and Mitigation Measures

Resource Area	Impacts of the Project	BMPs/Mitigation
Air Quality	Emissions from the Project will not exceed the *de minimis* thresholds and will be less than 10 percent of the emissions inventory for Southeast Arizona Intrastate Air Quality Control Region (SEIAQCR).	Dust Control Plan.
Noise	Minor temporary increases to noise levels during construction activities will occur. There is one residence approximately 500 feet of the Project area. Noise effects to that residence are expected to be between approximately 65-72 dBA.	Equipment will be operated on an as-needed basis. A majority of the activities will occur away from population centers.

Resource Area	Impacts of the Project	BMPs/Mitigation
Land Use and Recreation	Approximately 3 miles of the San Bernardino National Wildlife Refuge, 2.0 miles of BLM land, 15 miles of the Roosevelt Reservation and 1 mile of private land will be impacted. The Project will result in indirect beneficial effects such as reduced habitat degradation	None needed.
Aesthetics	There will be a minor permanent impact on aesthetics.	None needed.
Geology and Soils	Minor impacts to soils from a loss of biological production are expected as a result of new road construction. Construction of vehicle fence will have minor impacts.	Dust Control Plan and SWPPP.
Water Use and Quality		
Hydrology and Groundwater	Short-term, minor, direct, adverse construction-related impacts on groundwater resources is expected. Construction activities will require a temporary and one-time usage of 44.85 acre feet of water (14,625,000 gallons) for the entire length. Grading and contouring will result in short-term minor adverse impacts.	Revegetation of temporary staging areas, SWPPP, any applicable conservation methods as outlined by Arizona Department of Water Resources (ADWR).
Surface Waters and Waters of the United States	Construction will cause a minor and temporary impact on surface water resources from sedimentation and erosion. Impacts will be minimized through mitigation measures, as appropriate. Minor beneficial impacts on washes are expected from the reduction in cross-border traffic.	SWPPP, sediment and erosion control plans, wetlands mitigation and restoration plan.
Floodplains	The 100-year floodplains associated with the Black Draw and Hay Hollow Wash will be crossed by the tactical infrastructure, therefore negligible adverse impacts are expected. If possible, the floodplains will be avoided by limiting construction activities to beyond the reach of the floodplains along either side of Black Draw and Hay Hollow Wash.	Special fence design for stream crossings, planning guidance developed by the U.S. Army Corp of Engineers (USACE).

Resource Area	Impacts of the Project	BMPs/Mitigation
Biological Resources		
Vegetation	Permanent loss of 157.1 acres of vegetation communities, due to construction of tactical infrastructure. Approximately 49.7 acres of vegetation will be temporarily impacted via the staging area but will be rehabilitated upon completion of the construction activities.	Biological monitor on site to ensure all BMPs and mitigation plans are followed. Implementation of SWPPP, SPCC and CM&R plans, and Dust Control Plan.
Wildlife and Aquatic Species	Minor impacts on wildlife are expected from permanent loss of habitat. Potential loss of small mammals and reptiles during construction. Minor impacts on aquatic resources could result from increased sedimentation.	Construction start-date to consider migratory birds. Survey of nesting migratory birds. SWPPP, and sediment and erosion control plans.
Special Status Species	No direct effects to Federally listed species are expected. The Project may affect, but is not likely to adversely affect, the beautiful shiner, Yaqui chub, Yaqui catfish, Yaqui topminnow, Chiricahua leopard frog, yellow-billed cuckoo, jaguar, lesser long-nosed bat, Cochise pincushion cactus, and Huachuca water umbel.	Biological monitor on site to ensure all BMPs and mitigation plans are followed.
Cultural Resources	Adverse impacts to cultural resources.	The border monuments will be avoided and will not be impacted by construction activities. Mitigation for other cultural sites will include data recovery and the presence of archaeological monitors during construction to ensure recovery of data from unanticipated cultural resource finds.
Socioeconomic and Environmental Justice	Short-term minor beneficial impacts are expected from the procurement of construction materials and new employment opportunities.	None needed.
Hazardous Materials and Waste	Short- and long-term negligible to moderate adverse impacts will be expected.	SPCC and CM&R plans.

THIS PAGE INTENTIONALLY LEFT BLANK

5. RELATED PROJECTS AND POTENTIAL EFFECTS

5.1 PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS

DHS and CBP construct infrastructure as a part of their strategy to achieve and maintain effective control over the international border. However, while construction of tactical infrastructure will increase border security in the Tucson Sector, changes to illegal alien traffic patterns could occur. This happens due to a variety of factors.

To address changes in illegal cross-border activity, USBP continually reassesses border security requirements. These operational assessments could require alterations to tactical infrastructure. While CBP will install vehicle fence to meet current and reasonably foreseeable border security needs in this area (and this ESP evaluates those environmental impacts and appropriate mitigations), future illegal alien traffic patterns might require changes potentially including conversion of vehicle fence to pedestrian fence. The post-on rail style of vehicle fence to be used in this current project is structurally designed to easily accept a mesh pedestrian fence alteration. If and when this conversion were needed, CBP will perform the appropriate analysis to ensure our continued responsible environmental stewardship, minimizing the effects of construction on cultural, biological and natural resources wherever possible, and closely coordinate with Federal, state, and local agency stakeholders.

Cumulative Fencing, Southern Border. There are currently 62 miles of landing mat pedestrian fence at various locations along the U.S./Mexico border (Congressional Research Service [CRS] 2006); approximately 30 miles of single, double, and triple pedestrian fence in San Diego, California and Yuma, Arizona; 225 miles of new primary pedestrian fence approved at various locations along the U.S./Mexico border; vehicle fence along much of the Douglas Station's AO, and pedestrian fences at POE facilities throughout the southern border.

Past Actions**.** Past actions are those within the cumulative effects analysis areas that have occurred prior to the development of this ESP. The effects of these past actions are generally described under each resource area. For example, construction of pedestrian fence at the Douglas POE has contributed to the existing environmental conditions of the area.

Present Actions**.** Present actions include current or funded construction projects, USBP or other agency operations in close proximity to the fence locations, illegal crossings, and current resource management programs and land use activities within the cumulative effects analysis areas. Ongoing actions considered in the cumulative effects analysis include the following:

- New Fence. Construction of approximately 50.35 miles of vehicle barrier in the Tucson Sector.

Reasonably Foreseeable Future Actions. Reasonably foreseeable future actions consist of activities that have been approved and can be evaluated with respect to their effects. The following activities are reasonably foreseeable future actions:

- SBI*net.* The Secure Border Initiative (SBI) is a comprehensive multi-year plan established by the Department of Homeland Security (DHS) to secure America's borders and reduce illegal migration. SBI*net* is responsible for the development, installation and integration of technology solutions, and SBI TI develops and installs physical components designed to secure the border consisting of the following major components: pedestrian fence (PF), vehicle fence (VF), roads, lights and vegetation control. SBI*net* will improve deterrence, detection, and apprehension of illegal aliens into the United States. When fully implemented, SBI*net* and SBI TI will improve ability of CBP personnel to rapidly and effectively respond to illegal cross border activity and help DHS and CBP to manage, control, and secure the Nation's borders.

Table 5-1 presents the cumulative effects that might occur from implementation of the Project.

5.2 AIR QUALITY

Minor short-term adverse cumulative effects on air quality are expected from the construction of tactical infrastructure in combination with other reasonably foreseeable future actions. Emissions from construction, operation, and maintenance activities will not be expected to permanently affect local or regional air quality.

5.3 NOISE

Negligible cumulative effects on ambient noise will be expected as a result of construction, operation, and maintenance activities associated with the Project.

5.4 LAND USE AND RECREATION

Long-term cumulative impacts will occur to land use and recreation areas along the border where the fence deviates from the Roosevelt Reservation area. In most cases these areas will be permanently removed from their previously designated uses.

Table 5-1. Summary of Potential Cumulative Effects

Resource	Past Actions	Current Background Activities	Project	Known Future Actions	Cumulative Effects
Air Quality	County Federal moderate nonattainment area for PM_{10}.	Existing sources continue to adversely affect regional air quality (blowing dust).	Construction activities will temporarily contribute to PM_{10} emissions.	Existing emissions sources continue to adversely affect regional air quality. No new major sources identified in Cochise County.	Construction activities will temporarily contribute to regional PM emissions. These contributions are negligible.
Noise	Adjacent vehicle barrier construction (FV1-A).	Adjacent vehicle barrier construction (FV1-A).	Short-term noise impacts from construction.	None.	Negligible cumulative impacts from Project.
Land Use and Recreation	Illegal crossings.	Illegal crossings.	Most of the Project will occur on Roosevelt Reservation. Access roads will be constructed in lands designated as federal, state, and private.	None.	Moderate adverse impacts on natural areas.
Aesthetics	Scarring of landscape by illegal cross-border activity.	Off-road activity by both USBP and cross-border violators.	Minor long-term permanent impact on resource. Impact is lessened by limited access to area.	None.	Permanent visual interruption at fixed points.

Resource	Past Actions	Current Background Activities	Project	Known Future Actions	Cumulative Effects
Geology and Soils	Off-road activity by cross-border violators has modified soils.	Continued cross-border violators activities adversely affect soils.	Minor grading and recontouring will disturb soils.	Continued cross-border violator activities adversely affect soils.	Potential minor long-term impact from construction of additional infrastructure.
Water Use and Quality					
Hydrology and Groundwater	None.	Groundwater currently not used.	Short-term minor adverse effects from groundwater use for dust suppression during construction.	None.	Minor short-term impact from groundwater use during construction.
Surface Waters and Waters of the United States	Off-road activity by cross-border violators has modified Waters of the United States.	Continued activities by cross-border violators adversely affect Waters of the United States.	Soil disturbance, erosion during construction, impacts on Waters of the United States.	None.	Minor long-term effects of erosion and sediment runoff will be minimized by appropriate conveyance structures over and through Waters of the United States and overall effects will be further reduced by minimizing cross-border activity.

Resource	Past Actions	Current Background Activities	Project	Known Future Actions	Cumulative Effects
Floodplains	Floodplains adversely impacted by development, decreased vegetation, increased impervious surfaces, and soil compaction.	Various storm water and floodplain management practices when activities are in or near floodplains.	Negligible adverse impacts on floodplain resources are expected.	None.	Minor adverse impacts from increased impervious surfaces and soil compaction.
Biological Resources					
Vegetation Resources	Degraded habitat of sensitive and common vegetative species by illegal cross-border activity.	Continued illegal cross-border activity results in loss of native species.	Minor to moderate loss of native species and habitat.	None.	Moderate adverse impacts on native habitats and vegetation offset by reductions in cross-border activity.
Wildlife and Aquatic Resources	Loss or degradation of native habitat due to illegal cross-border activity.	Illegal cross-border activity degrading overall environment.	Minor loss of habitat for wildlife.	None.	Minor to moderate loss of habitat.
Special Status Species	Degraded habitat impacted sensitive species.	Illegal cross-border activity degrading overall environment for sensitive species.	Minor loss of habitat and short-term disturbance to sensitive species.	Continued disturbance to sensitive species.	Minor to moderate loss of habitat offset by reduction in species disturbance through improved border control.

Resource	Past Actions	Current Background Activities	Project	Known Future Actions	Cumulative Effects
Cultural Resources	Historic use of parts of Project corridor adversely affected cultural resources.	None.	Impacts may occur to known and unknown cultural resources in the project corridor.	None.	Impacts may occur to known and unknown cultural resources in the project corridor.
Socioeconomics and Environmental Justice	None.	None.	Minor, temporary contribution to local construction industry.	None.	Minor stimulation of local economies from construction activities. No adverse effects on environmental justice issues, children, or human health and safety.
Hazardous Materials and Waste	Use of hazardous substances in vehicles. Possible illegal dumping.	Use of hazardous substances in vehicles. Possible illegal dumping.	Minor use of hazardous materials during construction.	None.	None.

5.5 AESTHETICS

Minor to moderate impacts on aesthetics are expected from the additive effects of past, present, and reasonably foreseeable future actions. The presence of construction equipment under the Project will produce a short-term adverse impact on visual resources. Once installed, the tactical infrastructure will create a permanent and fixed visual interruption at fixed points.

5.6 GEOLOGY AND SOILS

Additive effects include a minor increase in erosion. Construction of the tactical infrastructure within the Tucson Sector will have a minor cumulative effect on soils due to construction and maintenance.

5.7 WATER USE AND QUALITY

5.7.1 Hydrology and Groundwater

Minor adverse cumulative effects could occur on groundwater resources if groundwater was to be used for dust suppression during Project construction. Due to the short-term nature of Project construction and the lack of other foreseeable actions potential adverse cumulative effects will be minor.

5.7.2 Surface Water and Waters of the United States

Minor impacts on surface water and waters of the United States could occur from the Project and reasonably foreseeable future actions. As discussed in **Section 3.7.2,** wetland and other waters of the United States delineations were completed in June and August 2008 and identified 0.36 acres of jurisdictional vegetated wetlands and 11.89 acres of jurisdictional washes within the potential impact areas. Long-term adverse cumulative impacts on Waters of the United States could occur following completion of Project due to the number of washes to be crossed by tactical infrastructure, the need for long-term access, and the need for continuous maintenance of associated conveyance structures. The cumulative impacts on wetlands will be long-term adverse and moderate.

5.7.3 Floodplains

No adverse cumulative impacts on floodplain resources will occur as a result of the Project.

5.8 BIOLOGICAL RESOURCES

5.8.1 Vegetation Resources

Vegetation in the Project corridor will be significantly impacted by Project construction activities. Impacts on native species vegetation and habitat are expected from the additive effects of past, present, and reasonably foreseeable future actions through unavoidable dust production and soil disturbance. Cumulative impacts to vegetation will be lessened by a reduction in illegal cross-border traffic.

5.8.2 Wildlife and Aquatic Resources

Minor impacts on wildlife are expected from the additive effects of past, present, and reasonably foreseeable future actions. Cumulative impacts will mainly result from loss of habitat, habitat disturbance and degradation, and construction traffic. Displaced wildlife will move to adjacent habitat if sufficient habitat exists. Wildlife could also be adversely impacted by noise during construction which when combined with the continued noise of past present and future USBP operations may have an adverse effect on wildlife. Minor cumulative impacts could occur to aquatic species within some of the larger washes from sedimentation. Cumulative impacts to aquatic species from sedimentation will be lessened through the use of BMPs such as the SWPPP. In addition, the reduction in illegal traffic across washes within the Project area will serve to lessen cumulative impacts.

5.8.3 Special Status Species

CBP is in continuing coordination with the USFWS regarding potential impacts on listed species or designated critical habitat. Special status species are commonly protected because their historic range and habitat has been reduced and will only support a small number of individuals. Minor adverse impacts are possible on the lesser long-nosed bat due to construction activity and possible loss of habitat. Construction, operation, and maintenance of tactical infrastructure have the potential to result in minor to major adverse cumulative impacts on these species; however, the construction of the Project, will serve to lessen cumulative impacts by reducing habitat destruction and disturbance caused by illegal cross-border activity.

5.9 CULTURAL RESOURCES

Long-term cumulative impacts may occur to known and unknown cultural resources in the project corridor. Several cultural resources site were identified in the Project area, and CBP continues to coordinate with the Arizona SHPO to mitigate these impacts.

5.10 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

Minor, short-term beneficial impacts on local and regional socioeconomic resources are expected from the additive effects of past, present, and reasonably foreseeable future actions. Economic benefits will be realized by construction companies, their employers and suppliers, and by Cochise County through a minor increase in tax receipts for the purchase of goods and services.

Construction of tactical infrastructure has the potential for minor beneficial effects from temporary increases in construction jobs and the purchase of goods and services. Since the construction jobs will be temporary, negligible cumulative effects on population growth, income, or other services are expected.

The cumulative impacts of USBP activities to control the border of the United States and the concomitant effects upon the Nation's health and economy, violent and drug-related crimes, community cohesion, property values, and traditional family values will be long-term and beneficial, both nationally and locally. Residents of nearby towns will benefit from increased security, a reduction in illegal drug-smuggling activities and the number of violent crimes, less damage to and loss of personal property, and less financial burden for entitlement programs. This will be accompanied by the concomitant benefits of reduced enforcement and insurance costs. Operation and maintenance of the tactical infrastructure has little potential for cumulative impacts on socioeconomics.

5.11 HAZARDOUS MATERIALS AND WASTE

Construction, operation, and maintenance of tactical infrastructure will require minimal quantities of hazardous materials and generate small quantities of hazardous wastes. In light of no other foreseeable past, present, or future activity likely to generate such wastes or materials, minimal cumulative impacts on hazardous materials and wastes will occur as a result of the Project.

THIS PAGE INTENTIONALLY LEFT BLANK

6. REFERENCES

ADEQ 2008	Arizona Department of Environmental Quality (ADEQ). 2008. *Interactive GIS eMAPS, Agency-wide.* Available online: <http://www.azdeq.gov/function/about/gis.html>. Accessed 1 July 2008.
ADWR undated a	ADWR. Undated. Arizona Water Atlas Volume 7. Available online: <*http://www.azwater.gov/dwr/Content/Find_by_Program/Rural_Programs/content/water_atlas/v7/WMD.pdf*>. Accessed 20 June 2008.
ADWR undated b	ADWR. Undated. Securing Arizona's Water Future: San Bernardino Valley Basin. Available online: <*http://www.azwater.gov/dwr/Content/Find_by_Program/Rural_Programs/OutsideAMAs_PDFs_for_web/Southeastern_Arizona_Planning_Area/San_Bernardino_Valley_Basin.pdf*>. Accessed 30 June 2008.
ADWR undated c	ADWR. Undated. Securing Arizona's Water Future: Mexican Drainage. Available online: <*http://www.azwater.gov/dwr/content/find_by_program/Rural_Programs/OutsideAMAs_PDFs_for_web/Southeastern_Arizona_Planning_Area/Mexican_Drainage.pdf*>. Accessed 30 June 2008.
ADWR 2008	ADWR. 2008. Commercial/Industrial Water Conservation. Available online: <*http://www.azwater.gov/dwr/Conservation/CommercialIndustrial.html*>. Accessed 1 July 2008.
AirNav 2008	AirNav. 2008. Airport Information for Douglas Municipal Airport. Available online: <*http://www.airnav.com/airport/KDGL*>. Accessed 12 June 2008.
Bailey 1995	Bailey, Robert F. 1995. Ecoregions of the United States. U.S. Forest Service. Accessed online at: <*http://www.fs.fed.us/colorimagemap/images/300.html*>. Accessed October 15 2007.
Bennett et al. 2004	Bennett, Peter S., Michael R. Kunzmann, and Lee A. Graham. 2004. *Descriptions of Arizona Vegetation Represented on the GAP Vegetation Map*. USGS, Biological Resources Division. Phoenix, AZ.
BLM 1986a	U.S. Bureau of Land Management (BLM). 1986. *BLM Manual H-8410-1, Visual Resource Inventory, Bureau of Land Management*. 17 January 1986.
BLM 1986b	BLM. 1986. BLM Manual 8431 *Visual Resource Contrast Rating, Bureau of Land Management*. 17 January 1986.
BLM 2008	Bureau of Land Management (BLM). 2008. *Arizona Bureau of Land Management, About Arizona BLM.* Available online: <*http://www.blm.gov/az/st/en/info/about.2.html*>. Accessed 3 July 2008.

CCAPD 2008 — Cochise County, Arizona Planning Department (CCAPD). 2008. *Planning and Zoning, Summary of Zoning Districts*. Available online: <*http://www.cochise.az.gov/cochise_planning_zoning.aspx?id=302&ekmensel=c580fa7b_182_0_302_1*>. Accessed 3 July 2008.

Cooke 2008 — Cooke, Scott. 2008. Personal communication between Mr. Scott Cooke (Field Manager for Bureau of Land Management Safford Field Office) and Ms. Audrey Wessel (e^2M) regarding BLM land use. 3 July 2008.

CRS 2006 — Congressional Research Service (CRS). 2006. *Border Security: Barriers Along the U.S. International Border.* Report For Congress prepared by Blas Nunez-Neto and Stephen Vina. Updated 12 December 2006.

Eredux.com 2008 — Eredux.com. 2008. Arizona Energy Consumption Information. Available online: <*http://www.eredux.com/states/state_detail.php?id=1130&state=ARIZOAR*>. Accessed 8 July 2008.

FEMA 1984 — Federal Emergency Management Agency (FEMA). 1984. Flood Insurance Rate Map: Cochise County, Arizona. March 1984.

FEMA 1986 — FEMA. 1986. *A Unified National Program for Floodplain Management.* March 1986.

Fish et al 2006 — Fish, P., S. K. Fish, J. H. Masden. 2006. *Prehistory and Early History of the Malpai Borderlands: Archaeological Synthesis and Recommendations*. United States Department of Agriculture, Rocky Mountain Research Station, General Technical Report RMRS-GTR-176.

Graber 1996 — Graber, D.M. 1996. "Status of terrestrial vertebrates." *Sierra Nevada Ecosystem 2:709-734. Davis, CA: University of California.* 1996.

Hirschberg and Pitts 2000 — Hirschberg, Douglas M., and Stephen G. Pitts. 2000. Digital geologic map of Arizona: a digital database derived from the 1983 printing of the Wilson, Moore, and Cooper 1:500,000-scale map. U.S. Geological Survey Open-File Report 00-409, U.S. Geological Survey, Menlo Park, California.

Hokanson, J. and M. Grant 2008 — Draft Historic Properties Treatment Plan for Data Recovery at AZ FF:11:48(ASM), AZ FF:10:74(ASM), AZ FF:10:68(ASM), AZ FF:10:69(ASM), AZ FF:12:59(ASM), and AZ FF:11:81(ASM) and Eligibility Testing at AZ FF:10:73(ASM). Engineering Environmental Management, Inc., Englewood, Colorado.

IBWC 2007 — International Boundary and Water Commission (IBWC). 2007. "The International Boundary and Water Commission, Its Mission, Organization and Procedures for Solution of Boundary and Water Problems." Available online: <*www.ibwc.state.gov/About_Us/About_Us.html*>. Accessed 20 September 2007.

IBWC 2008 — IBWC. Letter from IBWC to U.S. Customs and Border Protection dated July 29, 2008.

Landrum & Brown 2002	Landrum & Brown, Inc. 2002. *Common Noise Sources*. Available online <*www.landrum-brown.com/env/PVD/EIS/Jan%202002%20Chapter%204/ 4%201-1%20%20common_noise_sources.pdf*>. Accessed 6 July 2004.
Mills and Mills 1971	Mills, J. P. and V. Mills. 1971. The Slaughter Ranch Site. *The Artifact*, (9)3: 23-52. El Paso Archaeological Society.
NatureServe 2008	NatureServe Explorer. 2008. *An online encyclopedia of life* [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available online: http://www.natureserve.org/explorer. Accessed: June 3, 2008.
NPS undated	National Park Service (NPS). Undated. Saguaro National Park: Geology of the Tucson Mountains. Available online: <*http://www.nps.gov/sagu/planyourvisit/upload/geology%20of%20the%20tucson%20mountains.pdf*>. Accessed 25 June 2008.
NRC undated	U.S. Nuclear Regulatory Commission (NRC). Undated. Environmental Assessment: San Bernadino National Wildlife Refuge Well 10. Available online: <*http://64.233.169.104/search?q=cache: djMSnUwi6lYJ:www.osti.gov/bridge/servlets/purl/750992-4jpbzn/webviewable/750992.pdf+Geologic+cross+section+of+San+Bernardino+NWR&hl=en&ct=clcl&cd=1&gl=us&client=firefox-a*>. Accessed 27 June 2008.
NRCS 2008	Natural Resources Conservation Service (NRCS). 2008. National Cooperative Soil Survey (NCSS) Web Soil Survey Version 2.0. U.S. Department of Agriculture, NRCS. Available online: <*http://websoilsurvey.nrcs.usda.gov/app*>. Accessed 10 June 2008.
OSU 2007	Ohio State University. 2007. "Noise on the Farm Can Cause Hearing Loss" by Thomas Bean. Available online at: <*http://ohioline.osu.edu/aex-fact/0590.html*>. Accessed 19 August 2008.
Robinson et al. 2006	Robinson, Anthony T., Nick V. Paretti, and Gail E. Cordy. 2006. *Ecological Assessment of Arizona's Streams and Rivers*. AGFD and USGS, Arizona Water Science Center. Phoenix and Tucson, AZ.
U.S Census Bureau 2002	U.S. Census Bureau. 2002. The U.S. Census; American Fact Finder homepage. "*Employment and Economic Information for state of Arizona and Cochise County, Arizona". Available online* <*http://factfinder.census.gov/home/saff/main.html?_lang=en*>. Accessed June 11, 2008.
University of Arizona 1992	University of Arizona. 1992. Water Resources Research Center. Land subsidence, earth Fissures Change Arizona's Landscape. Available online: <*http://cals.arizona.edu/ZWATER/arroyo/ 062land.html*>. Accessed 10 June 2008.

University of Arizona 2000	University of Arizona. 2000. Southeastern Arizona Mountain Ranges and Natural Habitats. Available online: <*http://nitro.biosci.arizona.edu/zeeb/butterflies/seazhabits.html*>. Accessed 27 June 2008.
USACE 1987	U.S Army Corps of Engineers (USACE). 1987*. Wetland Delineation Manual*. Technical Report Y-87-1. 1987.
USACE 2006	USACE. 2006. *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region,* Technical Report ERDC/EL TR-06-16.
USAF 2008	U.S. Air Force (USAF). 2008. *U.S. Air Force Fact Sheet, Barry M. Goldwater Range*. Luke Air Force Base Library. Available online: <*http://www.luke.af.mil/library/factsheets/factsheet_print.asp?fsID=6384&page=1*>. Accessed 17 June 2008.
USDOJ 2007	U.S. Department of Justice (USDOJ). 2007. "Clean Water Act Jurisdiction Following the U.S. Supreme Court's Decision in *Rapanos v. United States* and *Carabell v. United States*." Prepared for the U.S. Environmental Protection Agency and U.S. Army Corps of Engineers. Available online: <*http://www.epa.gov/owow/wetlands/guidance/CWAwaters.html*>. Accessed 20 November 2007.
USEPA 1971	U.S. Environmental Protection Agency (USEPA). 1971. *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances.* 31 December 1971.
USEPA 1974	USEPA. 1974. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. March 1974.
USEPA 2006	EPA 2006. Documentation for the Final 2002 Nonpoint Sector (Feb 06 version) National Emission Inventory for Criteria and Hazardous Air Pollutants. Prepared for: Emissions Inventory and Analysis Group (C339-02) Air Quality Assessment Division Office of Air Quality Planning and Standards, United States Environmental Protection Agency. July 2006.
USEPA 2007	USEPA. 2007. *Green Book Nonattainment Areas for Criteria Pollutants*. Available online: <*http://www.epa.gov/oar/oaqps/greenbk*>. Accessed 3 October 2007.
USEPA 2008	USEPA. 2008. *Envirofacts Data Warehouse, Multisystem Search: Cochise County, Arizona.* Available online: <*http://www.epa.gov/enviro/html/multisystem.html*>. Accessed 3 July 2008.
USFS 1995	U.S. Forest Service (USFS). 1995. *Forested Wetlands: Functions, Benefits and the Use of Best Management Practices*. NA-PR-01-95. U.S. Department of Agriculture, USFS. David J. Welsch (USFS) with David L. Smart (NRCS) , James N. Boyer (USACE), Paul Minken (USEPA), Howard C. Smith (NRCS), and Tamara L. McCandless (USFWS).

USFWS 2006a	USFWS. 2006. *Notification of Preliminary Species Status Assessment and Information Request for the San Bernardino Springsnail*. Available online: <*http://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/SanBernSnail/BernardinoBernardinoNo.pdf*>. Accessed 30 June 2008.
USFWS 2006b	USFWS. 2006. *Cabeza Prieta National Wildlife Refuge: Comprehensive Conservation Plan, Wilderness Stewardship Plan, and Environmental Impact Statement.* August 2006.
USFWS 2008	USFWS. 2008. *San Bernardino and Leslie Canyon National Wildlife Refuges*. Available online: <http://www.fws.gov/southwest/refuges/arizona/sanbernardino.html>. Accessed 3 July 2008.
USFWS undated a	U.S. Fish and Wildlife Service (USFWS). Undated. *San Bernardino and Leslie Canyon National Wildlife Refuges.* Available online: <*http://www.fws.gov/southwest/REFUGES/arizona/sanbernardino.html*>. Accessed 27 June 2008.
USFWS undated b	USFWS. Undated. *San Bernardino National Wildlife Refuge*. Available online: <*http://www.fws.gov/refuges/profiles/index.cfm?id=22523*>. Accessed 30 June 2008.
Willbanks 2008	Willbanks, Jeff. 2008. Electronic communication between Mr. Jeff Willbanks (BLM Outdoor Recreation Planner for the BLM Safford Field Office) and Ms. Leigh Hagan (e²M) regarding VRM Classes in the Project Area. 5 August 2008

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A

Secretary's Published Waiver Pursuant to IIRIRA

DEPARTMENT OF HOMELAND SECURITY

Office of the Secretary

Determination Pursuant to Section 102 of the Illegal Immigration Reform and Immigrant Responsibility Act of 1996, as Amended

AGENCY: Office of the Secretary, Department of Homeland Security.

ACTION: Notice of determination.

SUMMARY: The Secretary of Homeland Security has determined, pursuant to law, that it is necessary to waive certain laws, regulations and other legal requirements in order to ensure the expeditious construction of barriers and roads in the vicinity of the international land border of the United States.

DATES: This Notice is effective on April 3, 2008.

Determination and Waiver: I have a mandate to achieve and maintain operational control of the borders of the United States. Public Law 109–367, § 2, 120 Stat. 2638, 8 U.S.C. 1701 note. Congress has provided me with a number of authorities necessary to accomplish this mandate. One of these authorities is found at section 102(c) of the Illegal Immigration Reform and Immigrant Responsibility Act of 1996 ("IIRIRA"). Public Law 104–208, Div. C, 110 Stat. 3009–546, 3009–554 (Sept. 30, 1996) (8 U.S.C 1103 note), as amended by the REAL ID Act of 2005, Public Law 109–13, Div. B, 119 Stat. 231, 302, 306 (May 11, 2005) (8 U.S.C. 1103 note), as amended by the Secure Fence Act of 2006, Public Law 109–367, § 3, 120 Stat. 2638 (Oct. 26, 2006) (8 U.S.C. 1103 note), as amended by the Department of Homeland Security Appropriations Act, 2008, Public Law 110–161, Div. E, Title V, Section 564, 121 Stat. 2090 (Dec. 26, 2007). In Section 102(a) of IIRIRA, Congress provided that the Secretary of Homeland Security shall take such actions as may be necessary to install additional physical barriers and roads (including the removal of obstacles to detection of illegal entrants) in the vicinity of the United States border to deter illegal crossings in areas of high illegal entry into the United States. In Section 102(b) of IIRIRA, Congress has called for the installation of fencing, barriers, roads, lighting, cameras, and sensors on not less than 700 miles of the southwest border, including priority miles of fencing that must be completed by December 2008. Finally, in section 102(c) of the IIRIRA, Congress granted to me the authority to waive all legal requirements that I, in my sole discretion, determine necessary to ensure the expeditious construction of barriers and roads authorized by section 102 of IIRIRA.

I determine that the areas in the vicinity of the United States border described on the attached document, which is incorporated and made a part hereof, are areas of high illegal entry (collectively "Project Areas"). These Project Areas are located in the States of California, Arizona, New Mexico, and Texas. In order to deter illegal crossings in the Project Areas, there is presently a need to construct fixed and mobile barriers (such as fencing, vehicle barriers, towers, sensors, cameras, and other surveillance, communication, and detection equipment) and roads in the vicinity of the border of the United States. In order to ensure the expeditious construction of the barriers and roads that Congress prescribed in the IIRIRA in the Project Areas, which are areas of high illegal entry into the United States, I have determined that it is necessary that I exercise the authority that is vested in me by section 102(c) of the IIRIRA as amended.

Accordingly, I hereby waive in their entirety, with respect to the construction of roads and fixed and mobile barriers (including, but not limited to, accessing the project area, creating and using staging areas, the conduct of earthwork, excavation, fill, and site preparation, and installation and upkeep of fences, roads, supporting elements, drainage, erosion controls, safety features, surveillance, communication, and detection equipment of all types, radar and radio towers, and lighting) in the Project Areas, all federal, state, or other laws, regulations and legal requirements of, deriving from, or related to the subject of, the following laws, as amended: The National Environmental Policy Act (Pub. L. 91–190, 83 Stat. 852 (Jan. 1, 1970) (42 U.S.C. 4321 *et seq.*)), the Endangered Species Act (Pub. L. 93–205, 87 Stat. 884 (Dec. 28, 1973) (16 U.S.C. 1531 *et seq.*)), the Federal Water Pollution Control Act (commonly referred to as the Clean Water Act) (33 U.S.C. 1251 *et seq.*)), the National Historic Preservation Act (Pub. L. 89–665, 80 Stat. 915 (Oct. 15, 1966) (16 U.S.C. 470 *et seq.*)), the Migratory Bird Treaty Act (16 U.S.C. 703 *et seq.*), the Clean Air Act (42 U.S.C. 7401 *et seq.*), the Archeological Resources Protection Act (Pub. L. 96–95, 16 U.S.C. 470aa *et seq.*), the Safe Drinking Water Act (42 U.S.C. 300f *et seq.*), the Noise Control Act (42 U.S.C. 4901 *et seq.*), the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (42 U.S.C. 6901 *et seq.*), the Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. 9601 *et seq.*), the Archaeological and Historic Preservation Act (Pub. L. 86–523, 16 U.S.C. 469 *et seq.*), the Antiquities Act (16 U.S.C. 431 *et seq.*), the Historic Sites, Buildings, and Antiquities Act (16 U.S.C. 461 *et seq.*), the Wild and Scenic Rivers Act (Pub. L. 90–542, 16 U.S.C. 1281 *et seq.*), the Farmland Protection Policy Act (7 U.S.C. 4201 *et seq.*), the Coastal Zone Management Act (Pub. L. 92–583, 16 U.S.C. 1451 *et seq.*), the Wilderness Act (Pub. L. 88–577, 16 U.S.C. 1131 *et seq.*), the Federal Land Policy and Management Act (Pub. L. 94–579, 43 U.S.C. 1701 *et seq.*), the National Wildlife Refuge System Administration Act (Pub. L. 89–669, 16 U.S.C. 668dd–668ee), the Fish and Wildlife Act of 1956 (Pub. L. 84–1024, 16 U.S.C. 742a, *et seq.*), the Fish and Wildlife Coordination Act (Pub. L. 73–121, 16 U.S.C. 661 *et seq.*), the Administrative Procedure Act (5 U.S.C. 551 *et seq.*), the Otay Mountain Wilderness Act of 1999 (Pub. L. 106–145), Sections 102(29) and 103 of Title I of the California Desert Protection Act (Pub. L. 103–433), 50 Stat. 1827, the National Park Service Organic Act (Pub. L. 64–235, 16 U.S.C. 1, 2–4), the National Park Service General Authorities Act (Pub. L. 91–383, 16 U.S.C. 1a–1 *et seq.*), Sections 401(7), 403, and 404 of the National Parks and Recreation Act of 1978 (Pub. L. 95–625), Sections 301(a)–(f) of the Arizona Desert Wilderness Act (Pub. L. 101–628), the Rivers and Harbors Act of 1899 (33 U.S.C. 403), the Eagle Protection Act (16 U.S.C. 668 *et seq.*), the Native American Graves Protection and Repatriation Act (25 U.S.C. 3001 *et seq.*), the American Indian Religious Freedom Act (42 U.S.C. 1996), the Religious Freedom Restoration Act (42 U.S.C. 2000bb), the National Forest Management Act of 1976 (16 U.S.C. 1600 *et seq.*), and the Multiple Use and Sustained Yield Act of 1960 (16 U.S.C. 528–531).

This waiver does not supersede, supplement, or in any way modify the previous waivers published in the **Federal Register** on September 22, 2005 (70 FR 55622), January 19, 2007 (72 FR

2535), and October 26, 2007 (72 FR 60870).

I reserve the authority to make further waivers from time to time as I may determine to be necessary to accomplish the provisions of section 102 of the IIRIRA, as amended.

Dated: April 1, 2008.

Michael Chertoff,

Secretary.

[FR Doc. 08–1095 Filed 4–1–08; 2:03 pm]

BILLING CODE 4410–10–P

DEPARTMENT OF HOMELAND SECURITY

Office of the Secretary

Determination Pursuant to Section 102 of the Illegal Immigration Reform and Immigrant Responsibility Act of 1996, as Amended

AGENCY: Office of the Secretary, Department of Homeland Security.

ACTION: Notice of determination.

SUMMARY: The Secretary of Homeland Security has determined, pursuant to law, that it is necessary to waive certain laws, regulations and other legal requirements in order to ensure the expeditious construction of barriers and roads in the vicinity of the international land border of the United States.

DATES: This Notice is effective on April 3, 2008.

Determination and Waiver: The Department of Homeland Security has a mandate to achieve and maintain operational control of the borders of the United States. Public Law 109–367, Section 2, 120 Stat. 2638, 8 U.S.C. 1701 note. Congress has provided the Secretary of Homeland Security with a number of authorities necessary to accomplish this mandate. One of these authorities is found at section 102(c) of the Illegal Immigration Reform and Immigrant Responsibility Act of 1996 ("IIRIRA"). Public Law 104–208, Div. C, 110 Stat. 3009–546, 3009–554 (Sept. 30, 1996) (8 U.S.C 1103 note), as amended by the REAL ID Act of 2005, Public Law 109–13, Div. B, 119 Stat. 231, 302, 306 (May 11, 2005) (8 U.S.C. 1103 note), as amended by the Secure Fence Act of 2006, Public Law 109–367, Section 3, 120 Stat. 2638 (Oct. 26, 2006) (8 U.S.C. 1103 note), as amended by the Department of Homeland Security Appropriations Act, 2008, Public Law 110–161, Div. E, Title V, Section 564, 121 Stat. 2090 (Dec. 26, 2007). In Section 102(a) of the IIRIRA, Congress provided that the Secretary of Homeland Security shall take such actions as may be necessary to install additional physical barriers and roads (including the removal of obstacles to detection of illegal entrants) in the vicinity of the United States border to deter illegal crossings in areas of high illegal entry into the United States. In Section 102(b) of the IIRIRA, Congress has called for the installation of fencing, barriers, roads, lighting, cameras, and sensors on not less than 700 miles of the southwest border, including priority miles of fencing that must be completed by December of 2008. Finally, in section 102(c) of the IIRIRA, Congress granted to me the authority to waive all legal requirements that I, in my sole discretion, determine necessary to ensure the expeditious construction of barriers and roads authorized by section 102 of the IIRIRA.

I determine that the area in the vicinity of the United States border as described in the attached document, hereinafter the Project Area, which is incorporated and made a part hereof, is an area of high illegal entry. In order to deter illegal crossings in the Project Area, there is presently a need to construct fixed and mobile barriers and roads in conjunction with improvements to an existing levee system in the vicinity of the border of the United States as a joint effort with Hidalgo County, Texas. In order to ensure the expeditious construction of the barriers and roads that Congress prescribed in the IIRIRA in the Project Area, which is an area of high illegal entry into the United States, I have determined that it is necessary that I exercise the authority that is vested in me by section 102(c) of the IIRIRA as amended. Accordingly, I hereby waive in their entirety, with respect to the construction of roads and fixed and mobile barriers (including, but not limited to, accessing the project area, creating and using staging areas, the conduct of earthwork, excavation, fill, and site preparation, and installation and upkeep of fences, roads, supporting elements, drainage, erosion controls, safety features, surveillance, communication, and detection equipment of all types, radar and radio towers, and lighting) in the Project Area, all federal, state, or other laws, regulations and legal requirements of, deriving from, or related to the subject of, the following laws, as amended: The National Environmental Policy Act (Pub. L. 91–190, 83 Stat. 852 (Jan. 1, 1970) (42 U.S.C. 4321 *et seq.*)), the Endangered Species Act (Pub. L. 93–205, 87 Stat. 884) (Dec. 28, 1973) (16 U.S.C. 1531 *et seq.*)), the Federal Water Pollution Control Act (commonly referred to as the Clean Water Act) (33 U.S.C. 1251 *et seq.*), the National Historic Preservation Act (Pub. L. 89–665, 80 Stat. 915 (Oct. 15, 1966) (16 U.S.C. 470 *et seq.*)), the Migratory Bird Treaty Act (16 U.S.C. 703 *et seq.*), the Clean Air Act (42 U.S.C. 7401 *et seq.*), the Archeological Resources Protection Act (Pub. L. 96–95, 16 U.S.C. 470aa *et seq.*), the Safe Drinking Water Act (42 U.S.C. 300f *et seq.*), the Noise Control Act (42 U.S.C. 4901 *et seq.*), the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (42 U.S.C. 6901 *et seq.*), the Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. 9601 *et seq.*), the Archaeological and Historic Preservation Act (Pub. L. 86–523, 16 U.S.C. 469 *et seq.*), the Antiquities Act (16 U.S.C. 431 *et seq.*), the Historic Sites, Buildings, and Antiquities Act (16 U.S.C. 461 *et seq.*), the Farmland Protection Policy Act (7 U.S.C. 4201 *et seq.*), the Coastal Zone Management Act (Pub. L. 92–583, 16 U.S.C. 1451 *et seq.*), the Federal Land Policy and Management Act (Pub L. 94–579, 43 U.S.C. 1701 *et seq.*), the National Wildlife Refuge System Administration Act (Pub. L. 89–669, 16 U.S.C. 668dd–668ee), the Fish and Wildlife Act of 1956 (Pub. L. 84–1024, 16 U.S.C. 742a, *et seq.*), the Fish and Wildlife Coordination Act (Pub. L. 73–121, 16 U.S.C. 661 *et seq.*), the Administrative Procedure Act (5 U.S.C. 551 *et seq.*), the Rivers and Harbors Act of 1899 (33 U.S.C. 403), the Eagle Protection Act (16 U.S.C. 668 *et seq.*), the Native American Graves Protection and Repatriation Act (25 U.S.C. 3001 *et seq.*), the American Indian Religious Freedom Act (42 U.S.C. 1996), the Religious Freedom Restoration Act (42 U.S.C. 2000bb), and the Federal Grant and Cooperative Agreement Act of 1977 (31 U.S.C. 6303–05).

I reserve the authority to make further waivers from time to time as I may determine to be necessary to accomplish the provisions of section 102 of the IIRIRA, as amended.

Dated: April 1, 2008.

Michael Chertoff,

Secretary.

[FR Doc. 08–1096 Filed 4–1–08; 2:03 pm]

BILLING CODE 4410–10–P

APPENDIX B

Coordination Activity

INTERNATIONAL BOUNDARY AND WATER COMMISSION
UNITED STATES AND MEXICO

OFFICE OF THE COMMISSIONER
UNITED STATES SECTION

July 29, 2008

Robert F. Janson
Acting Executive Director
Facilities Management and Engineering
U.S. Customs and Border Protection
Department of Homeland Security
Washington, D.C. 20229

Subject: Environmental Stewardship Plans for the Construction, Operation, and Maintenance of Tactical Infrastructure, U.S. Border Patrol, Yuma, Tucson, and El Paso Sectors

Dear Mr. Janson:

This letter responds to your letters dated July 1st, 2nd, and 7th requesting information on potential environmental impacts to natural resources along the international boundary in Arizona and New Mexico, specifically within the Yuma, Tucson and El Paso Sector areas of operation. In January 2008, the United States Section, International Boundary and Water Commission (USIBWC) and the United States Customs and Border Protection (CBP) signed a Memorandum of Agreement (MOA) that formalizes the procedures and coordination among the two agencies in implementing their respective duties and missions along the international border (see attached).

The USIBWC has a duty to access, maintain, and utilize the international boundary monuments along the U.S./Mexico international land boundary. The USIBWC is charged with these duties through treaties and international agreements between the United States and Mexico. We require that the proposed works and related facilities not affect the permanence (disturb the foundations) of existing boundary monuments nor impede access for their inspection and maintenance. In addition, any proposed construction must allow for line-of-sight visibility between each of the boundary monuments. The majority of the monuments along the international boundary are eligible for inclusion in the national register under Criterion A – a structure "…associated with events that have made a significant contribution to the broad patterns of our history." Therefore we request that you provide full consideration to the monuments in your Environmental Stewardship Plans, and avoid or minimize any potential adverse effects.

The USIBWC requires that engineering drawings be submitted to the USIBWC for review and approval prior to beginning any construction near the international boundary. These drawings must show the location of each component in relation to the international boundary and the monuments. The USIBWC requires that all structures be offset from the international boundary by a minimum of 3 feet and allow a clear line-of-sight between any affected boundary monuments.

The Commons, Building C, Suite 310 • 4171 N. Mesa Street • El Paso, Texas 79902
(915) 832-4100 • (FAX) (915) 832-4190 • http://www.ibwc.state.gov

The USIBWC requests that proposed construction activities be accomplished in a manner that does not change historic surface runoff characteristics at the international border. The USIBWC will not approve any construction near the international boundary in the United States that increases, concentrates, or relocates overland drainage flows into either country. This requirement is intended to ensure that developments in one country will not cause damage to lands or resources in the other country. The USIBWC will need copies of any hydrological or hydraulic studies and site-specific drawings for work proposed in the vicinity of the international boundary, particularly if culverts, roads or other structures are proposed to be constructed in any drainage courses that cross the boundary. We will also require that you assure that structures constructed along the U.S./Mexico border are maintained in an adequate manner.

We look forward to participating in the development and review of the ESP's as they become available. If you have any questions regarding these comments, please call me at (915) 832-4741 or contact Environmental Protection Specialist, Daniel Borunda at (915) 832-4767.

Sincerely,

Charles B. Kruse, IV, P.E.
Chief, Planning & Integration Division

Attachment:
As Stated

cc: Scott Recinos, Chief Engineer
Secure Border Initiative Tactical Infrastructure
1300 Pennsylvania Avenue,
Washington DC 20299

INTERAGENCY AGREEMENT BETWEEN
UNITED STATES CUSTOMS AND BORDER PROTECTION
AND
UNITED STATES SECTION, INTERNATIONAL BOUNDARY
AND WATER COMMISSION

This Memorandum of Agreement (MOA) is made by and between the United States Section, International Boundary and Water Commission, United States and Mexico, an instrumentality of the United States federal government, hereinafter referred to as the "USIBWC," and United States Customs and Border Protection, a component of the Department of Homeland Security, hereinafter referred to as "CBP." Collectively the USIBWC and CBP are hereinafter referred to as the "PARTIES" to this MOA.

WITNESSETH

WHEREAS, the International Boundary and Water Commission (the "IBWC") is an officially recognized international organization pursuant to Executive Order 12467, and in which the United States participates pursuant to 22 U.S.C. §277 *et seq.*, and *inter alia* the 1889 International Boundary Convention (26 Stat. 1512) and 1944 Treaty between the United States and Mexico for the "Utilization of Waters of the Colorado, Tijuana and Rio Grande Rivers" (59 Stat. 1219) (the "1944 Treaty"); and

WHEREAS, the 1944 Treaty provides that the jurisdiction of the IBWC shall extend to the limitrophe parts of the Rio Grande and the Colorado River, to the land boundary between the two countries, and to works located upon their common boundary;

WHEREAS, the President is authorized pursuant to 22 U.S.C. Section §277b to construct any project or works which may be provided for in a treaty entered into with Mexico and to repair, protect, maintain or complete works now existing or now under construction or those that may be constructed under treaty provisions; to construct any project or works designed to facilitate compliance with the provisions of the treaties between the United States and Mexico; and to operate and maintain any project or works so constructed and provide rules and regulations for continuing supervision by the USIBWC; and

WHEREAS, the 1970 Treaty to "Resolve Pending Boundary Differences and Maintain the Rio Grande and Colorado Rivers as the International Boundary" between the United States and Mexico (the "1970 Boundary Treaty") provides that both governments will prohibit the construction of works in the channel of the rivers or within its territory, which, in the judgment of the IBWC, may cause deflection or obstruction of the normal flow of the Rio Grande and Colorado River or of their flood flows; and

WHEREAS, the Secretary of State, acting through the United States Commissioner of the USIBWC, is authorized by 22 U.S.C. §277(a) to conduct technical and other investigations relating to the defining, demarcation, fencing construction, or monumentation of the land and water boundary between the United States and Mexico; to flood control, water resources, conservation, utilization of water, sanitation and prevention of pollution, channel rectification, stabilization, and other related matters upon the international boundary between the United States and Mexico; and to construct and maintain fences, monuments and other demarcations of the boundary line between the United States and Mexico; and

WHEREAS, CBP, as a component of the Department of Homeland Security, is authorized, pursuant to various provisions, including the Homeland Security Act of 2002, Pub. L. 107-296, codified at 6 U.S.C. §§ 101 *et seq.*, Section 102 of the Illegal Immigration Reform and Immigrant Responsibility Act of 1996 (IIRIRA), Pub. L. 104-208, as amended, 8 U.S.C. § 1103 and other Acts amendatory thereof and supplementary thereto, to control and guard the boundaries and borders of the United States against illegal border crossing activities, to install border infrastructure as needed to deter illegal crossings, and obtain operational control of the border; and

WHEREAS, this MOA is intended to provide for the coordination between the PARTIES in areas related to tactical infrastructure installation and utilization of land, floodways, levees and roads along the United States-Mexico border for security and law enforcement operations; and

WHEREAS, the intent of this MOA is to facilitate cooperation between the USIBWC and CBP in carrying out each party's responsibilities along the boundaries of the United States and the United Mexican States;

NOW THEREFORE, the USIBWC and CBP hereto agree as follows:

Article I. USIBWC'S RESPONSIBILITIES

The USIBWC agrees to the following:

1. USIBWC will cooperate with CBP in situations where CBP is conducting infrastructure construction or other security related activities at or near the U.S. - Mexico border that are subject to and/or implicate any provision of any law, treaty, or other legal requirement whose implementation is overseen by, under the jurisdiction of, or enforced by the USIBWC.

2. Subject to the provisions of this MOA, USIBWC will grant and/or facilitate CBP's access to property under USIBWC jurisdiction, including levee gates, areas with restricted access, and/or other areas under USIBWC control, for the purposes of securing the border, to include tracking, surveillance, interdiction, establishment of observation points, and installation of fences, roads, vehicle deterrent barriers, remote detection systems, and other related tactical infrastructure. However, nothing set forth in this MOA should be construed to restrict, limit, or otherwise affect CBP's statutory authority to access lands for the

purposes of patrolling the border and/or otherwise carry out its statutory mission to control and guard the borders and boundaries of the United States.

3. For each geographic region where CBP activities and/or projects are subject to terms and conditions of this MOA, USIBWC will provide a representative, and an alternate representative in case of emergency, authorized to act as the main point of contact regarding any provision in this MOA.

4. USIBWC will review and comment on CBP projects along the U.S.-Mexico border assuring expedited comments and revisions. USIBWC will strive to provide comments within three business days of receipt. Issues and concerns identified by the USIBWC that may delay or impede the construction of CBP infrastructure projects along the border will be elevated as necessary for resolution by leadership of the USIBWC and CBP.

5. In those instances where the USIBWC deems it appropriate to notify the Mexican Section of the IBWC (MXIBWC) of CBP projects or activities, the timing of any such notification will be coordinated between the PARTIES so that the notification takes place at a time that is mutually agreeable to both PARTIES. For construction activities on the western land boundary with no cross-boundary drainage issues, USIBWC will provide the MXIBWC courtesy notification of the proposed project. For construction activities on areas covered by the 1970 Boundary Treaty, USIBWC will endeavor to expedite its coordination with MXIBWC. It is understood that USIBWC cannot guarantee a timeline for MXIBWC response.

6. USIBWC will strive to perform a verification of the boundary in an expedited manner by coordinating with the MXIBWC with the understanding that verification must occur in a timely manner.

7. In the event of emergency flood operations, USIBWC will notify CBP at the earliest possible opportunity that it is invoking its right to remove or order removal of CBP infrastructure in order to gain access to project areas.

Article II. CBP'S RESPONSIBILITIES

CBP agrees to the following:

1. CBP will cooperate with the USIBWC in situations where CBP is conducting infrastructure construction or other security related activities at or near the U.S.-Mexico border that are subject to and/or implicate any provision of any law, treaty, or other legal requirement whose implementation is overseen by, under the jurisdiction of, or enforced by the USIBWC.

2. CBP will consult with the USIBWC as needed before construction of tactical infrastructure at or near the U.S.-Mexico border. CBP will ensure that there is a

three-foot setback from and gated access to the boundary monuments so as to not impede the ability of USIBWC to undertake periodic maintenance of its land-boundary markers or monuments. CBP will not undertake construction of works in the channel of the boundary rivers or within U.S. territory, which in the judgment of the USIBWC would cause deflection or obstruction of the normal flow of the Rio Grande and Colorado River or of their flood flows.

3. CBP will provide USIBWC all necessary information regarding construction and environmental review activities along the U.S.-Mexico border in an expedited manner. CBP will strive to provide comments within three business days of request of information. Issues and concerns identified by CBP that may delay or impede the construction of CBP infrastructure along the border will be elevated for resolution by leadership for the USIBWC and CBP.

4. CBP will endeavor to take the proper measures to protect existing USIBWC levees and hydraulic structures. In the event of any damage incurred as a direct result of CBP infrastructure changes to such levees or structures, CBP will restore the damaged levees and hydraulic structures to a condition equal to that existing before such damage in a timely manner. CBP will ensure that the U.S. Army Corps of Engineers will have documented the conditions of levees and hydraulic structures prior to any CBP construction efforts related to SBI infrastructure.

5. In the event of emergency flood operations, any repair or replacement of CBP infrastructure removed for flood control purposes would be repaired and replaced at CBP expense. USIBWC will assist where possible in the reinstallation of any CBP infrastructure damaged or removed during flood control operations.

6. CBP will consult with the USIBWC to coordinate the location, placement, design and hydraulic impact of fences, roads, vehicle deterrent barriers and, to the extent its location and placement may be disclosed and is not law enforcement sensitive information, other related tactical infrastructures that it plans to install or construct on the US-Mexico border. CBP agrees that the location and placement of such fences, roads, vehicle deterrent barriers, and other related tactical infrastructure will be subject to review and approval by the USIBWC to ensure construction is within U.S. territorial limits and does not obstruct the boundary line of sight between monuments or cause deflection or obstruction of the normal flow of transboundary creeks, arroyos, rivers or their flood flows or impede the operation of IBWC binational projects or activities. CBP will be responsible for ensuring environmental regulatory compliance for CBP infrastructure.

7. CBP will perform the required maintenance to remove accumulated debris from water crossings where CBP infrastructure crosses the path of transboundary flows.

8. CBP will be responsible for any liabilities, costs, claims, or expenses arising out of CBP employees' or contractors' activities along the U.S. – Mexico border that are subject to this MOA. USIBWC will be responsible for any liabilities, claims, costs or expenses arising out of activities undertaken by USIBWC employees or contractors that result in damage to the fences, roads, vehicle deterrent barriers, or other tactical infrastructure that is subject to this MOA. USIBWC will not be responsible for any damage to such fences, roads, vehicle deterrent barriers, or other tactical infrastructure due to flood or force majeure events.

9. CBP will coordinate and not interfere with the USIBWC, its employees, contractors or agents performing work on behalf of the USIBWC.

10. CBP will consult with USIBWC to coordinate the work needed to control the vegetation impeding DHS's ability to conduct border security operations along the U.S.-Mexico border.

11. CBP will provide a representative, and an alternate representative in case of emergency, authorized to act as the main point of contact with regard to any provision in Articles I and II of this MOA in each geographic area where work is to be performed.

12. DHS will respond appropriately to terrorist or criminal attacks and/or threats requiring emergency law enforcement action as a part of its core mission and CBP will coordinate with local law enforcement entities where necessary. When requested, and where operationally feasible, CBP will coordinate a security presence for USIBWC employees and contractors during maintenance activities.

13. CBP will be the sole owner of infrastructure constructed by CBP pursuant to U.S. law. Consequently, CBP, as the executive agent for DHS border infrastructure, will own, operate and fund all maintenance, construction and upgrades necessary to keep said CBP-owned infrastructure operational. This agreement does not effect the allocation of responsibility for the maintenance, operation, and upgrade of infrastructure owned by or under the jurisdiction of the USIBWC which has been coordinated between the PARTIES and memorialized in separate agreement(s) pursuant to Article V, Section 4 of this MOA.

Article III. DURATION AND MODIFICATION OF MOA

This MOA will take effect when signed by the PARTIES hereto and shall remain in effect unless terminated, in writing, by either PARTY after 60 days notice. This MOA may be modified at any time by written agreement of both PARTIES, and does not restrict either PARTY from enforcing any laws within its authority or jurisdiction.

Article IV. INTERAGENCY COMMUNICATIONS

To provide for consistent, recurring, and effective communication between both PARTIES, each PARTY shall immediately designate representatives to serve as the points of contact on all matters relating to this MOA. Each PARTY will advise the other PARTY, in writing, of the names and telephone numbers of the representative designated within 10 calendar days of the MOA's execution.

Article V. MISCELLANEOUS PROVISIONS

1. Nothing in this MOA may be construed to obligate the Parties or the United States to any current or future expenditure of funds in advance of the availability of appropriations, nor does this MOA obligate the agencies or the United States to spend funds for any particular project or purpose, even if funds are available.

2. This MOA is to be implemented consistent with the statutory and treaty provisions pursuant to which the PARTIES undertake their activities. Nothing in this MOA will be construed as affecting the authority or jurisdiction of either Party in carrying out its responsibilities under applicable statutes or treaties.

3. This document is an intra-governmental agreement among the PARTIES and does not create or confer any rights, privileges, or benefits upon any person, party, or entity. This MOA is not and shall not be construed as a rule or regulation.

4. This MOA will provide the basis for more detailed, project specific agreements between CBP and USIBWC for USIBWC projects along the U.S.-Mexico border. This MOA will not affect existing agreements between CBP and USIBWC for USIBWC projects along the U.S.-Mexico border.

5. In carrying out the provisions of this MOA, the PARTIES shall not release or disclose to any third party, any and all information that is pre-decisional, law enforcement sensitive, classified, or otherwise protected or sensitive information that relates to the construction, alignment, or placement of existing and/or proposed border infrastructure, including observation points, fences, roads, vehicle deterrent barriers, remote detection systems, and other related tactical infrastructure. The PARTIES shall also be prohibited from releasing or disclosing to any third party, any and all information that is pre-decisional, law enforcement sensitive, classified, or otherwise protected or sensitive information concerning existing or proposed border enforcement operations, activities, or constructs. In those instances where the USIBWC deems it appropriate to notify the Mexican Section of the IBWC (MXIBWC) of CBP projects or activities, the USIBWC will consult with CBP regarding the timing of any such notification or coordination with the MXIBWC so that contact with the MXIBWC is initiated at a time that is mutually agreeable to both PARTIES.

6. When appropriate and necessary the PARTIES will enter into specific reimbursable agreements for work performed by one Party on behalf of the other pursuant to the Economy Act, 31 U.S.C. Section 1535.

IN WITNESS WHEREOF, the PARTIES hereto execute this instrument on the date(s) set forth below:

FOR U.S. CUSTOMS AND BORDER PROTECTION

DATE: 1/18/08 W. Ralph Basham

W. Ralph Basham
Commissioner,
U. S. Customs and Border Protection,
Department of Homeland Security

FOR UNITED STATES SECTION, INTERNATIONAL BOUNDARY AND WATER COMMISSION, UNITED STATES AND MEXICO

DATE: 12/28/07

Carlos Marin,
Commissioner,
United States Section,
International Boundary and Water Commission
United States and Mexico

APPENDIX C

Detailed Project Maps

Environmental Stewardship Plan - Section FV-1B of Proposed Vehicle Fence

Environmental Stewardship Plan

Delineated Wetland Areas

Proposed Vehicle Fence (VF300)

Vehicle Fence (VF300) - Proposed

Access Roads (VF300)

Construction Staging Areas (VF300)

Boundaries

Border Monuments

Gates

International Boundary

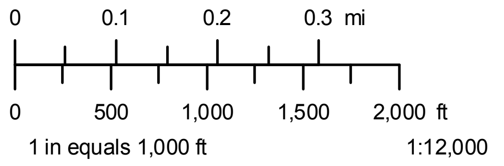
Local Roads

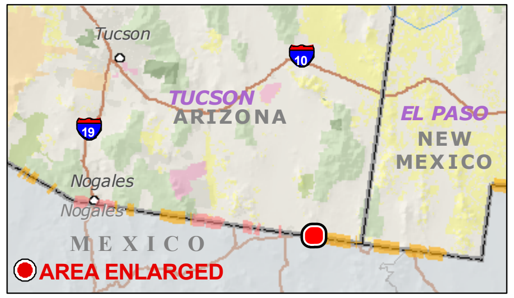
Intermittent Streams

Bureau of Land Management

National Wildlife Refuges

In some cases lengths reported are a combination of computed lengths in the GIS, and official lengths from RFP's (Requests for Proposals). Because of this, adding up GIS-computed segment lengths may not equal the total RFP project length.





December 12, 2008

Michael Baker Jr., Inc.

Environmental Stewardship Plan - Section FV-1B of Proposed Vehicle Fence

Environmental Stewardship Plan

Delineated Wetland Areas

Proposed Vehicle Fence (VF300)

Vehicle Fence (VF300) - Proposed

Access Roads (VF300)

Construction Staging Areas (VF300)

Boundaries

Border Monuments

Gates

International Boundary

Local Roads

Intermittent Streams

Bureau of Land Management

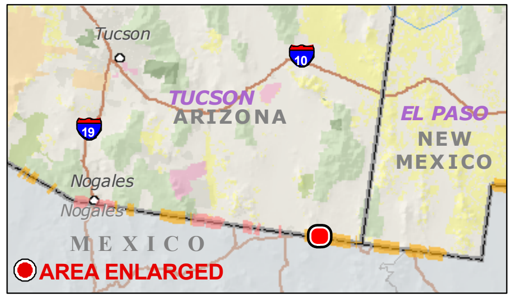
National Wildlife Refuges

*In some cases lengths reported are a combination of computed lengths in the GIS, and official lengths from RFP's (Requests for Proposals). Because of this, adding up GIS-computed segment lengths may not equal the total RFP project length.

0 0.1 0.2 0.3 mi

0 500 1,000 1,500 2,000 ft

1 in equals 1,000 ft 1:12,000



December 12, 2008

Michael Baker Jr., Inc.

Environmental Stewardship Plan - Section FV-1B of Proposed Vehicle Fence

Environmental Stewardship Plan

Delineated Wetland Areas

Proposed Vehicle Fence (VF300)

Vehicle Fence (VF300) - Proposed

Access Roads (VF300)

Construction Staging Areas (VF300)

Boundaries

Border Monuments

Gates

International Boundary

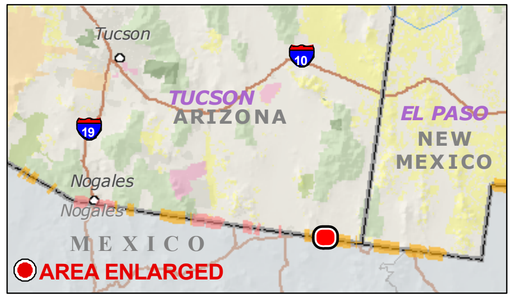
Local Roads

Intermittent Streams

Bureau of Land Management

National Wildlife Refuges

*In some cases lengths reported are a combination of computed lengths in the GIS, and official lengths from RFP's (Requests for Proposals). Because of this, adding up GIS-computed segment lengths may not equal the total RFP project length.



December 12, 2008

Michael Baker Jr., Inc.

Environmental Stewardship Plan - Section FV-1B of Proposed Vehicle Fence

Environmental Stewardship Plan

Delineated Wetland Areas

Proposed Vehicle Fence (VF300)

Vehicle Fence (VF300) - Proposed

Access Roads (VF300)

Construction Staging Areas (VF300)

Boundaries

Border Monuments

Gates

International Boundary

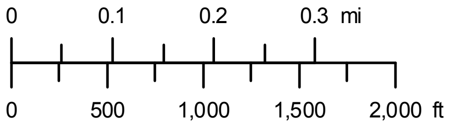
Local Roads

Intermittent Streams

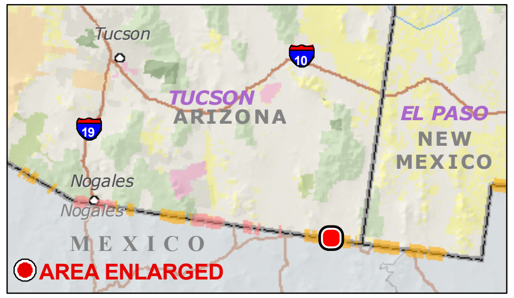
Bureau of Land Management

National Wildlife Refuges

In some cases lengths reported are a combination of computed lengths in the GIS, and official lengths from RFP's (Requests for Proposals). Because of this, adding up GIS-computed segment lengths may not equal the total RFP project length.



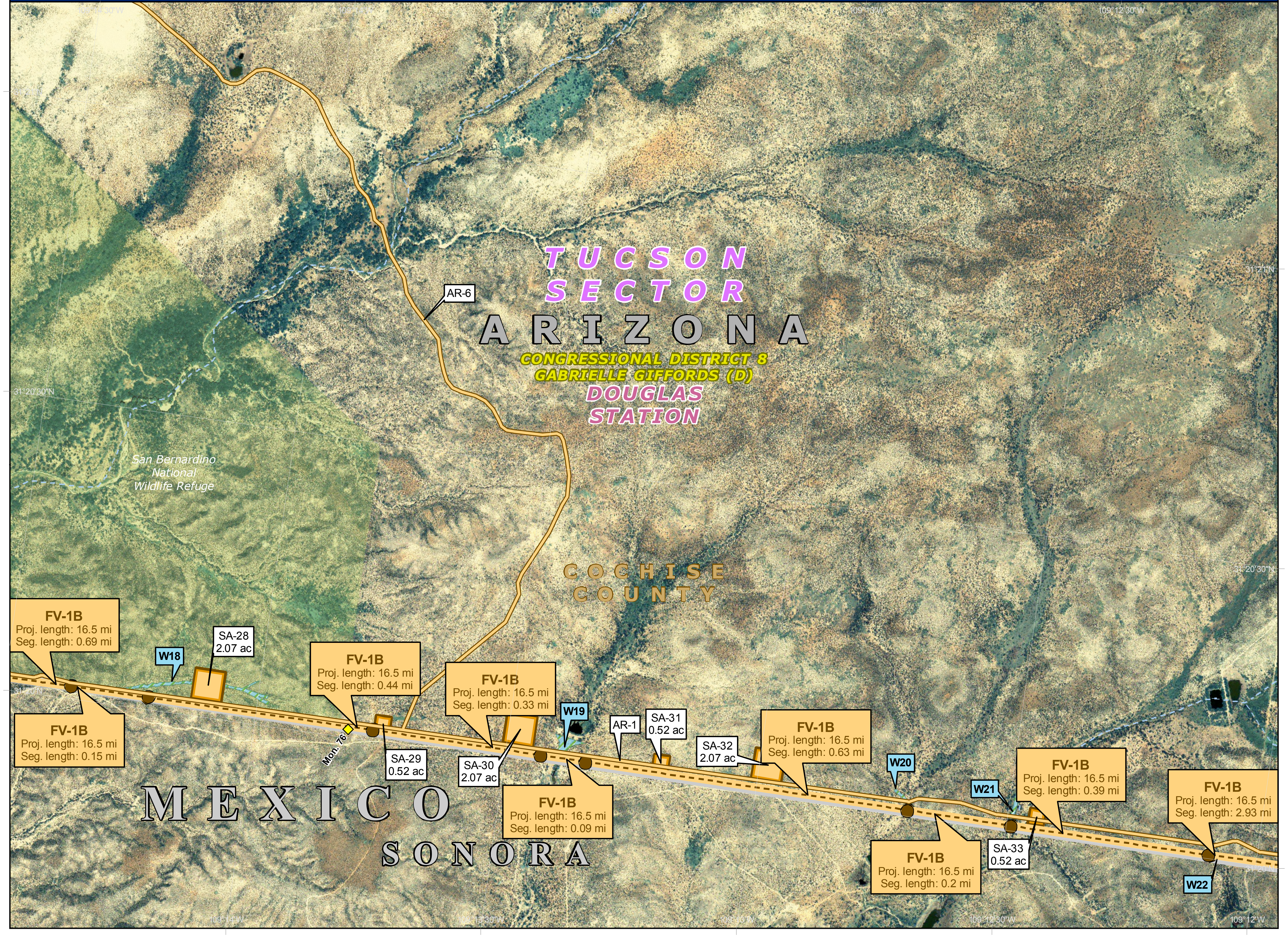
1 in equals 1,000 ft 1:12,000



December 12, 2008

Michael Baker Jr., Inc.

Environmental Stewardship Plan - Section FV-1B of Proposed Vehicle Fence



Environmental Stewardship Plan

Delineated Wetland Areas

Proposed Vehicle Fence (VF300)

Vehicle Fence (VF300) - Proposed

Access Roads (VF300)

Construction Staging Areas (VF300)

Boundaries

Border Monuments

Gates

International Boundary

Local Roads

Intermittent Streams

Bureau of Land Management

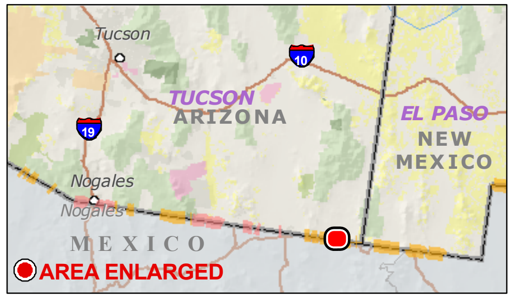
National Wildlife Refuges

*In some cases lengths reported are a combination of computed lengths in the GIS, and official lengths from RFP's (Requests for Proposals). Because of this, adding up GIS-computed segment lengths may not equal the total RFP project length.

0 0.1 0.2 0.3 mi

0 500 1,000 1,500 2,000 ft

1 in equals 1,000 ft 1:12,000



December 12, 2008

Michael Baker Jr., Inc.

Environmental Stewardship Plan - Section FV-1B of Proposed Vehicle Fence

Environmental Stewardship Plan

Delineated Wetland Areas

Proposed Vehicle Fence (VF300)

Vehicle Fence (VF300) - Proposed

Access Roads (VF300)

Construction Staging Areas (VF300)

Boundaries

Border Monuments

Gates

International Boundary

Local Roads

Intermittent Streams

Bureau of Land Management

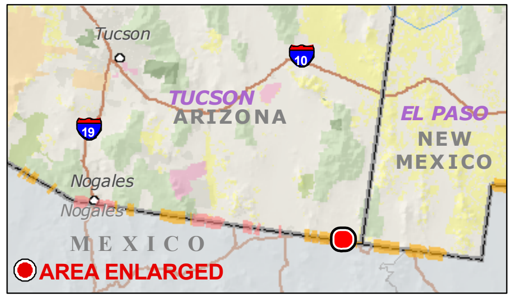
National Wildlife Refuges

*In some cases lengths reported are a combination of computed lengths in the GIS, and official lengths from RFP's (Requests for Proposals). Because of this, adding up GIS-computed segment lengths may not equal the total RFP project length.

0 0.1 0.2 0.3 mi

0 500 1,000 1,500 2,000 ft

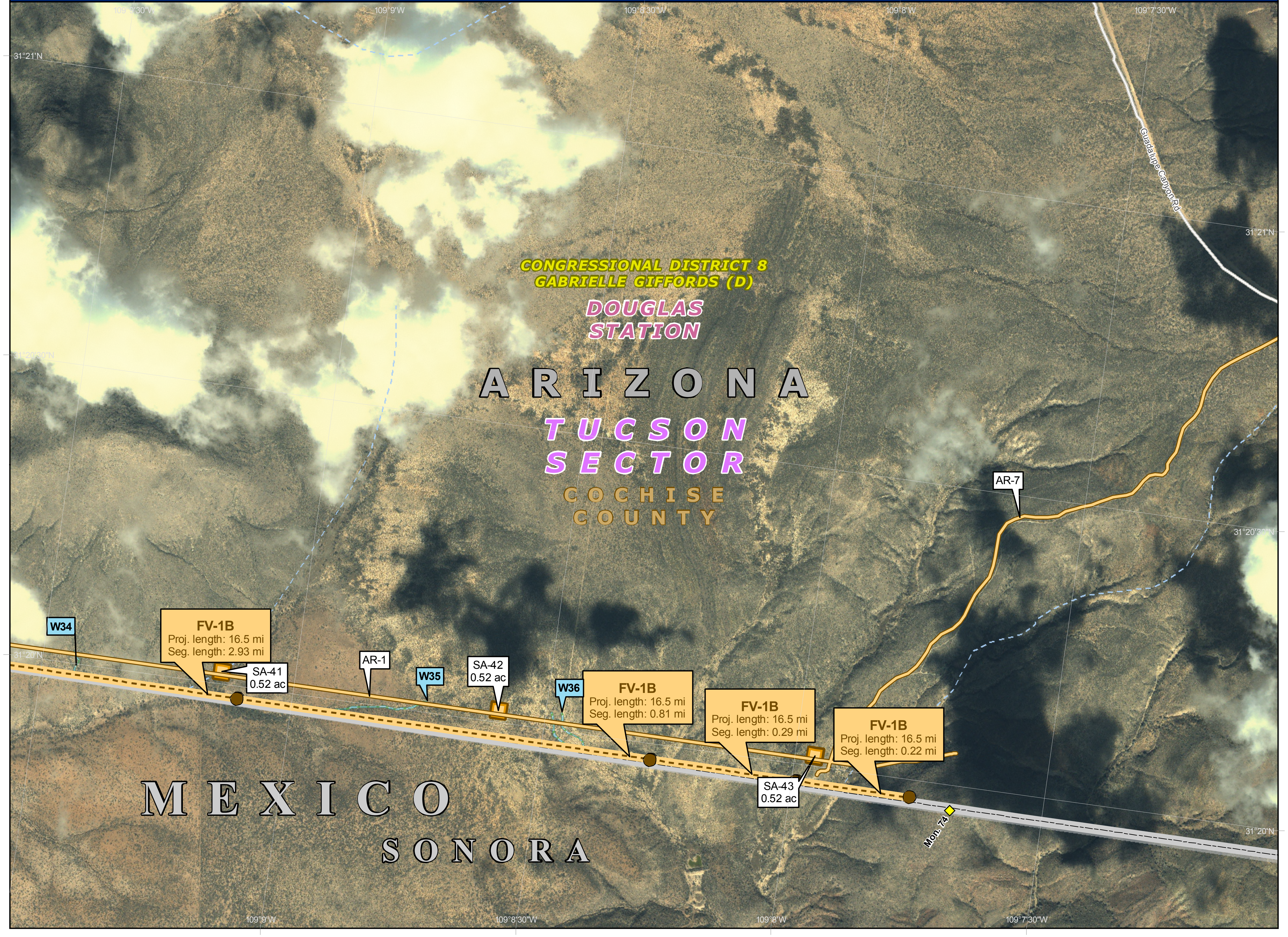
1 in equals 1,000 ft 1:12,000



December 12, 2008

Michael Baker Jr., Inc.

Environmental Stewardship Plan - Section FV-1B of Proposed Vehicle Fence



Environmental Stewardship Plan

- Delineated Wetland Areas

Proposed Vehicle Fence (VF300)

- Vehicle Fence (VF300) - Proposed
- Access Roads (VF300)
- Construction Staging Areas (VF300)

Boundaries

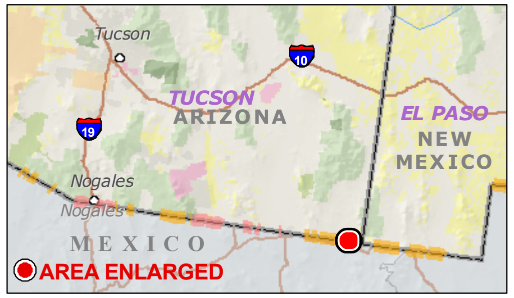
- Border Monuments
- Gates
- International Boundary
- Local Roads
- Intermittent Streams
- Bureau of Land Management
- National Wildlife Refuges

*In some cases lengths reported are a combination of computed lengths in the GIS, and official lengths from RFP's (Requests for Proposals). Because of this, adding up GIS-computed segment lengths may not equal the total RFP project length.

0 | 0.1 | 0.2 | 0.3 mi

0 | 500 | 1,000 | 1,500 | 2,000 ft

1 in equals 1,000 ft — 1:12,000



December 12, 2008

Michael Baker Jr., Inc.

Environmental Stewardship Plan - Section FV-1B of Proposed Vehicle Fence

Environmental Stewardship Plan

- Delineated Wetland Areas

Proposed Vehicle Fence (VF300)

- Vehicle Fence (VF300) - Proposed
- Access Roads (VF300)
- Construction Staging Areas (VF300)

Boundaries

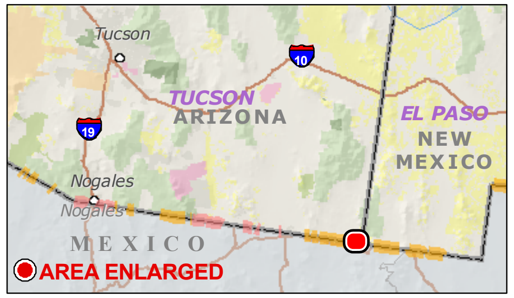
- Border Monuments
- Gates
- International Boundary
- Local Roads
- Intermittent Streams
- Bureau of Land Management
- National Wildlife Refuges

*In some cases lengths reported are a combination of computed lengths in the GIS, and official lengths from RFP's (Requests for Proposals). Because of this, adding up GIS-computed segment lengths may not equal the total RFP project length.

0 0.1 0.2 0.3 mi

0 500 1,000 1,500 2,000 ft

1 in equals 1,000 ft 1:12,000



December 12, 2008

Michael Baker Jr., Inc.

APPENDIX D

Biological Survey Report

FINAL

BIOLOGICAL SURVEY REPORT

FOR

CONSTRUCTION, OPERATION, AND MAINTENANCE OF VEHICLE FENCE AND RELATED TACTICAL INFRASTRUCTURE TUCSON SECTOR, ARIZONA

DOUGLAS STATION

U.S. DEPARTMENT OF HOMELAND SECURITY
U.S. CUSTOMS AND BORDER PROTECTION
U.S. BORDER PATROL TUCSON SECTOR, ARIZONA

Prepared by

Solutions Today for a Sustainable Tomorrow

SEPTEMBER 2008

ABBREVIATIONS AND ACRONYMS

AZDA	Arizona Department of Agriculture
AZGFD	Arizona Game and Fish Department
BLM	Bureau of Land Management
BMP	Best Management Practices
BSR	Biological Survey Report
CBP	U.S. Customs and Border Protection
CFR	Code of Federal Regulations
cm	centimeter(s)
CWA	Clean Water Act of 1977
°F	Degrees Fahrenheit
e^2M	engineering-environmental Management, Inc.
ESP	Environmental Stewardship Plan
FE	Federally Endangered
GAP	Gap Analysis Program
GIS	Geographic Information System
GPS	Global Positioning System
HDMS	Heritage Data Management System
HS	Highly Safeguarded
m	meter(s)
m^2	square meters
MBTA	Migratory Bird Treaty Act of 1918, as amended
MJD	Multi-Jurisdictional Dataset
mph	Miles per hour
NVCS	National Vegetation Classification System
OHM	Ordinary high water mark
ROE	Right-of-Entry
SBNWR	San Bernardino National Wildlife Refuge
USACE	U.S. Army Corps of Engineers
USBP	U.S. Border Patrol
U.S.C	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
WRCC	Western Regional Climate Center

FINAL BIOLOGICAL SURVEY REPORT
FOR
CONSTRUCTION, OPERATION, AND MAINTENANCE
OF VEHICLE FENCE AND RELATED TACTICAL INFRASTRUCTURE
TUCSON SECTOR, ARIZONA
DOUGLAS STATION

TABLE OF CONTENTS

ATTACHMENTS

FIGURES

TABLES

1. INTRODUCTION

This Biological Survey Report (BSR) synthesizes information collected from a variety of literature sources and field surveys to describe the biological resources within the survey corridor; provides supporting information from the Project region; allows evaluation within the Project Environmental Stewardship Plan (ESP) of the potential effects of the Project on those biological resources; and provides the basis of recommendations for avoidance or reduction of those effects using mitigation including best management practices (BMPs). Information was gathered from publicly available literature, data provided by relevant land management agencies such as the U.S. Fish and Wildlife Service (USFWS) San Bernadino National Wildlife Refuge (SBNWR), review of aerial photography and U.S. Geological Survey (USGS) topographic maps, data from the State of Arizona, data from NatureServe, and field surveys of the survey corridor conducted in January and May 2008. Of particular importance were data from the 2,309-acre SBNWR, whose entire southern boundary with Mexico comprises a portion of the survey corridor.

This BSR supports the Environmental Stewardship Plan by providing information on biological resources potentially affected by impacts resulting from the construction, operation, and maintenance of the tactical infrastructure. The BSR was prepared as an independent document that is an appendix to the Environmental Stewardship Plan developed for this Project. The survey corridor is approximately 16 miles in length, approximately 760.5 acres within a 60- to 700-foot-wide area. In total, approximately 700.6 acres of mostly native vegetation providing wildlife habitat occurs in the survey corridor. The remaining area (59.9 acres) supports land use in the form of unvegetated desert wash bottoms, irrigated pasture, and roads and trails.

Herbaceous vegetation (i.e., desert grasslands, forblands, emergent wetlands) composes approximately 15.5 acres. Shrublands (i.e., dwarf, short, and tall) compose approximately 587.8 acres. Forests and woodlands comprise 97.3 acres of vegetation cover. The vegetation represents a combination of mostly native Chihuahuan Desert shrublands that have become established in sparse to dense stands on ridges, slopes, alluvial fans, outwash plains, and along desert washes, draws, creeks, and springs.

THIS PAGE INTENTIONALLY LEFT BLANK

2. PROJECT DESCRIPTION

U.S. Customs and Border Protection (CBP) proposes to construct, maintain, and operate tactical infrastructure consisting of a vehicle barrier (post-and-rail or Normandy-style) and associated access roads along the U.S./Mexico border in the U.S. Border Patrol (USBP), Tucson Sector, Douglas Station, Arizona. The locations of tactical infrastructure are based on a USBP Tucson Sector assessment of local operational requirements where such infrastructure will assist USBP agents in reducing illegal cross-border activities. Tactical infrastructure will be constructed in Section FV-1b along the international border in Cochise County, Arizona (see **Table 2-1**).

Table 2-1. Tactical Infrastructure Sections, Tucson Sector, Douglas Station

General Location	Land Ownership	Type of Tactical Infrastructure	Length of New Fence Section/Length of Construction Access Roads
East of the City of Douglas	Private, Public, USWFS, BLM, Arizona State Lands	Primary vehicle fence, access roads	15.75/5.0miles
Near Guadalupe Canyon	Private, BLM	Primary vehicle fence, access roads	0.5/0.5 miles
		Total	**16.25/5.5 miles**

The vehicle barrier will be constructed in two distinct sections of 0.5 mile and 15.75 miles in length, partially within the Roosevelt Reservation, land reserved in 1907 within 60 feet of the international boundary between the U.S. and Mexico along California, Arizona, and New Mexico. It should be noted that, from the eastern boundary of the SBNWR to the terminus near Border Monument 74, the existing barbed-wire fence has been constructed on the Roosevelt Reservation boundary and is offset 60 feet north of the border. Constructing the vehicle barrier will require improving or building seven access roads, totaling 5.25 miles on USFWS, Bureau of Land Management (BLM), and private land parcels.

The final design will be prepared by a design/build contractor with oversight from the U.S. Army Corps of Engineers (USACE). Design criteria that have been established based on USBP operational needs require minimum standards for vehicle barriers, as follows: (1) capable of withstanding a crash of a 10,000–pound (gross weight) vehicle traveling at 40 miles per hour (mph); (2) capable of withstanding vandalism, cutting, or various types of penetration; (3) designed to survive extreme climate changes; (4) designed to reduce or minimize impacts on small animal movement; (5) not impede the natural flow of surface water; and (6) to be as aesthetically pleasing as possible.

The area of impact for barrier construction is approximately 60 feet wide along the entire survey corridor, with wider but temporary impacts occurring at staging areas for construction materials and vehicles. Vegetation removal and land clearing/grading activities may occur on an as-needed basis.

2.1 Survey Methods

To provide flexibility in placement of tactical infrastructure within the survey corridor and to ensure consideration of potential impacts due to construction, patrol, and maintenance, surveys were conducted in an area extending 150 feet to 700 feet on the north side (i.e., the side away from the international border) of the individual tactical infrastructure sections and extending at least 0.25 mile past the ends of the section (a total of 760.5 acres). Along access roads, the survey was conducted 75 feet on either side of the center line or within a 150-foot-wide corridor. The areas thus defined are referred to hereafter as the "survey corridor."

Field investigations of the survey corridor were conducted by biologists of engineering-environmental Management, Inc. (e²M): Jim Von Loh (senior ecologist), Karen Stackpole (staff biologist), Brent Eastty (staff botanist), and Shannon Cauley (senior wetlands biologist). The January, April/May, and June 2008 surveys examined the survey corridor on January 14, from April 28 through May 2, and from June 9 through 13, 2008. A Contractor Site Visit Request Form was approved by the USACE, with assistance from the USFWS, SBNWR Manager, William Radke, and USBP escorts. A second field visit was conducted on August 13, 2008 to assess a modification that exceeded the original survey corridor. The field investiagtiosn for this smaller area was conducted by senior e²M biologists Rod Dossey and Jon Chandler.

Due to the schedule requirements for acquiring field information, e²M assigned senior and staff ecologists/biologists familiar with the USBP Projects, reporting process, vegetation, wetlands/waters of the United States, wildlife habitat classification and mapping protocols, and field sampling methods to intuitively examine the landscape and survey corridor for the approximately 15.8-mile length. Further, senior e²M natural resources staff used USFWS species lists and comprehensive conservation planning data (USFWS 1995) to ensure accurate identification of plant species and competent surveys for rare plants, wildlife, and potential habitat. The surveys were controlled, in that right-of-entry (ROE) was approved for the entire corridor and access road widths, and survey crews were in contact with USBP operations. While on the SBNWR, field biologists were accompanied by a USFWS law enforcement officer and were met by the Refuge Manager for sensitive site overviews. Investigations included preparing lists of observed plant and wildlife species; an assessment of habitat and surveys for rare plant and wildlife species; landscape photography points; observation points recording dominant species, location, cover, environmental conditions, and photodocumentation; determination of potential wetlands and other waters of the United States for future research; locations of major desert washes; and general note taking of natural resources, cultural resources, and other Environmental Stewardship Plan reporting needs.

Biologists walked the entire survey corridor, including all the access road corridors and staging areas. The survey team conducted reconnaissance level surveys on areas of land use (irrigated pasture and sites devoid of vegetation including playas, desert wash bottoms, and access roads) and examined in detail areas containing unique species compositions or habitat that might be conducive to sensitive species (desert grasslands, shrublands, riparian woodlands and forests, emergent wetlands, etc.). Observation data (Universal Transverse Mercator [UTM] coordinates, photographs, field notes, environmental information, vegetation structure, and plant community composition) were recorded at regular intervals along the corridor where vegetation occurred as homogenous stands and also where plant communities presented substantial shifts in species composition. These data were used to generate a vegetation classification and map to facilitate delineation of habitat types, analyses of potential sensitive species occurrences, and analyses of potential Project impacts on biological resources. The botanist and wildlife biologist specifically examined habitats to determine the presence of state- and Federal-listed species (see **Table 2-2**). Descriptions of the federally listed species developed by NatureServe (2008) are provided in **Attachment A**.

Table 2-2. Federal Threatened and Endangered Species and Arizona Wildlife Species of Concern Occurring Within Cochise County

Common Name	Scientific Name	Federal Status	State Status
FISH AND INVERTEBRATES			
Beautiful shiner	*Cyprinella Formosa*	**LT**	**WSC**
Desert pupfish	*Cyprinodon macularius*	**LE**	**---**
Gila chub	*Gila intermedia*	**LE**	**WSC**
Yaqui chub	*Gila purpurea*	**LE**	**WSC**
Yaqui catfish	*Ictalurus pricei*	**LT**	**WSC**
Spikedace	*Meda fulgida*	**LT**	**---**
Gila topminnow	*Poeciliopsis occidentalis occidentalis*	**LE**	**---**
Yaqui topminnow	*Poeciliopsis occidentalis sonoriensis*	**LE**	**WSC**
Loach minnow	*Tiaroga cobitis*	**LT**	**---**
Huachuca springsnail	*Pyrgulopsis thompsonii*	**C**	**---**
AMPHIBIANS			
Sonora tiger salamander	*Ambystoma tigrinum stebbinsi*	**LE**	**---**

Common Name	Scientific Name	Federal Status	State Status
Ramsey Canyon leopard frog	*Lithobates subaquavocalis*	**CA**	**---**
Chiricahua leopard frog	*Rana chiricahuensis*	**LT**	**WSC**
REPTILES			
New Mexico ridge-nosed rattlesnake	*Crotalus willardi obscurus*	**LT**	**—**
BIRDS			
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	**C**	**WSC**
Southwestern willow flycatcher	*Empidonax traillii extimus*	**LE**	**WSC**
Northern aplomado falcon	*Falco femoralis septentrionalis*	**LT, XN**	**---**
American peregrine falcon	*Falco peregrinus anatum*	**SC**	**WSC**
California brown pelican	*Pelecanus occidentalis californicus*	**PDL**	**---**
Mexican spotted owl	*Strix occidentalis lucida*	**LT**	**WSC**
MAMMALS			
Ocelot	*Leopardus pardalis*	**LE**	**---**
Lesser long-nosed bat	*Leptonycteris curasoae*	**LE**	**WSC**
Jaguar	*Panthera onca*	**LE**	**WSC**
PLANTS			
Cochise pincushion cactus	*Coryphantha robbinsorum*	**LT**	**HS**
Lemmon fleabane	*Erigeron lemmonii*	**FC**	**HS**
Huachuca water umbel (Cienega false rush)	*Lilaeopsis schaffneriana* var. *recurva*	**LE**	**HS**
Madrean ladies'-tresses	*Spiranthes delitescens*	**LE**	**HS**

Source: AZFGD 2008b, USFWS 2008a

Notes: LE = Listed Endangered; LT = Listed Threatened; FC = Federal Candidate; C = Candidate; CA = Conservation Agreement; PDL = Proposed for Delisting; PR = Protected; SC = Species of Concern; XN: Experimental Population; WSC = Wildlife of Special Concern in Arizona; HS = Highly Safeguarded Protected Native Plants (no collection allowed)

2.2 Arizona Game and Fish Department; Arizona Natural Heritage Program, Heritage Data Management System

The Arizona Heritage Data Management System (HDMS) was established to collect, synthesize, and catalog information concerning the distribution and occurrence of species and habitats in need of special attention (Arizona Game and Fish Department [AZGFD] 2008a, 2008b). It is part of a global network of 80 Natural Heritage Programs and Conservation Data Centers. The HDMS is Arizona's most comprehensive source of information related to rare, threatened, and endangered animals, plants, exemplary natural communities, and other significant features. The data are publicly available from which to make prudent decisions weighing future development, economic growth, and environmental integrity (AZGFD 2008a, 2008b). While these data are continually updated, there are gaps in coverage and species information due to lack of access to land for inventory, data from many sources, and a lack of staff and resources to collect and process data for all rare and significant resources. To request information from the HDMS online, access: http://www.azgfd.gov/w_c/edits/hdms_ natural_ heritage.shtml.

For the survey corridor, HDMS data were used to assist with the evaluation of environmental impacts of the vehicle barrier section under consideration. The interpretation and extrapolation of the data included consideration that: (1) data gaps possibly occur because of the availability of data extraction from public information sources, (2) species and geographic coverage focused on the most rare species and ecosystems, and (3) the potential lack of precise locality data in some secondary sources exists. Because of the large proportion of public land versus private land in Arizona, the HDMS includes a representative inventory of rare resources in the state. It is based on the best data available to the AZGFD in terms of rare species locations and distributions.

The Cochise County list of rare species was acquired from HDMS and consolidated into **Table 2-2**. The county lists include wildlife species of special concern in Arizona and highly safeguarded plant species. In general, species that appear on county lists do not all share the same probability of occurrence within a county (e.g., some species are migrants or wintering residents and a few species might be historic or considered extirpated within a county).

THIS PAGE INTENTIONALLY LEFT BLANK

3. ENVIRONMENTAL SETTING

The survey corridor climate is semiarid within the Xeric Climatic Region as described in Robinson et al. (2006). This region is characterized by deep, northwest-trending, alluvium-filled basins separated by linear mountain ranges (basin and range lowlands). Relatively recent volcanic activity was evident with many slopes covered by gravel and cobble of volcanic origin. Land surface elevations range from approximately 3,720 feet above mean sea level to more than 5,000 feet above mean sea level in the immediate Project region. Precipitation typically increases and temperatures decrease with increasing altitude in the Xeric Climatic Region during all seasons of the year. Low rainfall and high temperatures are characteristic of the basin and range lowlands (e.g., summers are long and hot and winters are short, dry, and cold and can include brief periods when temperatures are below freezing) (Robinson et al. 2006, Bailey 1995). Many of the streams in the Xeric Climatic Region are intermittent or ephemeral (i.e., more than 250 days annually of no flow), but can have high flow in response to intense thunderstorms.

The general climatic summary records for Douglas, Arizona (Station 022659), have been prepared from 1948 to 2007 data (Western Regional Climate Center [WRCC] 2008). Average minimum temperatures in Douglas range from a low of 29 degrees Fahrenheit (°F) in December and January to 65°F in July, and average high temperatures range from 63°F in December and January to 96°F in June (WRCC 2008). The lowest temperature recorded was 2°F on December 8, 1978, and the highest temperature recorded was 109°F on June 26, 1990. The average annual precipitation is 14.2 inches, over half of which falls in July, August, and September during the summer monsoon season. A long growing season is experienced for the Project region, averaging 240 frost-free days (WRCC 2008). The evaporation rate during the summer season is high, about twice the precipitation amount, and averages about 70 inches annually in Tucson.

Upland soils within the survey corridor are classified within the Bonita-Sontag Association and valley floor soils have been classified within the Karro Association (USFWS 1995). Karro Association soils are typically deep and well-drained and formed in old alluvium from mixed igneous and sedimentary rocks on alluvial fans and uplands; they include (1) Karro Loam, (2) Bonita Clay, (3) Bonita Cobbly Clay, and (4) Riggs. The Bonita-Sontag Association soils are typically shallow and well-drained and formed in mixed slope alluvium from sedimentary and igneous rocks; they include (1) Stronghold, (2) Mabray, (3) Lampshire-Ridgelite, and (4) Gadwell-Caralampi Complex.

The vegetation of the basin and range lowlands of southeastern Arizona has generally been classified under the Dry Domain (Map Unit 300), Tropical/Subtropical Desert Division (Map Unit 320) of Bailey (1995). The survey corridor is more finely classified by Bailey (1995) as the Chihuahuan Desert Province (Map Unit 321). The Arizona Gap Project (Bennett et al. 2004) provided discussion and described plant geography to vegetation series using topographic features, climate, vegetation types, and terrestrial vertebrates. This system placed the survey corridor generally in the Nearctic Upland; Warm Temperate Desertland; Chihuahuan Desertscrub classification. Vegetation series that were described and are applicable to the survey corridor included (1) Creosotebush-Tarbush Series; (2) Mesquite Series; (3) Whitethorn Series; (4) Mixed Scrub Series, and (5) Scrub Grassland Series (Bennett et al. 2004).

4. BIOLOGICAL RESOURCES

4.1 Vegetation Classification

The USGS (Bennett et al. 2004) recognizes nine Nearctic Upland and Nearctic Wetland vegetation mapping units in the Douglas, Arizona, vicinity using a combination of plant species dominance, wildlife use, topography, hydrology, and geology. The vegetation series that are associated with the survey corridor include (1) Warm Temperate Grassland, Scrub-Grassland (Semidesert), Tobosa Grass-Scrub Series; (2) Warm Temperate Scrub-Grassland (Semidesert), Sacaton-Scrub Series; (3) Warm Temperate Desertland, Chihuahuan Desertscrub, Creosotebush-Tarbush Series; (4) Warm Temperate Desertland, Chihuahuan Desertscrub, Whitethorn Series; (5) Warm Temperate Desertland, Chihuahuan Desertscrub, Mesquite Series; (6) Warm Temperate Desertland, Chihuahuan Desertscrub, Mixed Scrub Series; (7) Tropical-Subtropical Swamp Riparian and Oasis Forests, Sonoran Riparian and Oasis Forest, Cottonwood-Willow Series; (8) Tropical-Subtropical Swamp and Riparian Scrub, Sonoran Deciduous Swamp and Riparian Scrub, Mixed Scrub Series; and (9) Tropical-Subtropical Marshland, Sonoran Interior Marshland, Cattail Series. The entire corridor was predominantly characterized by Chihuahuan Desertscrub vegetation series.

NatureServe (2008) has defined ecological systems to represent recurring groups of biological communities that are found in similar physical environments and are influenced by similar dynamic ecological processes such as drought, fire, or flooding. Ecological systems represent classification units that are readily identifiable by conservation and resource managers in the field. The ensuing vegetation description for the survey corridor was prepared in the framework of ecological systems that include (1) North American Warm Desert Riparian Woodland and Shrubland (CES302.753), (2) Apacherian-Chihuahuan Mesquite Upland Scrub (CES302.733); (3) Chihuahuan Mixed Desert and Thorn Scrub (CES302.734), (4) Apacherian-Chihuahuan Mesquite Upland Scrub (CES302.733), (5) North American Warm Desert Riparian Mesquite Bosque (CES302.752), (6) North American Warm Desert Wash (CES302.755), (7) Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (CES302.735), (8) North American Warm Desert Cienega (CES302.747), and (9) North American Warm Desert Playa (CES302.751). **Table 4-1** provides a crosswalk between the biotic communities described by the USGS and the ecological systems of NatureServe (2008).

Classification of existing vegetation within the survey corridor was achieved by accessing the survey corridor, access roads, and staging areas as planned, sampling observation points, and relating them to the NatureServe Explorer classification database directly or as provisional types (NatureServe 2008). At the coarsest level, the nine above-named ecological systems were determined and local vegetation types described using the national system.

Table 4-1. Crosswalk Relationship of USGS GAP Map Units and USFWS Habitat Types with NVCS Ecological Systems and Vegetation Alliances

Ecological System (NatureServe 2008) Provisional Vegetation Alliance	Vegetation Structure and Series	Habitat Types
Madrean Pinyon-Juniper Woodland - One-seed Juniper Wooded Herbaceous	Madrean Evergreen Forest - Oak-Pine Series	Chihuahuan Desert Scrub
North American Warm Desert Riparian Woodland and Shrubland - Fremont Cottonwood – Goodding Willow Forest - Fremont Cottonwood / Honey Mesquite Forest - Arizona Sycamore – Fremont Cottonwood / Honey Mesquite Woodland	Sonoran Riparian and Oasis Forest - Cottonwood-Willow Series Mogollon Mixed Broadleaf - Mixed Broadleaf Series Sonoran Deciduous Swamp and Riparian Scrub - Mixed Scrub Series Sonoran Interior Marshland - Cattail Series	Riparian Forest/Woodland Riparian Scrub Mesquite Bosque Marshland
Apacherian-Chihuahuan Mesquite Upland Scrub - Ocotillo – Tarbush Shrubland - Mortonia – Mariola Shrubland - Whitethorn – Mariola Shrubland	Chihuahuan Desertscrub - Whitethorn Series Chihuahuan Desertscrub - Mixed Scrub Series	Chihuahuan Desert Scrub
Chihuahuan Mixed Desert and Thorn Scrub - Creosotebush – Mariola Shrubland - Mariola Dwarf-shrubland - Creosotebush – Honey Mesquite Shrubland - Creosotebush – Tarbush Shrubland - Tarbush Shrubland - Shrubby Coldenia – Engelmann Prickly-pear Dwarf-shrubland	Chihuahuan Desertscrub - Creosotebush-Tarbush Series Chihuahuan Desertscrub - Mixed Scrub Series	Chihuahuan Desert Scrub
Apacherian-Chihuahuan Mesquite Upland Scrub - Honey Mesquite – Whitethorn Bajada Shrubland - Honey Mesquite / Hook Threeawn Shrubland - Honey Mesquite – Tarbush Shrubland	Chihuahuan Desertscrub - Mesquite Series	Chihuahuan Desert Scrub

Ecological System (NatureServe 2008) Provisional Vegetation Alliance	Vegetation Structure and Series	Habitat Types
North American Warm Desert Riparian Mesquite Bosque - Honey Mesquite – Four-wing Saltbush Shrubland - Honey Mesquite / Alkali Sacaton Woodland and Shrubland - Honey Mesquite Sparse Understory Woodland and Shrubland - Honey Mesquite – Littleleaf Sumac Shrubland	Chihuahuan Desertscrub - Mesquite Series	Chihuahuan Desert Scrub Mesquite Bosque Riparian Scrub
North American Warm Desert Wash - Seepwillow – Burro Bush Shrubland - Alkali Sacaton Herbaceous Vegetation - Wild Barley / Honey Mesquite Shrub Herbaceous Vegetation	Scrub-Grassland - Sacaton-Scrub Sonoran Deciduous Swamp and Riparian Scrub - Mixed Scrub Series	Chihuahuan Desert Scrub Desert Grassland Riparian Scrub
Apacherian-Chihuahuan Semi-Desert Grassland and Steppe - Hook Threeawn Herbaceous Vegetation - Desert Marigold Herbaceous Vegetation	Scrub Grassland	Desert Grassland

Note: NVCS = National Vegetation Classification System.

A finer level of classification equaling or approximating the vegetation alliance level of the National Vegetation Classification System (NVCS) (NatureServe 2008) was used to prepare the plant community discussions under each ecological system. Vegetation stands and patches that are generally unclassified in the current system and sampled within the Project area typically consisted of nonnative species including Bermuda Grass Herbaceous Vegetation, Russian-thistle Herbaceous Vegetation, and Common Cocklebur Herbaceous Vegetation.

Habitats observed, sampled, and photographed within the survey corridor range from upland mixed desert scrub and thorn-scrub throughout the alignment to riparian woodland and forest stands within SBNWR and Guadalupe Canyon. Much of the vegetation cover along the vehicle barrier fence section consists of native shrublands characterized by honey mesquite, creosotebush, tarbush, whitethorn, shrubby coldenia, mortonia, and ocotillo; vegetation cover occupies approximately 88 percent of the corridor. Development is limited to one irrigated pasture and existing roads and trails; these land uses occupy approximately 12 percent of the corridor.

A brief description of each plant community observed within the section (FV-1b) is provided herein; they are distinguished using the NatureServe Vegetation Alliance level of classification or an approximation. Each community is illustrated and supported by representative ground photographs and foliar cover information for dominant and characteristic plant species.

4.1.1 Madrean Pinyon-Juniper Woodland Ecological System (CES305.797)

One-seed Juniper / Whitethorn Wooded Shrubland

The uplands and associated small drainages within Guadalupe Canyon occupied 25.1 acres of the survey corridor and supported 2 to 4 meter (m) tall one-seed juniper that ranged in cover from 3 to 5 percent (see **Figure 4-1**). The tall shrub layer provided low to moderate coverand includes whitethorn, catclaw acacia, littleleaf sumac, and honey mesquite. The short and dwarf-shrub layers contribute low cover, up to 5 percent cover and include mortonia, creosotebush, prickly-pear cactus, and agave. The herbaceous layer provides low to moderate cover, predominantly from the bunchgrasses tobosa, black grama, bush muhly, and three-awn.

Figure 4-1. Representative Photographs of One-seed Juniper Habitat

4.1.2 North American Warm Desert Riparian Woodland and Shrubland Ecological System (CES302.753)

Fremont Cottonwood – Goodding Willow Forest

Black Draw (Rio San Bernardino) supports a forest stand in SBNWR at the international border which occupied 0.9 acre of the survey corridor. The draw was ponded at the international border and upstream approximately 50 m had been hardened using gabions filled with rocks to reduce erosion (see **Figure 4-2**). Black Draw measured approximately 60 m from bank-to-bank and had become incised from 5 to 8 m deep; the banks are nearly vertical. Debris lines on the trees suggest flows that could exceed 1.5 m in depth. The draw has perennial springs and near-to-surface ground water which provides habitat for riparian and wetland plant species. Fremont cottonwood trees up to 30 m tall have become established on the banks and first terrace of the draw and provide approximately 90 percent cover (see **Figure 4-2**). These trees were mature with large diameters-at-breast-height (60 to 70 centimeters [cm]). An understory layer of Goodding willow trees provided approximately 20 percent cover and attained heights of approximately 8 m tall. Honey mesquite trees provided low to moderate cover (10 to 15 percent cover) on the first terrace adjacent to the Fremont cottonwood stand. In the densest portion of this linear stand the understory was composed of leaf litter, but where canopy openings occurred the emergent wetland species southern cattail, three-square bulrush, and mixed graminoids provided moderate cover (up to 25 percent cover). Approximately 100 m west of Black Draw was a small stand of Fremont cottonwood trees with nearly 100 percent cover by three-square bulrush in the understory that was fed by a spring. Black Draw provided rare and valuable wildlife habitat with the tallest structural component of any plant community along this portion of the international border. Its waters also support three endangered fish species. The small Fremont cottonwood stand to the west provided active nest sites for the gray hawk, a pair of which was in residence.

Figure 4-2. Representative Photographs of Fremont Cottonwood – Goodding Willow Habitat

Apparently, Black Draw did not exist in the 1850s, but by the 1890s it occurred as a creek lined with cottonwood trees (Lanning 1981 in USFWS 1994). Later, it became a ditch approximately 3 to 5 m deep, 5 to 25 m in width, and was typically dry.

Fremont Cottonwood / Honey Mesquite Forest

Hay Hollow Wash supports a forest stand in SBNWR at the international border that occupied 3.6 acres within the survey corridor. The wash has a sandy bottom, is approximately 40 m wide, has incised up to 4 m deep within nearly vertical banks, and has sufficient surface flows and near-to-surface groundwater to support riparian plant species (see **Figure 4-3**). Debris lines captured on the trees suggest flows that could exceed 1 m in depth. Fremont cottonwood trees up to 25 m tall have become established in the wash bottom and on banks and provide approximately 70 percent canopy cover. These trees are approximately 15 years of age and have diameters-at-breast-height of approximately 35 to 40 cm. Higher on the banks and on the first wash terrace, honey mesquite trees to 15 m tall provide moderate cover, up to 20 percent cover. Giant dropseed and alkali sacaton contributed low cover on the wash banks and first terrace. This is a rare and valuable wildlife habitat, with the tallest structural component of any plant community along this portion of the international border.

Arizona Sycamore - Fremont Cottonwood / Honey Mesquite Woodland

The wash located in Guadalupe Canyon at the international border provides habitat for a sparse woodland community on the banks and terraces, occupying 14.8 acres within the survey corridor. The wash has incised approximately 4 m deep, contained a barren sandy or gravelly channel. Cobble was deposited on point bars and terraces; it ranged from 10 to 20 m wide (see **Figure 4-4**). Arizona sycamore and Fremont cottonwood trees up to 15 m tall have become established on the banks and first terraces of the moderately large desert wash and provide low to moderate cover, approximately 10 to 20 percent and 1 to 5 percent, respectively. The short-statured honey mesquite trees occurred as understory to the taller trees or formed monotypic stands or clumps on the desert wash banks and terraces; they provided low to moderate cover from 10 to 20 percent cover. Additional understory trees included hackberry, green ash, one-seed juniper, and oak which provided low cover. The tall shrub layer ranged from 2 to 5 m tall and was characterized by honey mesquite which provided moderate cover, from 10 to 30 percent cover. The short shrub layer provided sparse cover and was characterized by littleleaf sumac, wait-a-minute, wolfberry, and burro bush. The herbaceous layer was comprised of grasses providing low to moderate cover, from 10 to 25 percent cover and included sideoats grama, deer grass, sand dropseed, tobosa, and big dropseed.

Figure 4-3. Representative Photographs of Fremont Cottonwood / Honey Mesquite Habitat

Figure 4-4. Representative Photographs of Arizona Sycamore - Fremont Cottonwood / Honey Mesquite Habitat

4.1.3 Apacherian-Chihuahuan Mesquite Upland Scrub Ecological System (CES302.733)

Ocotillo – Tarbush Shrubland

Slopes of the Perilla Mountains supported tall shrub stands on rocky outcrops, cobbly and gravelly colluvial deposits, and outwash fans on 32.8 acres of the survey corridor (see **Figure 4-5**). The tall shrub layer was 3 to 5 m high and characterized by ocotillo that provided low to moderate cover (5 to 25 percent cover), typically with a short shrub understory of tarbush that provided low cover (5 to 15 percent cover). Associated short and dwarf-shrubs provided sparse cover and included mariola, yucca, little-head snakeweed, rainbow cactus, and wait-a-minute. South-facing rock outcrops within this type supported dense patches of little bluestem and sparse cover of tobosa and threeawn.

Mortonia - Mariola Shrubland

Limestone outcrops and colluvial slopes in the vicinity of Monument 74 and small drainage systems in Guadalupe Canyon supported unique short shrub stands on 26.6 acres within the survey corridor (see **Figure 4-6**). The short shrub layer was characterized by mortonia that provided low to moderate cover (5 to 15 percent cover) in association with the dwarf-shrub mariola that contributed low to moderate cover (5 to 20 percent cover). The tall shrub layer was often present, provided sparse to low cover, and included ocotillo, whitethorn, squawbush, and one-seed juniper. The remaining short and dwarf-shrub layers were diverse, contributed sparse to moderate cover, and included creosotebush, tarbush, althorn, agave, yucca, sotol, Engelmann prickly-pear, and shrubby coldenia. The herbaceous layer contributed sparse cover and included hook threeawn, tobosa, and fluffgrass.

Figure 4-5. Representative Photographs of Ocotillo – Tarbush Habitat

Whitethorn - Mariola Shrubland

Slopes of the Perilla Mountains supported short and dwarf-shrub stands on the driest exposures and steepest ridges (see **Figure 4-7**). The dwarf-shrub layer was characterized by mariola which provided low cover, up to 10 percent cover, and the tall shrub layer was characterized by low cover of whitethorn (5 percent cover). Associated tall and short shrubs that contributed sparse to low cover included ocotillo, yucca, and Palmer agave. The herbaceous layer provided sparse cover and was characterized by tobosa and fluffgrass. This type occurred on the edge of the survey corridor and occupied 0.7 acre.

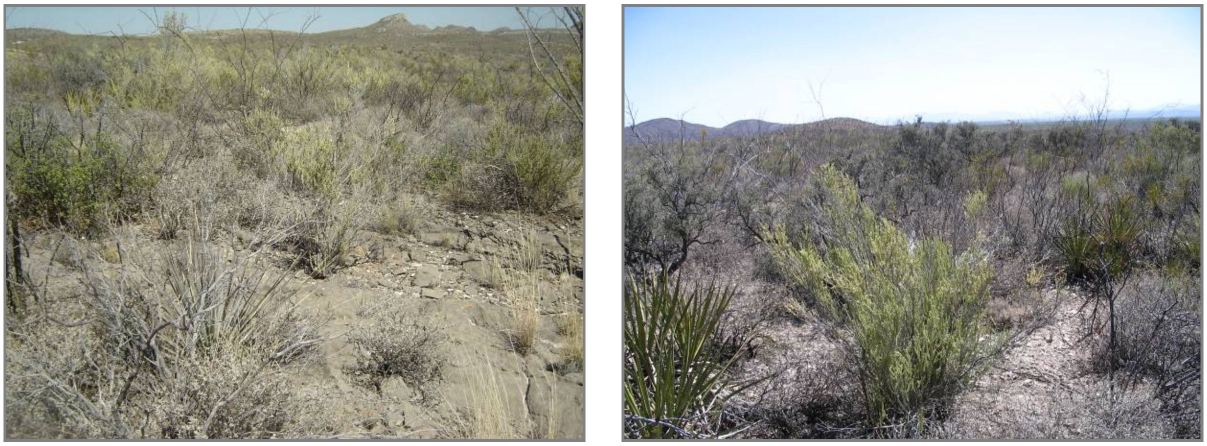


Figure 4.6. Representative Photographs of Limestone Ridge and Slope Habitat

Figure 4-7. Representative Photographs of Steep Ridge and Slope Habitat

4.1.4 Chihuahuan Mixed Desert and Thorn Scrub (CES302.734)

Creosotebush – Mariola Shrubland

Gentle slopes and alluvial outwash plains, typically gravelly and sandy in texture, supported consistent dominance by short and dwarf shrubs of this type which occupied 234.7 acres of the survey corridor (see **Figure 4-8**). The short shrub creosotebush and dwarf-shrub mariola characterized this type and each provided from 5 to 25 percent cover within stands. The tall shrub layer contributed sparse to low cover (1 to 10 percent cover) and included ocotillo, whitethorn, and honey mesquite. The remaining short and dwarf-shrub layers contributed sparse to low cover (1 to 10 percent cover) and included tarbush, yucca, Engelmann prickly-pear, cane cholla, and shrubby coldenia. The herbaceous layer was low in terms of species diversity, contributed sparse cover or was absent, and was characterized by fluffgrass, tobosa, and sprangletop.

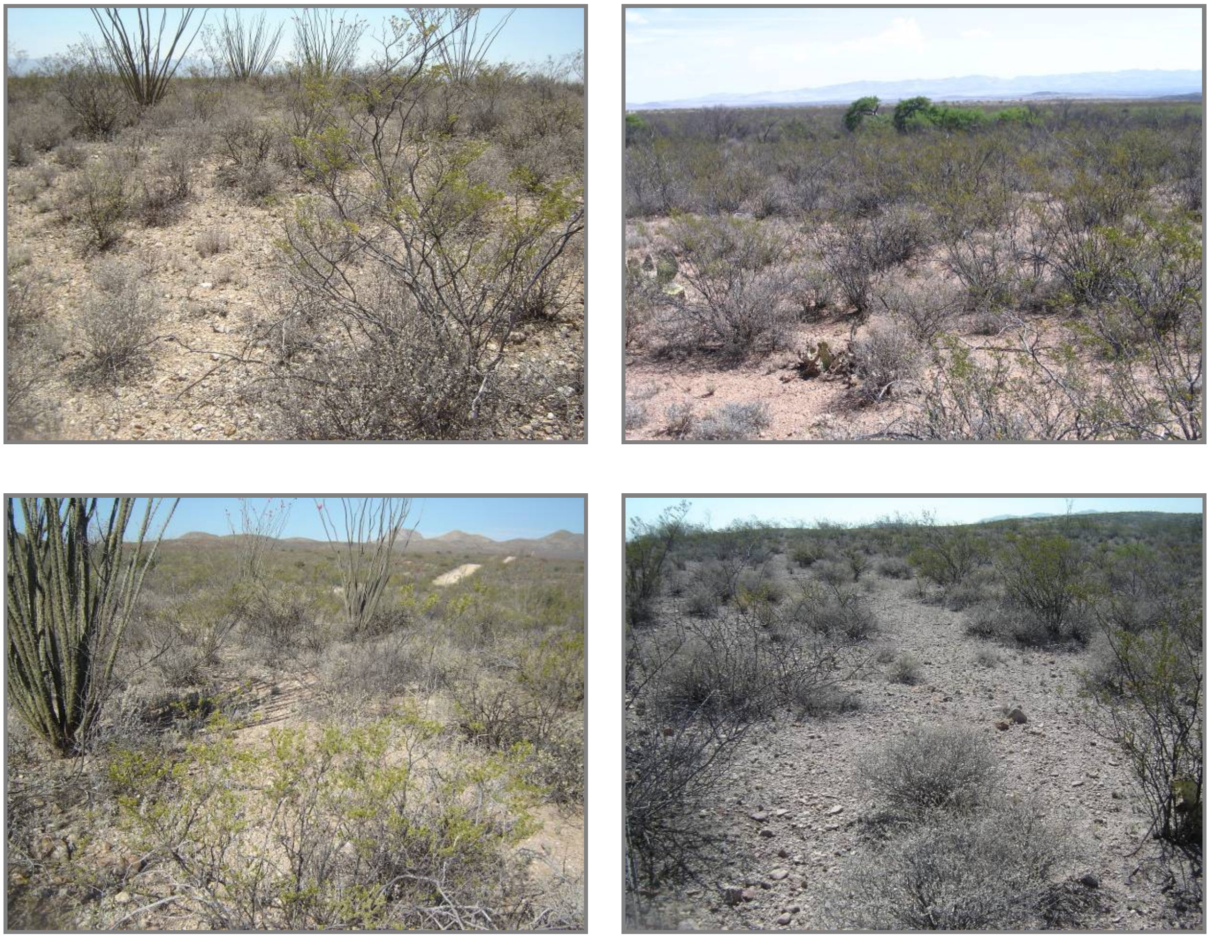


Figure 4-8. Representative Photographs of Creosotebush - Mariola Desert Slopes and Plains Habitat

Mariola Dwarf-shrubland

This type is unique and had become established on a south-facing slope armored by volcanic rocks, occupying 2.4 acres within the survey corridor (see **Figure 4-9**). The dwarf-shrub mariola characterized the site, providing 20 percent cover. Associated tall and short shrubs provided sparse cover and included creosotebush and honey mesquite. Herbaceous vegetation was nearly absent; the short bunchgrass tobosa contributed sparse cover.

Figure 4-9. Representative Photographs of Mariola - Volcanic Slope Habitat

Creosotebush – Honey Mesquite / Tobosa Shrubland

Gentle to steep slopes, volcanic cobble exposures, and dissected plains supported mixtures of tall and short shrubs that were relatively consistent on 73.0 acres throughout the survey corridor (see **Figure 4-10**). This type is characterized by creosotebush and honey mesquite tall shrubs that each range in cover from 5 to 15 percent. Associated tall shrubs provided sparse cover and included littleleaf sumac, tarbush, four-wing saltbush, whitethorn, and shrubby coldenia. The herbaceous layer was patchy in distribution, contributed sparse to low cover (2 to 12 percent cover), and included tobosa and black grama.

Creosotebush – Tarbush Shrubland

Broad, gravelly plains supported moderate stands of this type to the west of the SBNWR boundary where 48.1 acres of the survey corridor supported this type (see **Figure 4-11**). Creosotebush short shrubs provided low cover, up to 15 percent, and tarbush short shrubs provided sparse cover (up to 4 percent cover) in these open stands. In one stand, the tall shrub ocotillo contributed sparse cover. Associated short and dwarf-shrubs contributed sparse cover and included whitethorn, mariola, soaptree yucca, and shrubby coldenia. The grasses bush muhly and tobosa provided sparse cover in one stand.

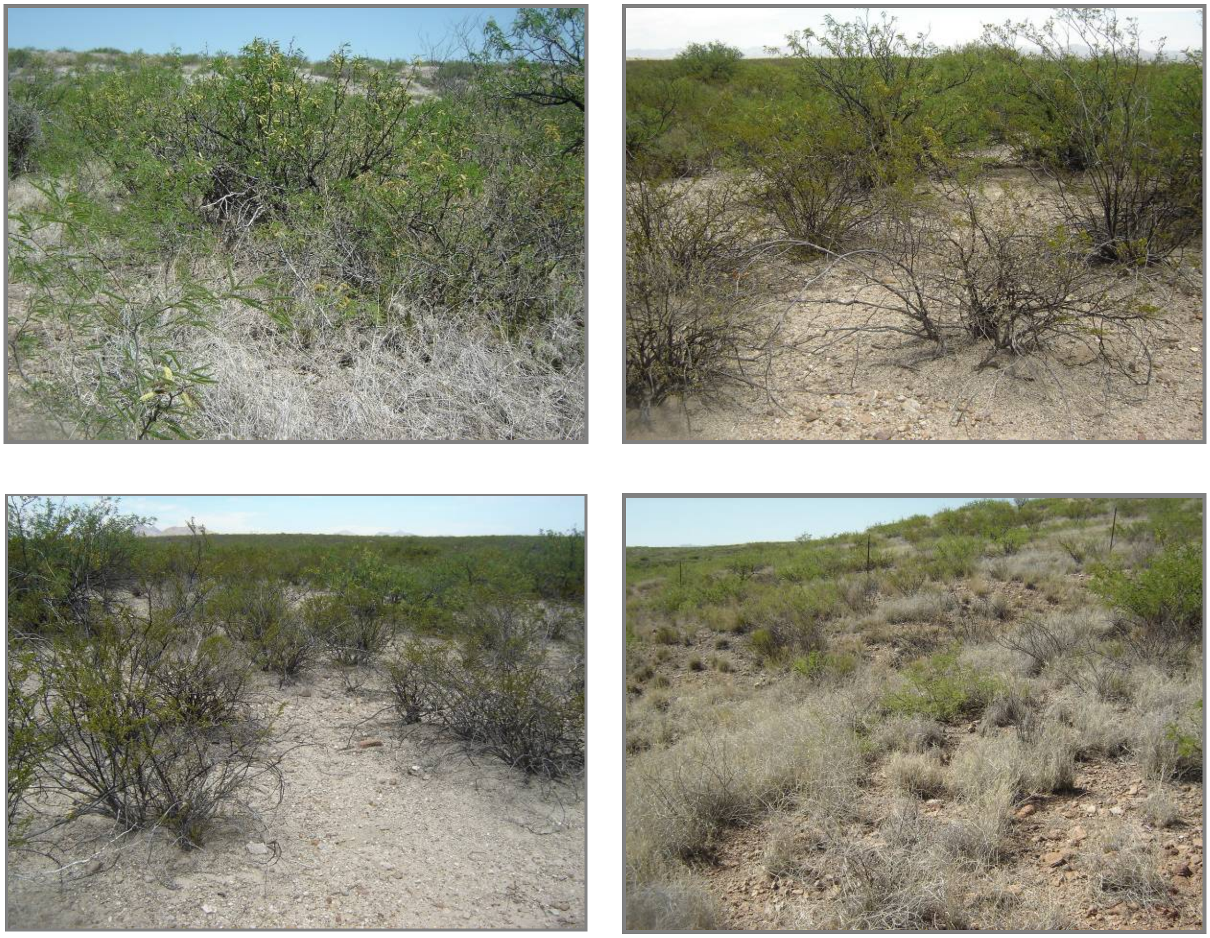


Figure 4-10. Representative Photographs of Creosotebush – Honey Mesquite Slope and Dissected Plain Habitat

Tarbush Shrubland

An individual sandy and gravelly alluvial fan was characterized by moderate cover (35 percent cover) of tarbush that occupied 1.1 acres of the survey corridor (see **Figure 4-12**). The remaining short and dwarf-shrub layers contributed sparse to low cover (up to 10 percent cover) and included whitethorn, honey mesquite, yucca, prickly-pear, and small-headed snakeweed. The herbaceous layer was absent from this stand.

Shrubby Coldenia – Engelmann Prickly-pear Dwarf-shrubland

This type became established on a dry ridge off a hill with gravelly, thin soils and occupied 1.6 acres in the survey corridor (see **Figure 4-13**). The dwarf-shrubs shrubby coldenia (12 percent cover) and Engelmann prickly-pear (8 percent cover) characterized the site and provided low to moderate cover. Sparse cover was provided by the short shrub creosotebush. The herbaceous layer contributed sparse cover and was characterized by fluffgrass.

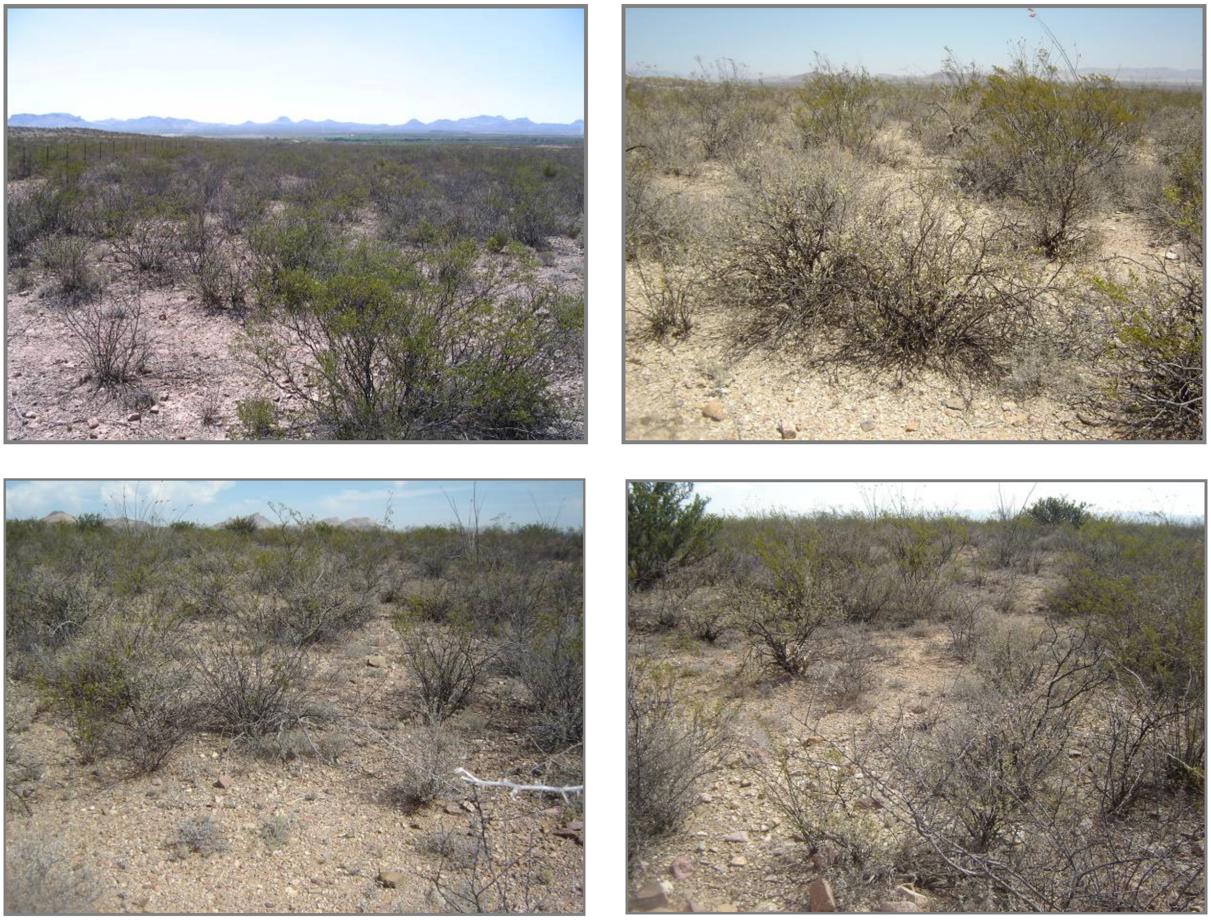


Figure 4-11. Representative Photographs of Creosotebush – Tarbush Desert Plain Habitat

4.1.5 Apacherian-Chihuahuan Mesquite Upland Scrub Ecological System (CES302.733)

Honey Mesquite – Whitethorn Bajada Shrubland

Several small, gravel and cobble-covered hilltops and ridges occur east of Hay Hollow Wash and continue to the eastern boundary of SBNWR, occupying 10.8 acres within the survey corridor (see **Figure 4-14**). These exposed sites support low cover, between 15 to 20 percent cover of short and dwarf-shrubs including honey mesquite, whitethorn acacia, four-wing saltbush, creosotebush, Mormon-tea or jointfir, and little-head snakeweed. No one shrub contributed more than 5 percent cover in these stands.

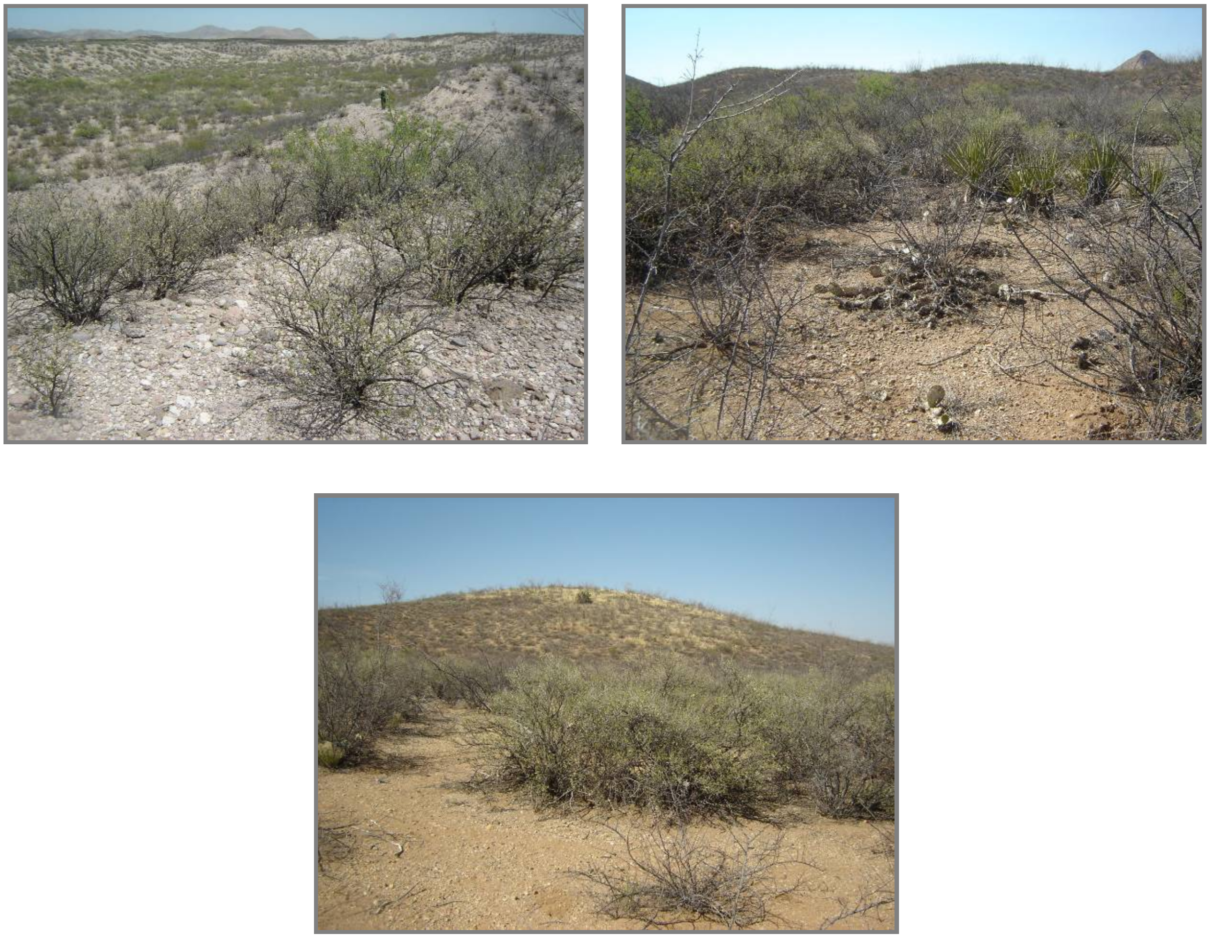


Figure 4-12. Representative Photographs ofTarbush Alluvial Fan Habitat

Honey Mesquite / Hook Threeawn Shrubland

A single stand of this vegetation type occurred on a cobbly ridge and occupied 7.7 acres of the survey corridor (see **Figure 4-15**). The tall shrub layer was characterized by 2 to 4 m high honey mesquite that provided moderate cover, up to 30 percent cover, and the short bunchgrass hook threeawn also provided moderate cover (up to 40 percent cover). The short shrub layer contributed low cover (less than 10 percent cover) and included whitethorn, yucca, and Engelmann prickly-pear. Tobosa provided low cover (5 percent cover) in the herbaceous layer.

Figure 4-13. Representative Photographs of Dwarf Shrub Dry Ridge Habitat

Honey Mesquite - Tarbush Shrubland

This vegetation type occurred on a cobbly volcanic slope and on sandy soils within a braided desert wash on the Slaughter Ranch, occupying 5.5 acres in the survey corridor (see **Figure 4-16**). The tall shrub (to 4 m high) honey mesquite provided moderate cover (20 to 35 percent cover) and the short shrub tarbush provided low cover (4 percent cover). Whitethorn provided sparse cover in the tall shrub layer of one stand, and the short and dwarf-shrubs creosotebush, four-wing saltbush, Engelmann prickly-pear, and small-headed snakeweed contributed sparse to low cover. The herbaceous layer provided sparse cover by fluffgrass and alkali sacaton.

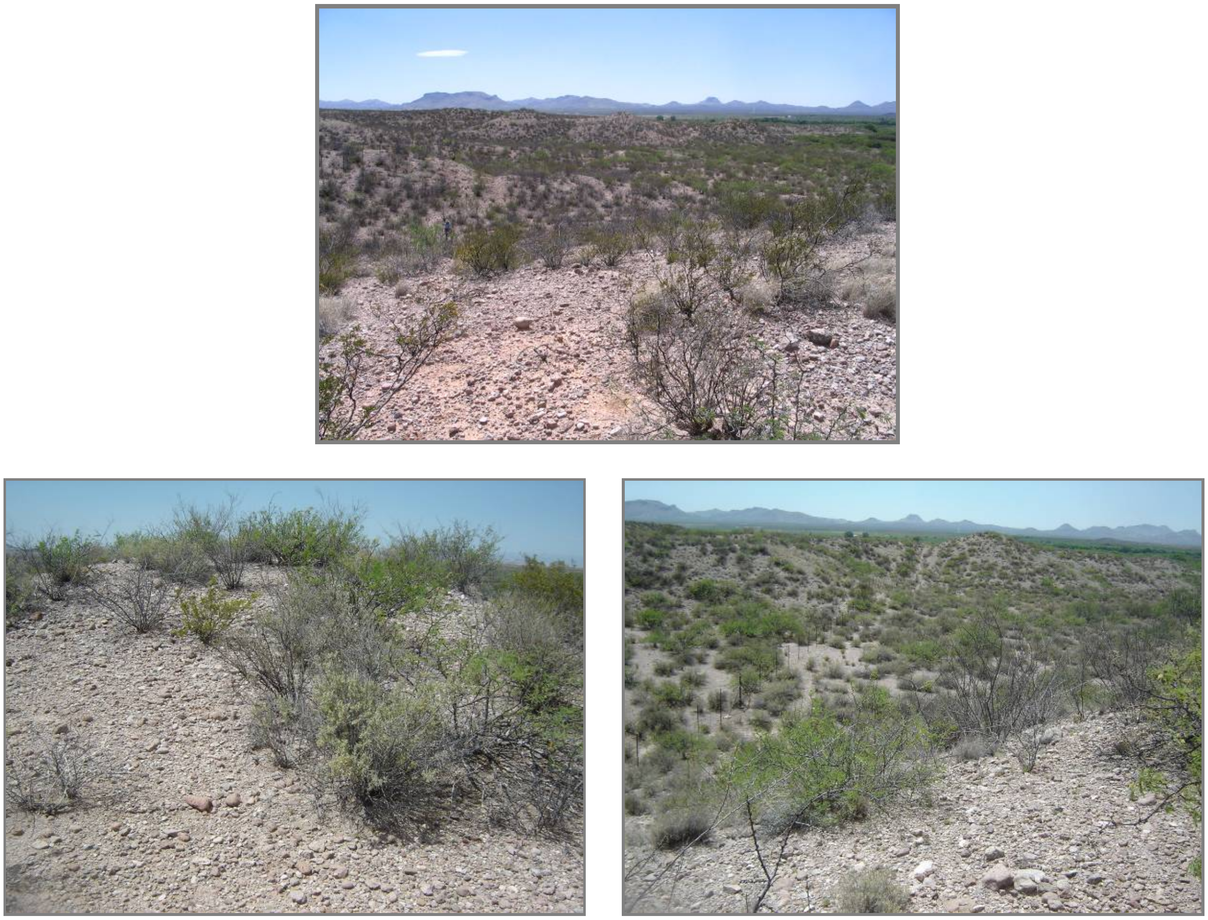


Figure 4-14. Representative Photographs of Honey Mesquite – Whitethorn Bajada Habitat

Figure 4-15. Representative Photographs of Honey Mesquite / Hook Threeawn Ridge Habitat

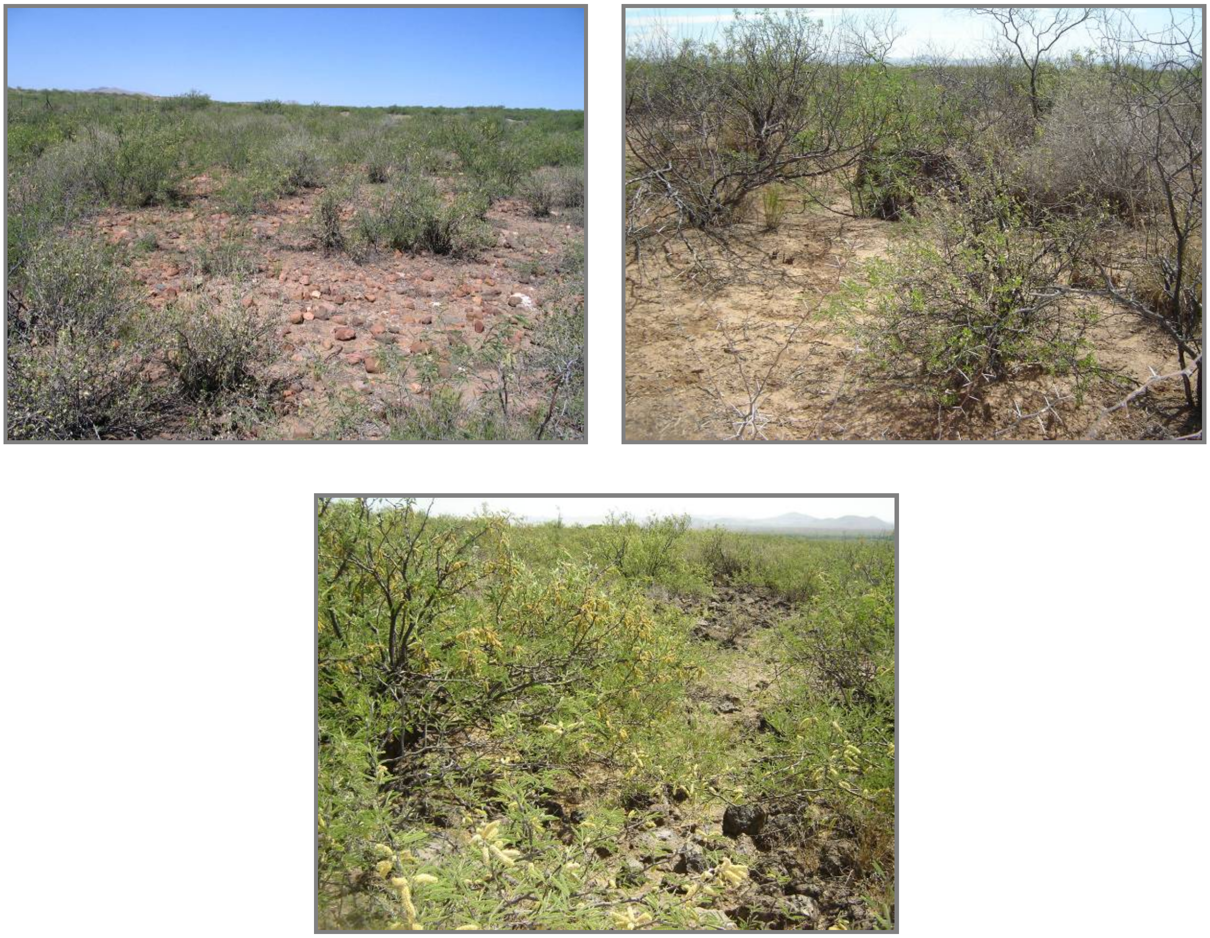


Figure 4-16. Representative Photographs of Honey Mesquite – Tarbush Slope and Braided Wash Habitat

4.1.6 North American Warm Desert Riparian Mesquite Bosque Ecological System (CES302.752)

Honey Mesquite – Four-wing Saltbush Shrubland

The relatively flat alkaline soils on the west side of SBNWR and the volcanic cobble slopes west of the SBNWR supported this type on 25.8 acres of the survey corridor (see **Figure 4-17**). Honey mesquite tall shrubs to 4 m high provided low to high cover (15 to 60 percent cover) and four-wing saltbush short shrubs provided 5 to 12 percent cover in the understory. In one stand, creosotebush and soaptree yucca provided sparse cover in the short shrub layer and small-headed snakeweed provided sparse cover in the dwarf-shrub layer. The herbaceous layer was characterized by sparse cover of tobosa and alkali sacaton. Within the refuge a strip of land adjacent to the border appeared to have been bladed or similarly treated to remove honey mesquite shrubland habitat. The treated area occupied 4.1 acres within the survey corridor and had recovered to sparse cover of honey mesquite, four-wing saltbush, and tobosa that in total provided less than 10 percent cover (see **Figure 4-17**).

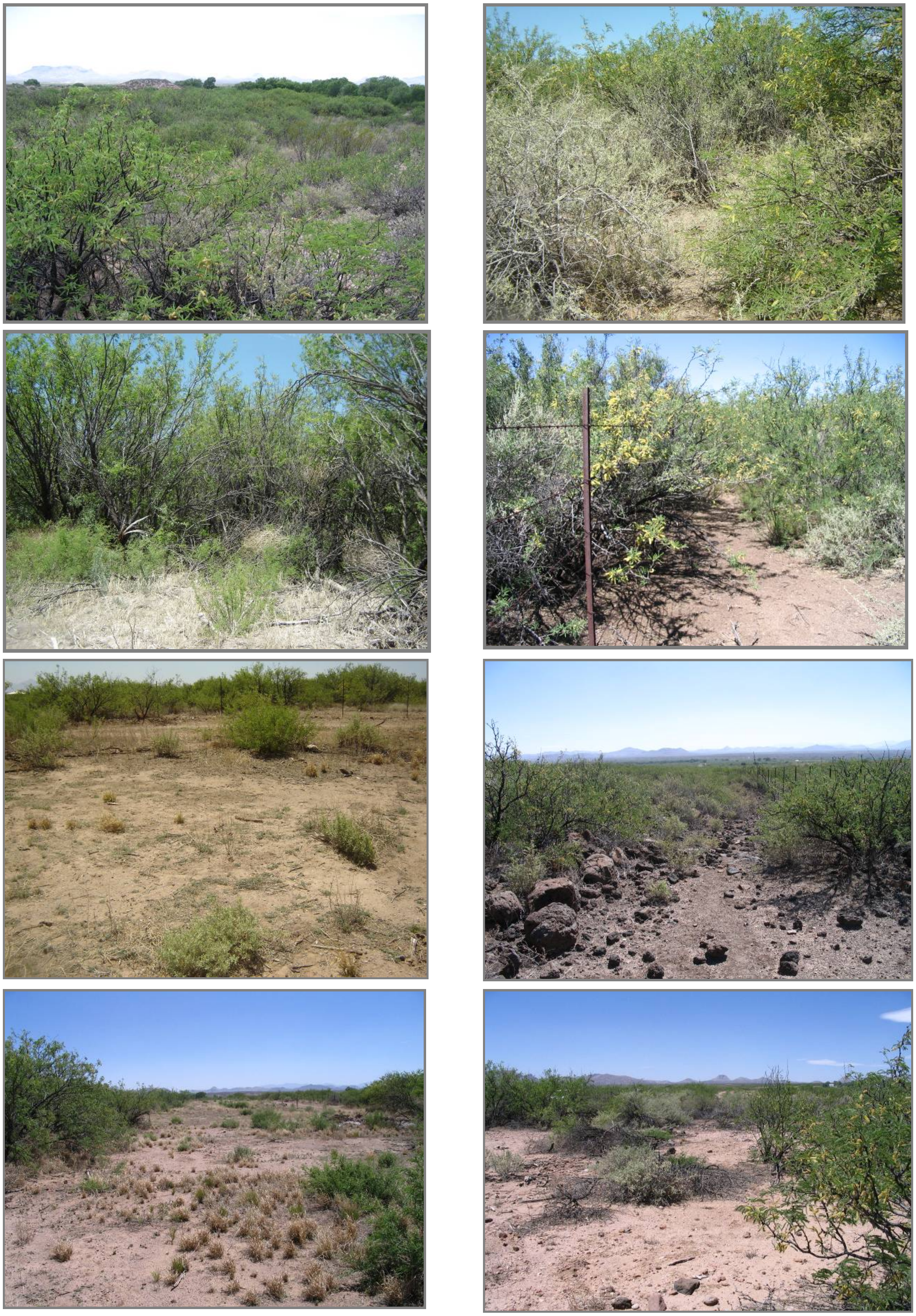


Figure 4-17. Representative Photographs of Honey Mesquite – Four-wing Saltbush Alkaline Flat, Volcanic Slope, and Bladed Habitat

Honey Mesquite – Alkali Sacaton Woodland and Shrubland

This type occurs in drainage bottoms that include upper Hay Hollow Wash, large desert washes, and broad swales of the eastern Project terminus and occupies 32.2 acres within the survey corridor (see **Figure 4-18**). Honey mesquite trees or tall shrubs to 5 m tall occurred on the wash and swale banks or elevated sediment bars and provided low to moderate cover (15 to 40 percent cover). The tall bunchgrass alkali sacaton provided low to moderate cover (5 to 25 percent cover) on the wash and swale bottoms. In the remaining shrub layer, sparse cover was contributed by netleaf hackberry, four-wing saltbush, desert broom, yerba de pasmo, burro bush, littleleaf sumac, tarbush, and little-head snakeweed. In the remaining herbaceous layer, sparse cover was contributed by scratchgrass and Dakota verbena. This type was similar to the Honey Mesquite / Four-wing Saltbush Shrubland; however, the cover by four-wing saltbush short shrubs was sparse, typically 1 percent or less in terms of foliar cover.

Figure 4-18. Representative Photographs of Honey Mesquite – Alkali Sacaton Creek and Wash Habitat

Honey Mesquite Sparse Understory Woodland and Shrubland

Stands of honey mesquite with little understory vegetation have become established on the terraces of Silver Creek, Hay Hollow Wash, and a relatively flat plain where they form moderately dense woodlands and tall shrublands (see **Figure 4-19**). Honey mesquite trees and tall shrubs range from 3 to 10 m in height, provided 40 to 85 percent cover, and occupied 20.7 acres of the survey corridor. The short shrub layer provides sparse cover and may include four-wing saltbush, creosotebush, and burro bush. The herbaceous layer provides sparse cover and includes tobosa, giant dropseed, six weeks fescue, Russian-thistle, and London rocket. One stand occurred near a windmill and exhibited signs of cattle foraging and resting under the tree canopies, likely on an annual basis.

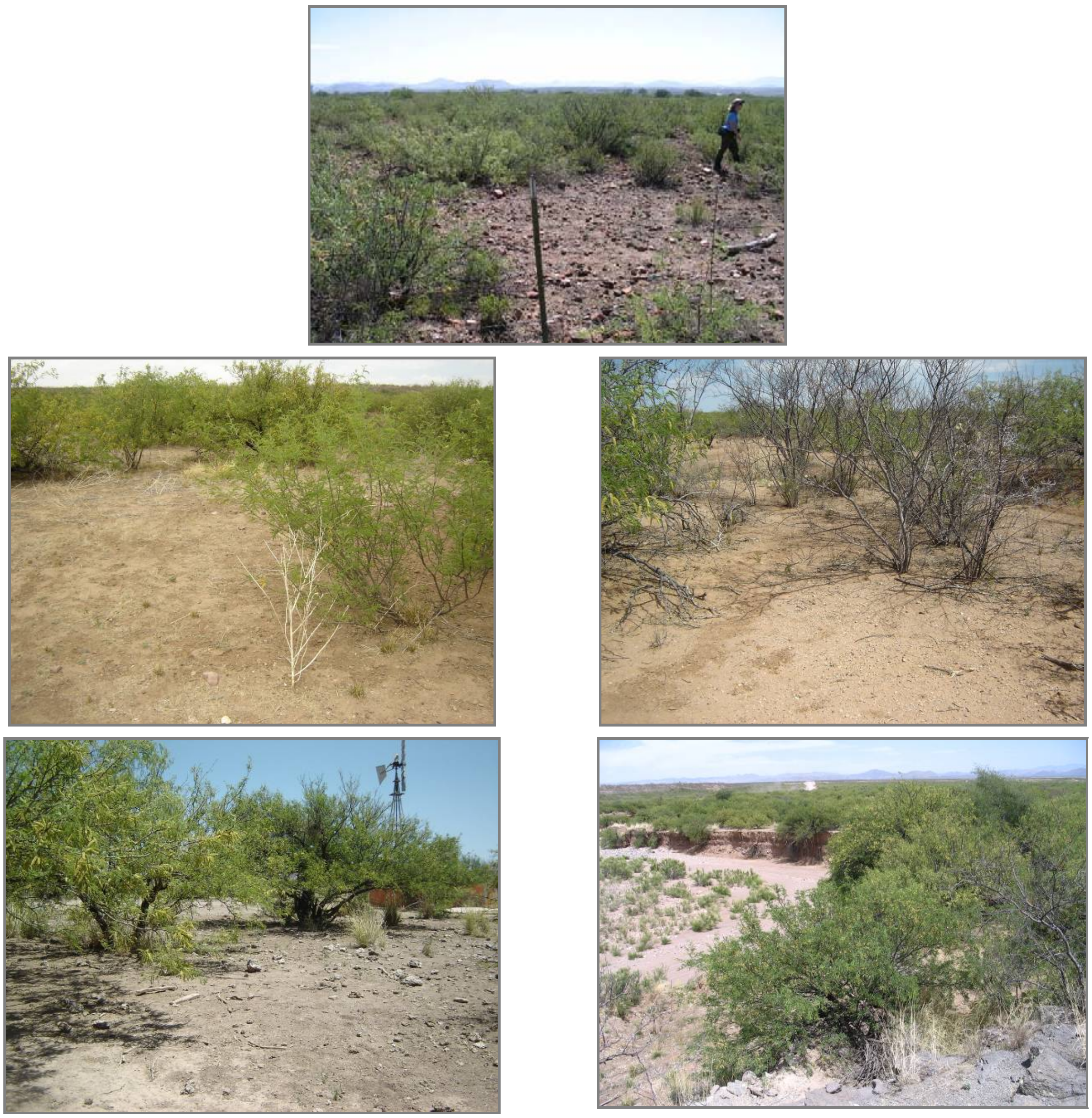


Figure 4-19. Representative Photographs of Honey Mesquite with Little Understory Cover Habitat

Honey Mesquite – Littleleaf Sumac Shrubland

Small desert washes, approximately 5 to 15 m wide, totaled 7.3 acres in the survey corridor and will be crossed by access roads (see **Figure 4-20**). The washes were coequally characterized by 2 to 5 m tall honey mesquite and littleleaf sumac tall shrubs that together provided 30 percent cover. Short shrubs occupied the understory and small openings on wash banks and were characterized by low cover of tarbush (10 percent cover) and four-wing saltbush (4 percent cover). The herbaceous layer contributed sparse cover and included giant dropseed and annual desert holly.

Figure 4-20. Representative Photograph of Honey Mesquite – Littleleaf Sumac Desert Wash Habitat

4.1.7 North American Warm Desert Wash Ecological System (CES302.755)

Seepwillow – Burro Bush Shrubland

This type occurs just outside the survey corridor on a meander terrace (oxbow bend) within Silver Creek and occasionally to rarely experiences overbank flooding following precipitation events. Silver Creek is very broad at this location, up to 100 m wide from bank to bank, has a sandy to gravelly channel that is mostly devoid of vegetation, and is incised up to 10 m deep (see **Figure 4-21**). The tall shrub yerba de pasmo (seepwillow) provides low cover (up to 10 percent cover) along with a few individual desert willow tall shrubs, which occupy a slightly elevated second terrace. The first terrace lay slightly above the channel and supported the short shrub burro bush which provided low cover up to 15 percent cover. Alkali sacaton, the medium-tall bunchgrass, provided sparse cover in the herbaceous layer.

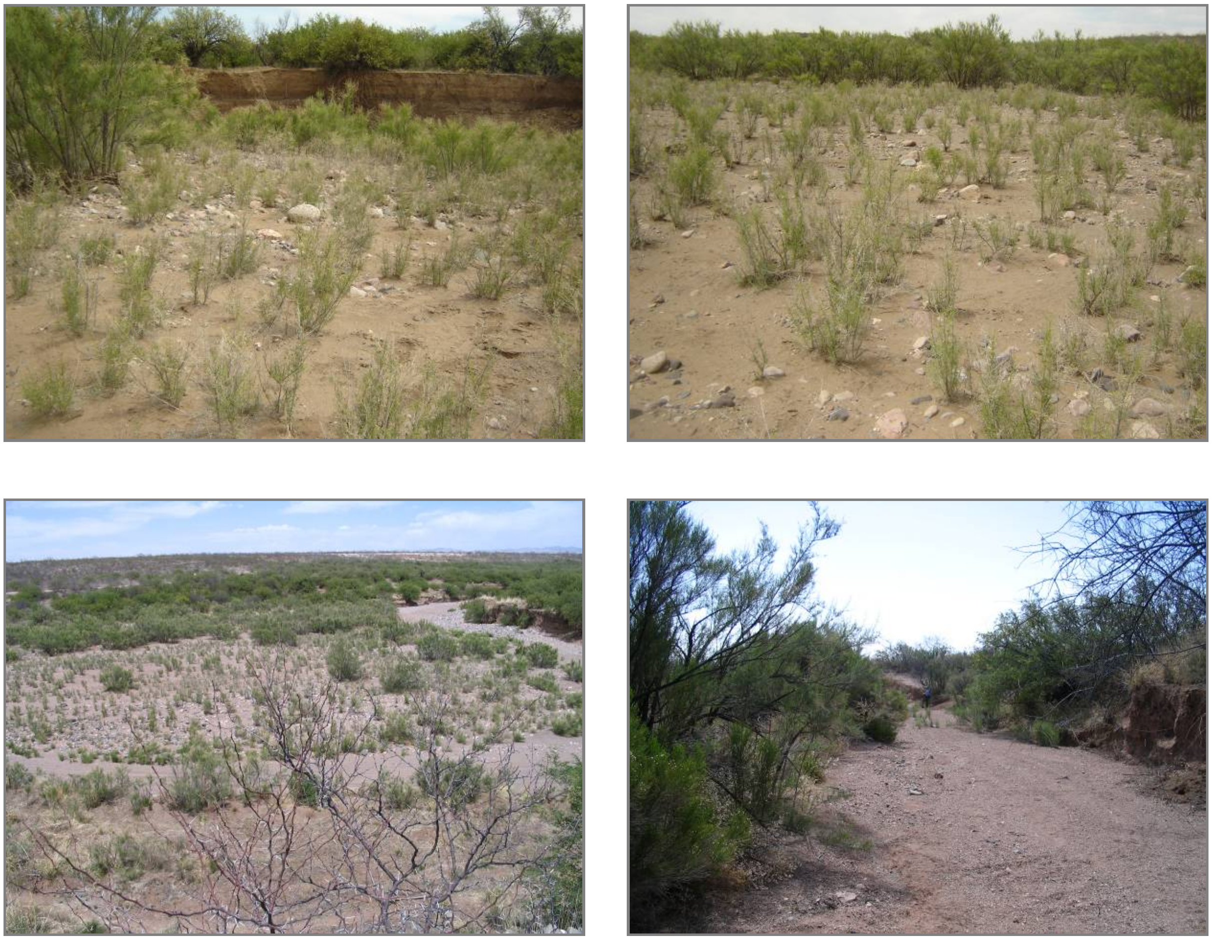


Figure 4-21. Representative Photographs of Seepwillow – Burro Bush Silver Creek Habitat

Alkali Sacaton Herbaceous Vegetation

A few larger desert washes and large swales (from 40 to 75 m wide) were characterized by 45 to 65 percent cover of alkali sacaton, a coarse bunchgrass that may be 1.5 m tall (see **Figure 4-22**). Additional grass and forb species occurred in sparse cover and included vine mesquite, Dakota verbena, and crimson sage. The tall and short shrub layer provided low to moderate cover (up to 15 percent cover) and included honey mesquite, littleleaf sumac, creosotebush, and four-wing saltbush. The shrub layer ranged from 1 to 4 m tall and contributed valuable wildlife habitat structure in the 6.9 acres examined in the survey corridor.

Figure 4-22. Representative Photographs of Alkali Sacaton Desert Wash Habitat

Wild Barley / Honey Mesquite Shrub Herbaceous Vegetation

A narrow drainage, up to 5 m wide, occurs on the western edge of SBNWR and carries flows across the international border into Mexico (see **Figure 4-23**). The drainage, which occupies 0.3 acre within the survey corridor, is cobble-lined, appears to be spring-fed, and has a high groundwater table. The drainage was characterized by low cover of the annual wild barley, which provided up to 15 percent cover in addition to sparse cover provided by the grasses foxtail barley, rescue grass, and rabbitfoot grass. The forbs common sunflower and yellow sweetclover provided sparse cover. Along the drainage banks, honey mesquite shrubs to 4 m tall and netleaf hackberry trees to 7 m tall contributed low cover (up to 10 percent cover) and provided structural value as wildlife habitat.

Figure 4-23. Representative Photographs of Wild Barley/ Honey Mesquite Small Drainage Habitat

4.1.8 Apacherian-Chihuahuan Semi-Desert Grassland and Steppe Ecological System (CES302.735)

Hook Threeawn Herbaceous Vegetation

A moderately large stand of hook threeawn, providing approximately 15 percent cover, has become established on clay soils deposited in the vicinity of a livestock corral (see **Figure 4-24**). Sparse shrub cover (up to 2 percent cover) of creostebush also occurs in this otherwise monotypic stand which occupies 1.8 acres within the survey corridor.

Figure 4-24. Representative Photographs of Hook Threeawn Flats Habitat

Desert Marigold Herbaceous Vegetation

An area that had been graded and cleared of creosotebush and mariola shrubs currently supported short-stature desert marigold forbs that provided low cover, (up to 8 percent cover) (see **Figure 4-25**). The disturbance covered 0.9 acre of the survey corridor and was maintained by ground squirrel and kangaroo rat burrowing and foraging activity, which was extensive across the site. The low-growing fluffgrass provided sparse grass cover, as did the dwarf-shrub little-head snakeweed.

Figure 4-25. Representative Photographs of Desert Marigold Flats Habitat

4.1.9 North American Warm Desert Cienega Ecological System (CES302.747)

Slimleaf Bursage – Common Sunflower Herbaceous Vegetation

A large old field, formerly an extensive cienega drained historically to support farming, occurs adjacent to the international border in SBNWR near the western bank of Black Draw (see **Figure 4-26**). It holds water following large precipitation events and the old field/former cienega bottom is well-vegetated with forbs and grasses. The forbs slimleaf bursage, common sunflower, and prostrate saltbush provide moderate cover (up to 30 percent cover) within the 2.2 acres of the stand within the survey corridor. Common sunflower stalks from the previous year's growth attained heights to 3 m tall. Grasses provide low to moderate cover and include inland saltgrass, giant dropseed, and the nonnative Bermuda grass. The dwarf-shrub seep weed provides sparse cover. A post-and-rail vehicle barrier was constructed across the southern edge of the cienega and is illustrated in **Figure 4-26**.

According to the USFWS (2008), the San Bernardino Valley once supported permanently flowing creeks, springs, and marshy wetlands composing this cienega. Giant sacaton grasslands occupied portions of the valley and were described as a luxuriant meadow some 8 or 10 miles wide. The dependable water sources and herbaceous vegetation cover made the area invaluable to fish and wildlife and to humans.

Figure 4-26. Representative Photographs of Slimleaf Bursage – Common Sunflower Cienega Habitat and Existing Vehicle Barrier

4.1.10 North American Warm Desert Playa Ecological System (CES302.751)

Russian-thistle Semi-natural Herbaceous Vegetation

A depression or playa that was nearly devoid of vegetation occurred within SBNWR and formed across the border into Mexico. This depression apparently fills and ponds with water following large precipitation events. At the time of site visit (April 2008), sparse cover (less than 5 percent cover) of the annual forb Russian-thistle or tumbleweed and the perennial forb narrowleaf globemallow was emerging on the 2.8 acres examined in the survey corridor (see **Figure 4-27**). Dead stems from the previous year's growth indicated that low to moderate cover (up to 15 to 20 percent cover) by Russian-thistle could occur on this site. A single honey mesquite shrub provided sparse cover within this depression. The soils of this site are highly erosive with a texture of fine clay and silt and are apparently quite alkaline; water and wind erosion of these soils during construction could occur and could affect adjacent drainages with fine sediments. Equipment would have difficult access across this area when the soils are saturated and would damage the playa bottom with tire ruts.

Figure 4-27. Representative Photographs of Russian-thistle Playa Habitat

Common Cocklebur Semi-natural Herbaceous Vegetation

An abandoned excavation occurs on 0.3 acre across an access road and ponds water on both sides of the road when sufficient runoff is collected (see **Figure 4-28**). The annual forb common cocklebur had become established and provided moderate cover (35 percent) across the excavation bottom. Associated mesic grasses included Johnsongrass and scratchgrass that provided low cover (5 percent cover) along the excavation margin. The dwarf-shrub little-head snakeweed occurred on the excavation margin above the level of inundation and contributed sparse cover. This site could have difficult access when ponded water is present following precipitation events.

Figure 4-28. Representative Photographs of Common Cocklebur Excavation Habitat

4.1.11 Other Nonnative Herbaceous Vegetation Alliances and Associations

Bermuda Grass Semi-natural Herbaceous Vegetation

A small irrigated pasture characterized by the nonnative Bermuda grass was maintained at the Slaughter Ranch, located adjacent to the SBNWR and the international border (see **Figure 4-29**). The pasture occupied 0.3 acre in the survey corridor, provided 40 to 80 percent cover of Bermuda grass, and supported annual forbs along its edges and in bare patches. The annual forbs provided sparse cover and included Russian-thistle or tumbleweed, horsenettle, whitetop, and London rocket. A sprinkler irrigation system was installed that used rotating Rain-Bird style heads for water distribution.

Figure 4-29. Representative Photographs of Bermuda Grass Irrigated Pasture Habitat

4.2 Plant Species Identified

A list of plant species prepared during the field surveys and annotated for nonnative and Arizona protected status is provided in **Table 4-2**. An early spring survey identified 125 taxa.

Table 4-2. Plant Species List, Relative Abundance in the Survey Corridor, and Habitat for Douglas Station, FV-1b

Species / Common Name	Distribution	Location / Habitat
Trees and Tall Shrubs		
Baccharis pteronoides / Yerba de Pasmo	Rare	Silver Creek
Baccharis sarothroides / Desert broom	Uncommon	Desert washes, roadsides
Celtis reticulata / Netleaf hackberry	Rare	Desert washes, springs
Chilopsis linearis / Desert willow[4]	Rare	Silver Creek
Fouquieria splendens / Ocotillo[3]	Common	Rocky slopes, alluvial plains
Fraxinus velutina / Green ash	Rare	Guadalupe Canyon
Juniperus monosperma / One-seed juniper	Rare	Limestone outcrops, Guadalupe Canyon
Populus fremontii / Fremont cottonwood	Rare	Black Draw, Hay Hollow Wash, springs
Prosopis glandulosa / Honey mesquite[4,5]	Abundant	Rocky slopes, alluvial plains, desert washes, swales, cienegas, playas
Salix gooddingii / Goodding willow	Rare	Black Draw
Short and Dwarf Shrubs		
Acacia constricta / Whitethorn	Abundant	Most upland habitats
Acacia millefolia / Acacia	Uncommon	Rocky slopes
Agave palmeri / Century plant[3]	Uncommon	Rocky slopes
Agave parryi / Parry agave[3]	Uncommon	Rocky slopes
Agave sp. / Agave[3]	Rare	Limestone bedrock
Anisacanthus thurberi = Justicia californica / Chuparosa	Uncommon	Desert washes
Atriplex canescens / Fourwing saltbush	Common	Rocky slopes, alluvial fans, desert washes
Bebbia juncea / Rush bebbia	Rare	Desert washes
Brickellia californica / Brickelbush, Pachaba	Rare	Rocky slopes, Desert washes
Bumelia lanuginosa / Buckthorn	Rare	Rocky slopes
Clematis drummondii / Texas virgin's bower	Rare	Desert wash
Condalia spathulata / Squawbush	Uncommon	Rocky slopes, alluvial fans
Dalea formosa / Feather peabush	Uncommon	Rocky slopes
Dasylirion wheeleri / Sotol[3]	Uncommon	Rocky slopes, limestone bedrock

Species / Common Name	Distribution	Location / Habitat
Short and Dwarf Shrubs (continued)		
Dyssodia acerosa / Spiny dogweed, Prickly fetid marigold	Uncommon	Rocky slopes
Echinocereus engelmannii / Strawberry hedgehog[3]	Rare	Rocky slopes
Echinocereus pectinatus / Rainbow cactus[3]	Rare	Rocky slopes, alluvial fans
Encelia farinosa / Brittlebush	Rare	Rocky slopes
Ephedra trifurca / Long-leaved jointfir, Mormon-tea	Rare	Rocky slopes
Flourensia cernua / Tarbush	Abundant	Rocky slopes, alluvial fans, plains, desert washes
Gutierrezia microcephala / Little-head snakeweed	Common	Rocky slopes, alluvial fans, plains, desert washes
Hymenoclea monogyra / Burro bush	Uncommon	Creek bed
Hymenoclea salsola / Cheesebush	Uncommon	Desert washes
Koeberlinia spinosa / Junco, Allthorn	Rare	Limestone outcrops
Larrea tridentata / Creosotebush	Abundant	Most upland habitats
Mammillaria sp. / Fishhook cactus[3]	Rare	Rocky slopes, alluvial fans
Menodora scabra / Rough menodora	Uncommon	Limestone outcrops
Mimosa biuncifera / Wait-a-minute	Uncommon	Rocky slopes
Mortonia scabrella / Mortonia	Uncommon	Limestone outcrops and colluvium
Opuntia leptocaulis / Desert Christmas cactus[3]	Uncommon	Rocky slopes
Opuntia phaeacantha / Engelmann prickly pear[3]	Common	Rocky slopes, alluvial fans
Opuntia ramosissima / Diamond cholla[3]	Uncommon	Rocky slopes
Opuntia spinosior / Cane cholla[3]	Uncommon	Rocky slopes
Opuntia violacea / Purple prickly pear[3]	Uncommon	Rocky slopes
Parthenium incanum / Mariola	Abundant	Most upland habitats
Peniocereus greggii / Deerhorn cactus[3]	Rare	Volcanic cobble slope
Platanus wrightii / Arizona sycamore	Rare	Guadalupe Canyon bottom
Quercus sp. / Oak	Rare	Limestone outcrop
Rhus microphylla / Littleleaf sumac	Uncommon	Desert washes, swales, creeks, draws
Suaeda torreyana / Seepweed	Rare	Cienega

Species / Common Name	Distribution	Location / Habitat
Short and Dwarf Shrubs (continued)		
Tiquilia canescens = Coldenia canescens / Dog's ear	Abundant	Most upland habitats
Yucca elata / Soaptree yucca[3]	Uncommon	Sandy plains
Yucca schottii / Yucca[3]	Uncommon	Rocky slopes, alluvial fans
Ziziphus obtusifolia = Condalia lycioides / Graythorn	Uncommon	Rocky slopes
Graminoids		
Aristida adscensionis / Annual threeawn	Uncommon	Alluvial fans, plains, disturbed sites
Aristida purpurea / Purple threeawn	Uncommon	Rocky slopes
Aristida hamulosa / Hook threeawn	Common	Rocky slopes, alluvial fans, plains
Bouteloua eriopoda / Black grama	Uncommon	Rocky slopes
Bromus wildenowii = Bromus catharticus / Rescue grass	Rare	Spring-fed drainage
Carex sp. / Sedge	Rare	Spring-fed drainage
Chloris virgata / Windmill grass[1]	Rare	Spring-fed drainage
Cynodon dactylon / Bermudagrass[1]	Rare	Irrigated pasture
Distichlis spicata / Saltgrass	Rare	Cienega
Erioneuron pulchellum = Tridens pulchellus / Fluffgrass	Abundant	Most upland habitats
Hilaria mutica / Tobosa	Common	Most upland habitats
Hordeum jubatum / Foxtail barley[1]	Rare	Spring-fed drainage
Hordeum leporinum / Wild barley[1]	Rare	Spring-fed drainage
Juncus balticus / Baltic rush	Rare	Spring-fed drainage
Leptochloa dubia / Sprangletop	Uncommon	Rocky slopes
Muhlenbergia asperifolia / Scratchgrass	Rare	Excavated site
Muhlenbergia porteri / Bush muhly	Uncommon	Rocky slopes
Polypogon monspeliensis / Rabbitsfoot grass[1]	Rare	Spring-fed drainage
Schismus barbatus / Mediterranean grass[1]	Uncommon	Alluvial fans, plains
Scirpus americanus = Schoenoplectus pungens / Three-square bulrush	Rare	Black Draw, spring-fed sites, ponds

Species / Common Name	Distribution	Location / Habitat
Graminoids (continued)		
Schizachyrium scoparium / Little bluestem	Rare	rock outcrops
Sorghum halepense / Johnsongrass[1]	Rare	Spring-fed drainage
Sporobolus airoides / Alkali sacaton	Common	Desert washes, swales
Sporobolus cryptandrus / Sand dropseed	Uncommon	Desert washes, sandy areas
Sporobolus giganteus / Giant dropseed	Common	Desert washes
Typha domingensis / Southern cattail	Rare	Black draw, springs, ponds
Forbs		
Acourtia nana = *Perezia nana* / Dwarf desert holly	Common	Most upland habitats
Allionia incarnata / Trailing windmills	Uncommon	Rocky slopes, desert washes
Amaranthus palmeri / Palmer's amaranth[1]	Rare	Cienega
Ambrosia confertiflora = *Franseria confertiflora* / Slimleaf bursage	Rare	Cienega
Argemone sp. / Prickly poppy	Rare	Guadalupe Canyon
Astragalus sp. / Milkvetch	Rare	Desert wash
Atriplex sp. / Prostrate saltbush	Rare	Cienega, playa, irrigated pasture
Baileyia multiradiata / Desert marigold	Uncommon	Alluvial fans, plains, bladed site
Cardaria sp. / Whitetop[1]	Uncommon	Irrigated pasture
Centaurea melitensis / Malta starthistle	Rare	Spring-fed drainage
Chenopodium fremontii / Fremont goosefoot	Rare	Cienega, Irrigated pasture
Cryptantha sp. / Cryptantha	Common	Most upland habitats
Cucurbita foetidissima / Buffalo gourd	Rare	Desert wash
Cymopterus multinervatus / Purple cymopterus	Rare	Rocky slopes
Datura meteloides / Sacred datura	Rare	Desert washes
Descurainia pinnata / Tansy mustard[1]	Rare	Irrigated pasture, disturbed roadside
Eriastrum diffusum / Miniature wool-star	Uncommon	Rocky slopes, alluvial fans
Erodium cicutarium / Filaree[1]	Rare	Irrigated pasture

Species / Common Name	Distribution	Location / Habitat
Forbs (continued)		
Euphorbia albomarginata / Rattlesnake weed	Rare	Spring-fed drainage
Haplopappus spinosus / Golden aster	Uncommon	Rocky slopes
Helianthus annuus / Common sunflower	Uncommon	Cienega, playa, spring-fed drainage
Lappula redowskii / Stickweed	Uncommon	Rocky slopes, cienega, disturbed roadsides
Lepidium thurberi / Thurber's peppergrass	Rare	Plains
Medicago lupulina / Black medic[1]	Rare	Spring-fed drainage
Melilotus officianalis / Yellow sweetclover[1]	Rare	Spring-fed drainage
Mentzelia albicaulis / White stem stickleaf	Uncommon	Rocky slopes, desert washes
Mentzelia pumila / Stickleaf	Uncommon	Rocky slopes
Notholaena sp. / Cloak fern	Rare	Limestone bedrock
Pectis fillipes / Threadstem cinchweed	Rare	Rocky slopes
Penstemon superbus / Superb penstemon	Rare	Desert washes
Penstemon sp. / Beardtongue	Rare	Limestone bedrock
Phacelia coerulea / Blue scorpionweed	Uncommon	Desert washes
Phoradendron californicum / Mistletoe	Uncommon	Honey mesquite trees and shrubs, many habitats
Phoradendron flavescens / Mistletoe	Rare	Arizona sycamore trees, desert washes
Plantago patagonica / Plantain	Common	Rocky slopes, alluvial fans, plains
Proboscidea parviflora / Devil's claw	Rare	Alluvial plains, desert washes
Rumex hymenosepalus / Canaigre	Rare	Cienega
Salsola iberica / Russian-thistle[1]	Rare	Playa, disturbed roadsides
Salvia henryi / Crimson sage	Uncommon	Desert washes
Selaginella sp. / Club moss	Rare	Limestone bedrock
Silene antirrhinum / Sleepy catchfly[1]	Uncommon	Most upland habitats
Sisymbrium irio / London rocket[1]	Rare	Irrigated pasture, disturbed roadsides
Forbs (continued)		

Species / Common Name	Distribution	Location / Habitat
Solanum eleagnifolium / Horse nettle[1]	Rare	Desert washes, irrigated pasture, cienega
Sphaeralcea angustifolia / Narrowleaf globemallow	Uncommon	Rocky slopes
Sphaeralcea laxa / Caliche globemallow	Rare	Playa
Verbena gooddingii / Goodding (Dakota) verbena	Uncommon	Desert washes
Verbesina encelioides / Cowpen daisy	Rare	Irrigated pasture
Xanthium strumarium / Common cocklebur[1]	Rare	Excavated depression

Notes:
[1] Nonnative species (noxious weeds were not identified within the corridor).
[2] Highly Safeguarded Protected Native Plants (this category was not identified within the corridor): species of native plants whose prospects for survival in Arizona are in jeopardy or are in danger of extinction).
[3] Salvage Restricted Protected Native Plants (species of native plants that are subject to damage by theft or vandalism).
[4] Salvage Assessed Protected Native Plants (species of native plants that have a sufficient value if salvaged to support the cost of salvage).
[5] Harvest Restricted Protected Native Plants (species of native plants that are subject to excessive harvesting or overcutting because of their intrinsic value).

4.3 Survey Corridor Characteristics and Description of Habitat Quality

To ensure the most recent data were acquired for rare species analyses, e²M requested Element Occurrence Data from NatureServe Central Databases in Arlington, Virginia, through a referral from the USFWS (NatureServe and e²M 2007a). Additionally, rare species data were acquired from AZGFD and USFWS at Project inception. General descriptions of the habitat quality as it relates to rare plant species and the landscape characteristics of the survey cooridor are provided herein and are based on field observations, personal communications, and the literature.

SECTION FV-1b

County: Cochise
Potential Listed
Plant Occurrence: *Spiranthes delitescens* (Canelo Hills or Madrean ladies'-tresses) (Federal [FE], state [HS])
Coryphantha robbinsorum (Cochise pincushion cactus) (Federal [FE], state [HS])
Lilaeopsis schaffneriana ssp. *recurva* (Huachuca water umbel) (Federal [FE], state [HS])

Erigeron lemmonii (Lemmon fleabane) (Federal [FC], state [HS])

Listed Plants Observed: None

Suitable Listed Plant Habitat Present: Possible habitat (perennial low gradient streams and wetlands) for the Huachuca water umbel occurs adjacent to Black Draw.

If so, Habitat Quality: Fair to Good

Section Habitat Description: This section includes approximately 16 miles of vehicle barrier corridor and 5.25 miles of access roads in the area east of Douglas and south of Geronimo Trail Road. The western portion of section FV-1b occurs on steep slopes dominated by ocotillo, transitioning to alluvial fans and plains characterized by creosotebush, mariola, tarbush, and honey mesquite shrubs. A few slopes are armored by volcanic gravel and cobble where patches of tobosa occur amid shrublands dominated by honey mesquite and/or creosotebush. Gullies and desert washes commonly occur in this terrain. Within SBNWR, lowland habitats including irrigated pasture, go-back fields, and extensive stands of honey mesquite with four-wing saltbush in the understory, and riparian forests and woodlands occur. Particularly good riparian forest habitats occupy Black Draw and Hay Hollow Wash, and thick honey mesquite woodlands occur along Silver Creek. The easternmost portion of the FV-1b survey cooridor consists of ridges and drainages supporting creosotebush and mariola shrublands, honey-mesquite-dominated lower slopes and drainage bottoms, and stands of alkali sacaton in narrow drainages. The road providing access between Geronimo Trail Road and the vicinity of Border Monument 74 crosses exposed Permian limestone, and the shrubland is dominated by mortonia, tarbush, and mariola. This access road traverses the only small trees of one-seed juniper and shrubs of oak and junco observed in the survey corridor.

- Madrean ladies'-tresses occur in the San Pedro watershed in cienegas with finely grained, highly organic, saturated soils. This habitat does not occur within the survey corridor.

Cochise pincushion cactus occurs on gray (Permian) limestone hills that support semi-desert grassland with small shrubs, agave, cacti, and grama grass. It does not co-occur with mortonia shrubs on lower slopes (USFWS 1993). Permian limestone outcrops exposed along an paccess road on the eastern end of FV-1b survey corridor were searched for Cochise pincushion cactus, but none were observed and mortonia was a dominant shrub. There are no limestone outcrops within the Project area. The hill or small mountain upon which border monument 74 is placed does have appropriate Permian limestone habitat and does support a semi-desert grassland community on its upper one-fourth; however, there will be no construction and hence no impact to this potential habitat for the Cochise pincushion cactus.

Huachuca water umbel occurs in cienegas, perennial low gradient streams, and wetlands. Black Draw and one nearby spring within SBNWR provide this habitat and represent potential sites for Huachuca water umbel establishment.

Lemmon fleabane occurs in pine-oak woodlands in rock crevices, on ledges, and among boulders in canyon bottoms. This habitat does not occur within the survey corridor.

4.4 Wetlands and Waters of the United States

Wetlands and waters of the United States can be confusing terms and are defined here for the convenience of document users. The USACE has jurisdiction to protect wetlands under section 404 of the Clean Water Act using the following definition:

> *. . . areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (33 Code of Federal Regulations [CFR] 328.3[b]). Wetlands generally include swamps, marshes, bogs, and similar areas.*

Wetlands have three diagnostic characteristics that include (1) more than 50 percent of the dominant species present must be classified as obligate, facultative wetland; or facultative, (2) the soils must be classified as hydric; and (3) the area is either permanently or seasonally inundated (Environmental Laboratory 1987).

Waters of the United States are defined under 33 *United States Code* (U.S.C.) 1344, as follows:

a. The term "waters of the United States" means
   1. All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
   2. All interstate waters including interstate wetlands;
   3. All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters:
      i. Which are or could be used by interstate or foreign travelers for recreational or other purposes; or
      ii. From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or

    iii. Which are used or could be used for industrial purpose by industries in interstate commerce;

4. All impoundments of waters otherwise defined as waters of the United States under the definition;
5. Tributaries of waters identified in paragraphs (a) (1)-(4) of this section;
6. The territorial seas;
7. Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (a) (1)-(6) of this section.
8. Waters of the United States do not include prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other federal agency, for the purposes of the Clean Water Act (CWA), the final authority regarding CWA jurisdiction remains with the EPA.
9. Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of the CWA (other than cooling ponds as defined in 40 CFR 123.11(m) which also meet the criteria of this definition) are not waters of the United States.

b. The term "wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

c. The term "adjacent" means bordering, contiguous, or neighboring. Wetlands separated from other waters of the United States by man-made dikes or barriers, natural river berms, beach dunes and the like are "adjacent wetlands."

d. The term "high tide line" means the line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

e. The term "ordinary high water mark" means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

The term "tidal waters" means those waters that rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by hydrologic, wind, or other effects.

The survey corridor lies within the San Bernardino Valley Watershed (15080302), which includes approximately 250,000 acres (USEPA 2008; NRCS 2008). The watershed occurs in the Whitewater Draw Natural Resources Conservation District and is served by the Douglas Natural Resources Conservation Service Field Office (NRCS 2008). The San Bernardino Valley Watershed and artesian aquifer cover approximately 900 square miles with approximately 420 square miles occurring in the United States and 580 square miles occurring in Mexico.

Generally, the San Bernardino Valley is an asymmetric extensional basin that experienced extensive mafic volcanism in the Cenozoic Period (Earman et al. 2002). On a large scale, it lies within the Rio Yaqui Watershed (USFWS 1994a). In Arizona, the basin's major fault lies on the western side of the basin, and in Sonora, the Pitaycachi Fault occurs on the eastern side of the basin (Earman et al. 2002). In Arizona, the bedrock forms a half graben down-dropped on the western side by antithetic normal faults with structural highs formed by transfer faults. The heterogenous basin fill, which contains numerous basalt interbeds, was deposited predominantly in alluvial fan and alluvial slope environments. Generally, the basin structure does not have a large effect on groundwater flow as most water is transmitted through paleochannel deposits that make up a relatively small portion of the aquifer.

Arizona water rights on the SBNWR date from 1882 for unlitigated surface water rights and from 1903 for groundwater permits (USFWS 1995). Surface water rights include (1) Headquarters Spring (100 acre-feet per year); (2) Headquarters Domestic (19 gallons per minute); (3) Barn Spring (15 gallons per minute); (4) Bathtub Spring (9.5 gallons per minute); (5) Cattail/Fig Spring (49 gallons per minute); and (6) Mesa Seep Spring (3.8 gallons per minute). There are ten permitted groundwater wells on the refuge that each are adjudicated for 250 acre-feet of water production annually.

4.4.1 Field Evaluation Summary

Observations and initial identification of potential wetlands and waters of the United States for the survey corridor were recorded during the April/May 2008 field inventory.

Field surveys were conducted on June 10 through 13, 2008, to delineate jurisdictional wetlands and other Waters of the United States within the survey corridor. Delineations were also conducted along access roads and staging areas associated with the fence alignments. Formal delineations were conducted within a 150-foot corridor associated with the fence alignments, 60 feet to either side of the center line of access roads, and within staging areas.

Determination of the occurrence and extent of jurisdictional wetlands and other Waters of the United States were based on the application of procedures established in the USACE *Wetlands Delineation Manual*, Technical Report Y–87–1 (USACE 1987) and the *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region,* Technical Report ERDC/EL TR-06-16 (USACE 2006). Determination of the occurrence of jurisdictional wetlands was based on the presence or absence of hydrophytic (wetland) vegetation, hydric (wetland) soils, and wetland hydrology. The presence of all three of the criteria is necessary for an area to be designated as a jurisdictional wetland under normal conditions.

Determination of the extent of jurisdictional washes and other Waters of the United States in the survey corridor was based on characterization of the landward extent of the ordinary high water mark (OHM). Indicators used to determine the occurrence and extent of jurisdictional washes included the presence of developed channels, typically 2 feet or greater in width; the occurrence of an OHM; the absence of fine sediments along flow paths; distinct changes in the vegetative assemblage or larger or more dense vegetation than surrounding areas; the presence of cut banks; the presence of litter, debris, or wrack lines; occurrence of desiccation cracks or other indicators of hydrology; and other indicators of the occurrence of intermittent water flow regimes.

All wetlands and other Waters of the United States within the survey corridor were delineated.

Table 4-3 provides wetland and other Waters of the United States types and delineated acreages within a 150-foot corridor associated with the fence alignments, 60 feet to either side of the center line of access roads, or within planned staging areas; and potential impact acreages in Section FV-1b. A 60-foot impact corridor to the north of the fence alignment or adjacent to access roads is considered the maximum width of potential impact associated with implementing the Project. All wetland or other Waters of the United States acreages within staging areas are included as potential impact areas. The following text provides general descriptions of wetlands and other Waters of the United States identified within the Project assessment areas in Section FV-1b.

Table 4-3. Delineated Acreages, General Locations and Potential Impact Acreage of Wetlands and Other Waters of the United States in Douglas, AZ Section FV-1b

WL ID	Wetland or Other WOUS Type	General Location	Delineated Area (acres)	Potential Impacts (acres)
W1N	Wash	Near west end of FV-1b	5.14	1.75
W1S	Wash	Near west end of FV-1b		
W2	Wash	First access road east of the west end of FV-1b	0.27	0.07
W3	Wash	First access road east of the west end of FV-1b	0.18	0.07
W4	Wash	First access road east of the west end of FV-1b	0.28	0.09
W5	Wash	Second access road east of the west end of FV-1b	0.26	0.07
W6	Wash	Second access road east of the west end of FV-1b	0.98	0.31
W7	Wash	Approximately 1,900 feet east of W6 at the border	0.43	0.20
W8	Wash	Tributary draining to the east along the border and into the west side of Silver Creek at the border	4.88	1.66
W9	Wash	Tributary to W8	0.17	0.08
W10	Wash	Tributary to W8	0.29	0.17
W11	Wash	Tributary to W8	0.46	0.15
W12	Wash	Tributary to W8	0.25	0.01
W13	Wash	Silver Creek	6.07	0.42
W14	Wash	South of Slaughter Ranch in the SBNWR	0.55	0.29
W15	Emergent wetland	On the border in the SBNWR	0.11	0.01
W16	Riverine and palustrine forested wetland	Black Wash in the SBNWR	1.74	0.35
W17	Wash	Hay Hollow in the SBNWR	1.92	1.31

WL ID	Wetland or Other WOUS Type	General Location	Delineated Area (acres)	Potential Impacts (acres)
W18	Wash	Approximately 0.42 mile west of the eastern SBNWR boundary on the border	1.33	0.36
W19	Wash	Approximately 0.45 mile east of the western boundary of the SBNWR on the border	1.07	0.25
W20	Wash	Approximately 0.7 mile east of W19 on the border	0.27	0.11
W21	Wash	Approximately 0.2 mile east of W20 on the border	0.44	0.15
W22	Wash	Approximately 0.4 mile east of W21 on the border	0.61	0.18
W23	Wash	Approximately 0.25 mile east of W22 on the border	0.30	0.15
W24	Wash	Approximately 0.18 mile east of W23 on the border	0.21	0.12
W25	Wash	Approximately 0.41 mile east of W24 on the border	0.46	0.09
W26	Wash	Approximately 0.18 mile east of W25 on the border	0.49	0.12
W27	Wash	Approximately 0.36 mile east of W26 on the border	3.68	2.54
W28	Wash	Approximately 0.15 mile east of W27 on the border	0.26	0.10
W29	Wash	Approximately 0.23 mile east of W28 on the border	0.45	0.22
W30	Wash	Approximately 0.24 mile east of W29 on the border	0.38	0.05
W31	Wash	Approximately 0.27 mile east of W30 on the border	0.32	0.16
W32	Wash	Approximately 0.22 mile east of W31 on the border	0.17	0.03
W33	Wash	Approximately 600 feet east of W32 on the border	0.19	0.08
W34	Wash	Approximately 800 feet east of W33 on the border	0.14	0.07
W35	Wash	Approximately 0.48 mile east of W34 on the border	0.50	0.10

WL ID	Wetland or Other WOUS Type	General Location	Delineated Area (acres)	Potential Impacts (acres)
W36	Wash	Approximately 0.49 mile east of W34 on the border	0.55	0.08
W37	Wash	Guadalupe Canyon	0.69	0.34
W38	Wash	Guadalupe Canyon	1.24	0.84
W39	Wash	Guadalupe Canyon	0.13	0.13
W40	Wash	Guadalupe Canyon	0.15	0.04
Totals			**38.01**	**13.32**

Based on the field surveys, 37 ephemeral wash channels and 2 vegetated wetlands occur within the 150-foot corridor associated with the fence alignments, 60 feet to either side of the center line of access roads, or within staging areas. Of the 37.87 total delineated acres of wetlands and other Waters of the United States, 13.28 acres occur within the potential impact areas. Wetlands and other Waters of the United States delineated in Section FV-1b were designated as W1 through W40.

W1 is characterized by two ephemeral wash channels (W1N and W1S) that flow to the east along the U.S./Mexico international border. W1N flows along the border and crosses it at several locations. W1S is located primarily in Mexico, but crosses the Project alignment at two locations. The two channels converge just to the north of the international border and then direct flows to the northeast and east in the United States. Channel width at base in the two channels ranges from 2 feet to 5 feet with near-vertical banks. Vegetation characterizing the banks of the two channels is characterized by creosotebush (*Larrea tridentate*), honey mesquite (*Prosopis glandulosa*) and littleleaf sumac (*Rhus microphylla*).

W2, W3, and W4 are ephemeral washes that cross the westernmost north/south access road on the FV-1b alignment. The access road is located approximately 0.5 mile to the east of the confluence of W1N and W1S. W3 is the downstream component of W1N and W1S. W2 and W3 join downstream of the access road and then join with W4 approximately 0.5 mile east of the access road. W2 and W3 have wide shallow channels at the access road crossing that range from 12 to 15 feet in width at their base. The banks range from approximately 1 to 2 feet in height with bank slopes ranging from 45 percent to near vertical. W4 has a narrow channel that ranges from 2 to 4 feet in width at base with approximately 2-foot-high banks and slopes ranging from 45 percent to near vertical. Vegetation characterizing the banks of the three wash channels includes littleleaf sumac, honey mesquite, desert broom (*Baccharis sarothroides*), whitethorn acacia (*Acacia constricta*), tar bush (*Flourensia cernua*), little-head snakeweed (*Gutierrezia microcephala*), and Engelmann prickly-pear (*Opuntia engelmannii*).

W5 and W6 are ephemeral washes that cross the existing access road located approximately 1.5 miles east of the access road associated with W2, W3, and W4. W5 is a narrow wash with an approximately 2-foot-wide channel at base and near-vertical 2-foot-high banks where it crosses the access road. The channel directs flows to the southeast. Vegetation on the wash banks is characterized by honey mesquite and Engelmann prickly-pear. W6 is a wide, incised ephemeral wash with an approximately 25- to 35-foot-wide channel at base. Where it crosses the access road, the channel is characterized by near vertical 6 to 8 foot high banks on its south side and 2 foot high banks with 45 percent slopes on the north side. The channel flows to the east along the border then turns south and crosses the fence alignment approximately 350 feet east of the access road. The wash continues to direct flows to the east in Mexico and eventually discharges into Silver Creek. Vegetation occurring on the wash banks in proximity to the access road and fence alignment is characterized by honey mesquite.

W7 is a narrow ephemeral wash that drains south across the fence alignment and into Mexico. The wash is characterized by a 4-foot-wide channel at base and near-vertical 3-foot banks. Vegetation of the banks of the wash is characterized by honey mesquite.

W8 is an ephemeral wash that drains from west to east along the U.S./Mexico international border for approximately 2.0 miles before discharging into Silver Creek just north of the border. The wash crosses the Project alignment four times along its course. Channel width at base ranges from approximately 15 feet at the confluence with Silver Creek to approximately 3 feet to 8 feet at the four upstream Project alignment crossings. Channel banks are near vertical and range from approximately 3 feet to 8 feet in height at Project alignment crossing. Vegetation on the banks of W8 is characterized by honey mesquite, littleleaf sumac, desert broom, and creosotebush.

W9, W10, W11, and W12 are tributary washes that drain into W8. W9 is a narrow ephemeral wash that directs flows north from Mexico, across the Project alignment, discharging into W8. W10 and W11 direct flows south from the United States across the Project alignment and into Mexico where they discharge into W8. W12 directs flows to the southeast and discharges into W8 in the United States, north of the Project alignment. Channel widths at base range from 3 feet to 5 feet in the survey corridor and the channel banks range from 1 to 3 feet in height with bank slopes ranging from 45 percent to near vertical. Vegetation characterizing the wash banks is characterized by white thorn acacia, littleleaf sumac, and creosotebush.

W13 is Silver Creek. Silver Creek is a large, wide, ephemeral wash with high, near-vertical banks on outside bends and well-developed alluvial bars on inside bends. The wash directs flows to the south into Mexico. The channel width at base ranges from approximately 400 feet just upstream of the border in association with river bends, to approximately 160 feet at the border. Bank heights on outside bends exceed 20 feet in places. Honey mesquite and desert broom characterize the vegetation of the wash banks and alluvial bar deposits.

W14 is an ephemeral wash that is the downstream segment of a wash that crosses through the Slaughter Ranch in the SBNWR. Most of the historical natural flow in the wash has probably been cut off as a result of an upstream impoundment constructed on the Slaughter Ranch. The wash within the Project alignment has been disturbed and is characterized an approximately 30-foot-wide channel at base, with 2-foot-high, non-distinct banks having 25 percent slopes. Vegetation on the banks of the wash is characterized by honey mesquite. Several species of grasses occur in the wash channel.

W15 is a palustrine emergent wetland located along the Project alignment in the SBNWR. The small emergent wetland is characterized by a near monotypic stand of three square (*Scirpus olneyi*). A few Goodding's willows (*Salix nigra* var. *goodingii*) and Freemont cottonwoods (*Populus fremontii*) occur on the perimeter of the wetland. A vehicle fence has been placed within the boundaries of the wetland by the USFWS.

W16 is a riverine and palustrine forested wetland associated with Black Draw in the SBNWR. Black Draw is a perennial stream that directs flows south into Mexico. Black Draw has a deeply incised central channel that is approximately 60 feet wide at base. The central channel was maintaining flow at the time of the site survey. Base flow in the channel is supported by upstream springs. The riverine component of Black Draw occurs in association with the central channel. Vegetation occurring in association with the riverine wetland is characterized by southern cattail (*Typha domingensis*) and three square. The channel is bordered by a low terrace. The width of the central channel and terrace is approximately 100 feet with near-vertical 10-foot banks bordering the terrace. The palustrine forested component of Black Draw occurs in association with the terrace. Vegetation occurring in association with the palustrine forested wetland includes Freemont cottonwood and Goodding's willows with some honey mesquite. Vegetation on the upper banks of Black Draw is characterized by honey mesquite. An impoundment has been constructed across the channel and terrace with gabions. The existing access road crosses the draw at the impoundment.

W17 is Hay Hollow. Hay Hollow in proximity to the Project alignment is characterized by a vegetated ephemeral wash with an approximately 75-foot channel width at base. Channel banks are approximately 8 feet in height and vertical. Freemont cottonwood and Goodding's willow occur in association with alluvial bars in the wash and some giant dropseed (*Sporobolus giganteus*) occurs along the base of the channel banks. Vegetation on the wash banks is characterized by honey mesquite. The wash channel and banks have been disturbed at the border as a result of border crossings.

W18 is a deeply incised ephemeral wash that directs flows to the southwest into Mexico. The channel width at base is approximately 7 feet. Channel banks are near vertical and are approximately 8 feet in height. Vegetation on the banks of the wash is characterized by white thorn acacia and creosotebush.

W19 is a disturbed ephemeral wash that historically directed flows to the south into Mexico. Flow to the wash has been cut off by an impoundment located approximately 300 feet upstream from the border. At the border, the channel base is approximately 20 feet wide. Channel banks have been disturbed and are approximately 3 feet high with 35percent slopes. Giant dropseed and little-head snakeweed occur in the wash channel and vegetation on the banks is characterized by Russian thistle (*Salsola kali*), four-wing saltbush (*Atriplex canescens*), and honey mesquite.

W20 and W21 are ephemeral washes that direct flows to the south into Mexico. The two washes join approximately 2 miles to the south in Mexico. W19 discharges into the main wash channel approximately 450 feet downstream of the confluence of W20 and W21. W20 has an incised channel that is approximately 5 feet wide at base with 5-foot-high banks in the survey corridor. The channel banks slope at approximately 60 percent. W21 has an approximately 20-foot-wide channel at base with 3-foot banks in the survey corridor. The channel banks have 35 percent slopes. Vegetation on the banks of both washes is characterized by honey mesquite, creosotebush, four-wing saltbush, and tar bush.

W23 is an ephemeral wash that directs flows to the north into the United States. The channel width at base is approximately 4 feet. Channel banks are approximately 4 feet high with 45 percent slopes at the border and become near vertical downstream in the United States. Evidence of active headwall cutting is present in places along the channel. Vegetation on the banks of the wash is characterized by honey mesquite and white thorn acacia.

W24 is an ephemeral wash that directs flows to the north into the United States. The channel width at base is approximately 8 feet. Channel banks are near vertical and approximately 5 feet in height. Vegetation on the banks of the wash is characterized by honey mesquite, four-wing saltbush, white thorn acacia, and little-head snakeweed.

W25 is an ephemeral wash that directs flows to the north into the United States. The channel width at base is approximately 2 feet. Channel banks are approximately 4 feet high with 55 percent slopes. The wash in the survey corridor is characterized by two channels with an alluvial island in the center. The channels join upstream and downstream of the Project alignment. Vegetation on the banks of the channels is characterized by honey mesquite, four-wing saltbush, and little-head snakeweed.

W26 is an ephemeral wash that directs flows south into Mexico. The channel width at base is approximately 4 feet. Channel banks are approximately 8 feet high with 45 percent slopes. Vegetation on the banks of the wash is characterized by honey mesquite and little-head snakeweed.

W27 is an ephemeral wash that directs flows to the east along the border, then south into Mexico. The channel widths at base range from approximately 3 to 8 feet. Channel bank heights range from 3 feet to 8 feet with bank slopes ranging from approximately 75 percent to near vertical. Vegetation on the banks of the wash is characterized by honey mesquite, giant dropseed, four-wing saltbush, and little-head snakeweed.

W28 is a narrow ephemeral wash that directs flows south into Mexico. The channel width at base is approximately 3 feet. Channel banks are approximately 2 feet high with 45 percent slopes. Vegetation on the banks of the wash is characterized by honey mesquite, littleleaf sumac, and creosotebush.

W29 is an ephemeral wash that directs flows south into Mexico. The channel width at base in the staging area is approximately 5 feet. Channel banks are approximately 2 feet high with 45 percent slopes. The channel becomes indistinct and braided where it crosses the border. Vegetation on the banks of the wash is characterized by white thorn acacia, tar bush, creosotebush, giant dropseed, and littleleaf sumac.

W30 is an ephemeral wash that directs flows south into Mexico. The channel width at base is approximately 3 feet. Channel banks are approximately 5 feet high with 55 percent slopes. Vegetation on the banks of the wash is characterized by tar bush, littleleaf sumac, white thorn acacia, purple three awn (*Aristida purpurea*), and little-head snakeweed.

W31 is an ephemeral wash that directs flows north into the United States. The channel base is approximately 2 feet wide where the wash crosses the border. The channel banks are near vertical and approximately 2 feet high. Approximately 60 feet downstream of the border the channel width at base is approximately 4 feet with 1-foot near-vertical banks. Vegetation on the banks of the wash is characterized by honey mesquite, littleleaf sumac, tar bush, creosotebush, and giant dropseed.

W32 is an ephemeral wash that directs flows south into Mexico. The channel width at base is approximately 4 feet. Channel banks are approximately 2 feet high with 45 percent slopes. Vegetation on the banks of the wash is characterized by creosotebush, white thorn acacia, littleleaf sumac, and tar bush.

W33 is a narrow ephemeral wash that directs flows south into Mexico. The channel width at base is approximately 3 feet. Channel banks are approximately 2 feet high with 35 percent slopes. Vegetation on the banks of the wash is characterized by tar bush, littleleaf sumac, white thorn acacia, and creosotebush.

W34 is a narrow ephemeral wash that directs flows south into Mexico. The channel width at base is approximately 3 feet. Channel banks are approximately 2 feet high with 45 percent slopes. Vegetation on the banks of the wash is characterized by creosotebush, tar bush, littleleaf sumac, little-head snakeweed, and white thorn acacia.

W35 is a narrow ephemeral wash that directs flows south into Mexico. The channel width at base is approximately 2 to 3 feet. Channel banks are approximately 4 feet high with 60 percent slopes. Vegetation on the banks of the wash is characterized by creosotebush, littleleaf sumac, white thorn acacia, little-head snakeweed, honey mesquite, and giant dropseed.

W36 is a narrow ephemeral wash that directs flows southwest into Mexico. W36 is comprised of two channels at the border. The western channel directs flows to the east into the eastern channel. The western channel's width at base is approximately 2 feet. Channel banks in the western channel are approximately 4 feet high with 45 percent slopes. The eastern channel directs flows to the south. The channel width at base is approximately 2 feet. Channel banks in the eastern channel are near vertical and approximately 4 feet in height. Vegetation on the banks of both wash channels is characterized by white thorn acacia, creosotebush, and little-head snakeweed.

W37 is a narrow ephemeral wash downstream of an impoundment. The channel directs flows south into Mexico. Historical flow in the wash has been cut off by the impoundment and the channel has been disturbed. The channel width at base is approximately 20 feet. Channel banks are approximately 3 feet high with 35 percent slopes. Vegetation on the banks of the wash is characterized by Russian thistle, creosotebush, four-wing saltbush, honey mesquite, little-head snakeweed, and giant dropseed.

W38 is a wide ephemeral wash in Guadalupe Canyon that directs flows south into Mexico. The channel width at base is approximately 40 feet. Channel banks are near vertical and 3 feet to 6 feet in height. Vegetation on the banks of the wash is characterized by burrobush (*Hymenoclea monogyra*), little-head snakeweed, western sycamore (*Platanus wrightii*), velvet ash (*Fraxinus velutina*), western hackberry (*Celtis reticulata*), mule fat (*Baccharis salicifolia*), and honey mesquite.

W39 is an ephemeral wash that directs flows into W38. The wash was cut to direct storm water flows from an existing access road into W38. The channel width at base is approximately 12 to 15 feet. The channel banks are near vertical and approximately 3 feet in height. Vegetation on the banks of the wash is characterized by western hackberry, western sycamore, burrobush, and little-head snakeweed.

W40 is a northern extension of W38 that was evaluated independently due to a change in alignment. W40 has similar vegetation as W38 and ranges from 12 to 20 feet in width. W40 is north of the gated dirt road in Guadalupe Canyon; W38 is the area south.

4.4.2 Wetlands and Other Waters of the United States Vegetation Summary

Wetlands and other Waters of the United States delineated within the survey corridor included one palustrine emergent habitat, one palustrine forested/riverine, a palustrine emergent habitat, and 37 ephemeral washes. The characteristic vegetation species for each wetland type sampled and delineated during the April/May 2008 field inventory are presented below by stand physiognomy.

4.4.3 Forest and Woodland Palustrine Forested

Four forested and woodland palustrine forested plant communities are found in the survey corridor. They include (1) Fremont Cottonwood – Goodding Willow Forest; (2) Fremont Cottonwood – Honey Mesquite Forest; (3) Arizona Sycamore – Fremont Cottonwood / Honey Mesquite Woodland; and (4) Honey Mesquite / Alkali Sacaton Woodland.

4.4.4 Shrubland

Two shrubland plant communities are found in the survey corridor. They include (1) Seepwillow – Burro Bush Shrubland; and (2) Honey Mesquite – Littleleaf Sumac Shrubland.

4.4.5 Herbaceous Palustrine Emergent

Three herbaceous palustrine emergent plant communities are found in the survey corridor. They include (1) Alkali Sacaton Herbaceous Vegetation; (2) Wild Barley / Honey Mesquite Shrub Herbaceous Vegetation; and (3) Bermuda Grass Herbaceous Vegetation.

4.4.6 Wetlands Soil Summary

Soils identified within vegetated wetlands in FV-1b exhibited hydric soil characteristics.

4.5 Noxious Weeds and Invasive Nonnative Plant Species

Noxious weeds have been addressed nationally under Public Law 108-412 (U.S.C. 2004) "Subtitle E – Noxious Weed Control and Eradication." The Arizona legislature addressed noxious weeds under Title 3 – Agriculture; Chapter 2 – Regulatory Provisions; Article 1 – Dangerous Plant Pests and Diseases; Section 3-205.01 – Summary abatement of noxious weeds, crop pests, or diseases under preapproved programs (AZDA 2008). The survey corridor does not support Federal-listed (USDA 2006) noxious weeds. One state-listed noxious weed, a species of whitetop, occurred on the edges of the irrigated pasture of the Slaughter Ranch (AZDA 2008a). Eighteen nonnative plant species were observed on-site (see **Table 4-2**); thirteen were annuals and five were biennial or perennial. All nonnative species occurred on disturbed sites receiving higher moisture amounts than normally occur in this region; the sites included roadsides, excavated areas, sandy desert wash bottoms, and irrigated pasture.

In general, nonnative noxious and invasive plant species represent a serious management concern and their inventory, monitoring, and control can be expensive for land managers. Nonnative species usually lower the value of wildlife habitat and they increase with disturbance, including livestock grazing and road maintenance. Once inventoried, methods commonly used to control nonnative species include biological, mechanical, and chemical. Controls must be ongoing to be effective in reducing, but only rarely eliminating, nonnative plant species.

4.6 Protected Native Plants

The Arizona Department of Agriculture (AZDA) oversees rules associated with the use and harvest of native plants, including protected native plant species (see **Table 4-2**) (AZDA 2008b, 2008c). Four categories of protected native plants have been established by the AZDA (2008c):

1. Highly Safeguarded – prospects for survival in Arizona are in jeopardy or are in danger of extinction.
2. Salvage Restricted – subject to damage by theft or vandalism.
3. Salvage Assessed – have sufficient value if salvaged to support the cost of salvage.
4. Harvest Restricted – subject to excessive harvesting or overcutting because of their intrinsic value.

There were no highly safeguarded protected native plants observed within the Douglas Station survey corridor. Fifteen species of “salvage restricted” protected native plants were observed (see **Table 4-2**); the most common of these were pencil cholla, species of yucca, and species of agave. Honey mesquite and desert willow represented the species of “salvage assessed” protected native plants to occur on-site (see **Table 4-2**). Honey mesquite was the single “harvest restricted” protected native plant observed (see **Table 4-2**).

In general, landowners have the right to destroy or remove plants growing on their land, but 20 to 60 days prior to the destruction of any protected native plants landowners are required to notify the AZDA (AZDA 2008). The landowner also has the right to sell or give away any plant growing on the land; however, protected native plants may not be legally possessed, taken, or transported from the growing site without a permit from the AZDA.

4.7 Wildlife and Wildlife Habitat

4.7.1 Introduction

Wildlife habitats of the survey corridor are predominantly Chihuahuan Desert shrublands that at the highest elevations are characterized by ocotillo, tarbush, and mortonia. In the middle elevations, creosotebush, tarbush, and honey mesquite compose the shrubland canopy. The lowest elevations support extensive honey mesquite shrublands and woodlands, gallery forests of Fremont cottonwood and Goodding willow, small stands of grasslands, and forb-dominated go-back agricultural fields.

The entire survey corridor occurs within the Rio Yaqui Basin, a large watershed that drains portions of southeastern Arizona and southwestern New Mexico in the United States and eastern Sonora and western Chihuahua in Mexico. Historically, the basin bottom was a large cienega (marshy wetland) composed of herbaceous vegetation with a few honey mesquite trees and shrubs. Due to ground water pumping, surface water diversion, and farming and ranching pursuits, the basin bottom has become invaded by extensive stands of honey mesquite trees and shrubs. Riparian and wetland plant communities have become established along draws and washes with adequate surface and groundwater flows, on seeps, and adjacent to springs. Limited open water and aquatic habitat occurs. The semi-arid desert uplands contrast sharply with the lowland artesian wells, associated ponds, and mesic habitats.

Recreation at SBNWR and its adjacent environs is centered on wildlife (USFWS 2008). Typical forms include birdwatching, landscape and wildlife photography, and hiking. In season, hunting for species of dove, quail, and desert cottontail rabbits is permitted on designated sites in the refuge. Within the survey corridor, hunting for mule and whitetail deer and collared peccary also occurs.

4.7.2 Wildlife and Habitat Overview

The survey corridor supports diverse populations and individuals of vertebrate wildlife species (see **Attachment C**) and unique-to-common native and nonnative wildlife habitats, described as vegetation alliances, plant associations, or land-use types in this BSR. **Table 4-4** lists wildlife observed during the field surveys that were conducted in early spring (April to May) of 2008. Along the international border, climate, geology, soils, land forms, geography, precipitation, and plant communities combine to provide moderate habitat diversity.

Table 4-4. Wildlife Species Observed Within the Survey Corridor, Staging Areas, and Associated Access Roads

Group / Scientific Name	Common Name	Relative Abundance
BIRDS		
Falco sparverius	American kestrel	Rare
Corvus corax	Common raven	Uncommon
Corvus cryptoleucus	Chihuahuan raven	Common
Geococcyx californianus	Greater roadrunner	Rare

Group / Scientific Name	Common Name	Relative Abundance
Zenaida asiatica	White-winged dove	Rare
Zenaida macroura	Mourning dove	Common
Chordeiles acutipennis	Lesser nighthawk	Uncommon
Buteo jamaicensis	Red-tailed hawk	Uncommon
Buteo nitidus	Gray hawk	Rare
Eremophila alpestris	Horned lark	Uncommon
Callipepla gambelii	Gambel's quail	Common
Fulica americana	American coot	Uncommon
Zonotrichia leucophrys	White-crowned sparrow	Common
Tyrannus verticalis	Western kingbird	Uncommon
Cathartes aura	Turkey vulture	Common
MAMMALS		
Unknown bat	Bat	Rare
Canis latrans	Coyote	Uncommon
Odocoileus hemionus	Mule deer	Uncommon
Lepus californicus	Black-tailed jackrabbit	Common
Sylvilagus audubonii	Desert cottontail	Abundant
REPTILES AND AMPHIBIANS		
Elgaria kingii	Madrean alligator lizard	Uncommon
Heloderma suspectum	Gila monster	Rare
Phrynosoma sp.	Horned lizard	Unknown
Masticophis flagellum	Coachwhip	Common
Pituophis catenifer	Gopher snake	Common
Crotalus atrox	Western diamondback rattlesnake	Common

Within the survey corridor, the broad habitat types available to resident and migrating wildlife species include herbaceous vegetation, shrubland, woodland, and forest. Most of the available wildlife habitat consists of semi-arid desert shrubland communities that have become established on ridges, slopes, alluvial fans and plains, and along arroyos, gullies, and desert washes. This section provides a brief summary of wildlife habitats observed and sampled in 2008 during Environmental Stewardship Plan preparation, categorized as follows:

1. Herbaceous Vegetation: This class of wildlife habitat includes annual and perennial species of grasses, forbs, and graminoids, which typically are characterized by no less than 15 percent cover by shrubs or trees. Stands of herbaceous vegetation range from less than 0.5 m to 2.0 m tall and low to dense in terms of cover. Herbaceous wildlife habitat occurs in small bunchgrass patches on ridges and slopes, small stands on disturbed sites of alluvial plains, and large stands within the cienega bottom.

   a. *Grasslands* – On ridges and slopes of upper elevations, patches of tobosa occur within larger stands of ocotillo, creosotebush, and honey mesquite shrublands. Rock outcrops occasionally supported patches of little bluestem. One heavily grazed alluvial plain site near a livestock corral supported hook threeawn almost exclusively. Desert wash bottoms, particularly the broader ones, often supported stands of alkali and giant sacaton and scattered shrubs of honey mesquite and littleleaf sumac. One irrigated pasture was planted to Bermuda grass. Grassland dominated habitats occur on approximately 9.1 acres within the survey corridor and provide forage, escape cover, and breeding/nesting sites for several species of wildlife. Species common to grassland habitats include desert cottontail, pocket gophers, pocket mice, harvest mice, deer mouse, grasshopper mice, coyote, mule deer, falcons, hawks, turkey vulture, ravens, quail, doves, loggerhead shrike, sparrows, meadowlarks, toads, lizards, and snakes.

   b. *Forblands* – Forbs, including baileya, slimleaf bursage, Russian-thistle, common cocklebur, and annual sunflowers are rare dominants within the survey corridor, becoming established on one disturbed alluvial plain site, in an excavation used for road fill material, and in the large fallow agricultural field that was once part of a cienega bottom. Forb-dominated habitats occur on approximately 6.2 acres within the survey corridor and provide forage, escape cover, and breeding/nesting sites for several species of wildlife. Species common to forbland habitats include desert cottontail, ground squirrels, pocket gophers, pocket mice, harvest mice, deer mouse, grasshopper mice, coyote, collared peccary, mule and whitetail deer, falcons, hawks, turkey vulture, ravens, quail, doves, loggerhead shrike, sparrows, goldfinch, meadowlarks, toads, lizards, and snakes.

   c. *Emergent Wetlands* – Narrowleaf cattail, three-square bulrush, saltgrass, alkali sacaton, and sedges occur on the margins of ponds, seeps, springs, and on the banks of Black Draw, occupying approximately 0.1 acre within the survey corridor. Emergent wetlands can be from 0.5 m to 3 m in height, dense, and along with associated aquatic habitat supporting diverse birds, mammals, reptiles, amphibians, fishes, and many invertebrates. Species common to emergent wetland and associated aquatic habitats include desert shrew, bats, pocket gophers, mice, raccoon, skunks, collared peccary, coyote, whitetail deer, American coot, ring-necked duck, gadwall, Mexican duck, mallard, great blue heron, pied-billed grebe, falcons, hawks, quail, killdeer, doves, owls, flycatchers, vireos, swallows, wrens, northern mockingbird, warblers, sparrows, blackbirds, toads, leopard frogs, bullfrogs, Sonoran mud turtle, garter snakes, and fishes (minnows, suckers, catfish, topminnows).

2. Shrublands: This habitat class is dominant within the survey corridor, occupying approximately 404.2 acres. The characteristic upland shrubs range from 0.5 m to 5 m tall and include ocotillo, creosotebush, honey mesquite, tarbush, whitethorn, four-wing saltbush, shrubby coldenia, and mortonia. Characteristic shrubs of desert washes, creeks, and draws include honey mesquite, seepwillow, burro bush, and littleleaf sumac. Shrublands provide sparse to dense cover and are common on the ridges and hills of the western Project terminus.

   a. *Dwarf-shrublands* – Dwarf-shrub stands occur on approximately 8.2 acres of exposed hilltop along access roads and bladed sites within SBNWR. This habitat is characterized by shrubby coldenia, foure-wing saltbush, honey mesquite, and creosotebush that provided limited wildlife habitat. Common wildlife species likely to use this habitat include desert cottontail, black-tailed jackrabbit, ground squirrels, pocket mice, coyote, mule deer, turkey vulture, ravens, falcons, hawks, quail, doves, loggerhead shrike, sparrows, lizards, and snakes.

   b. *Short Shrublands* – Stands of short shrubs occur throughout the survey corridor on approximately 385.2 acres of gravelly to cobbly ridges, hills, and slopes, on exposed bedrock of ridges, on alluvial fans and plains, and along desert washes and gullies. Short shrub stands are characterized by creosotebush, honey mesquite, whitethorn, tarbush, and mortonia primarily. Stands range from 1 m to 3 m tall and provide low to moderately high foliar cover. Nearly all wildlife species within the survey corridor use the short shrub habitats for forage, escape cover, breeding/nesting, and resting. The most common species include bats, desert cottontail, black-tailed jackrabbit, ground squirrels, pocket mice, deer mouse, other mice, kangaroo rats, coyote, gray fox, badger, bobcat, collared peccary, mule deer, Swainson's hawk, red-tailed hawk, American kestrel, turkey vulture, quail, greater roadrunner, owls, nighthawks, flycatchers, kingbirds, Chihuahuan raven, wrens, thrashers, sparrows, Madrean alligator lizard, collared lizard, horned lizards, colubrid snakes, and western diamondback rattlesnake.

   c. *Tall Shrublands* – Stands of tall shrubs occur on ridges and slopes characterized by ocotillo and on slopes, along desert washes, and on flats characterized by honey mesquite. Tall shrubs typically range from 3 m to 6 m tall, this habitat type ranges from low to dense in terms of foliar cover, and approximately 90.1 acres occur in the survey corridor. Tall shrubs provide important perching, breeding, nesting, brood rearing, and escape cover for a variety of wildlife including bats, desert cottontail, ground squirrels, pocket mice, deer mouse, other mice, kangaroo rats, coyote, gray fox, badger, bobcat, collared peccary, mule deer, Swainson's hawk, red-tailed hawk, American kestrel, turkey vulture, quail, owls, nighthawks, flycatchers, kingbirds, Chihuahuan raven, warblers, wrens, thrashers, towhees, sparrows, colubrid snakes, and western diamondback rattlesnake.

3. <u>Woodlands and Forests</u>: Open- to closed-canopy stands of trees occupy approximately 19.3 acres of Silver Creek, Black Draw, Guadalupe Canyon, and Hay Hollow Wash drainage banks and terraces. Fremont cottonwood, Arizona sycamore, and Goodding willow trees have become established as a gallery forest on the banks of Black Draw and in Guadalupe Canyon. Hay Hollow Wash supports Fremont cottonwood and honey mesquite trees adjacent to the international border and honey mesquite trees updrainage. Silver Creek is dominated by honey mesquite trees on an elevated terrace. Other drainages, terraces, and depressions support woodlands dominated by honey mesquite that cover approximately 78 acres. Woodlands typically provide moderate canopy cover and range between 4 m to 10 m tall and forest stands range between 10 m to 35 m tall, provide dense canopy cover, and usually have a subcanopy layer, which enhances the wildlife habitat value in terms of structure.

   a. *Drainage Banks, Floodplain Terraces, and Springs* – The riparian gallery forest and woodland habitats of Silver Creek, Black Draw, Guadalupe Canyon, and Hay Hollow Wash support moderately open- to close-canopied stands dominated by Fremont cottonwood, Arizona sycamore, and honey mesquite. A moderately well-developed subcanopy in Black Draw and Hay Hollow Wash stands provide additional wildlife habitat values. Numerous avifauna use the bank and terrace woodland habitat for foraging, breeding, nesting, brood rearing, perching, and escape cover, including the Swainson's hawk, red-tailed hawk, American kestrel, doves, owls, nighthawks, hummingbirds, Gila woodpecker, northern flicker, flycatchers, kingbirds, vireos, verdin, northern mockingbird, warblers, common yellowthroat, yellow-breasted chat, summer tanager, towhees, sparrows, northern cardinal, pyrrhuloxia, grosbeaks, and Bullock's oriole. Mammal use is high in these mesic habitats with common species and groups including bats, raccoon, desert cottontail, pocket gophers, skunks, mice, coyote, bobcat, collared peccary, and mule and white-tailed deer. Reptiles and amphibians common to the riparian habitats of these drainages include species of toads, lizards, colubrid snakes, and rattlesnakes. Moderate to high diversity of invertebrates occurs within these terrace woodlands and forests.

4. <u>Open Water</u>: Occupying approximately 0.1 acre within the Project area, open water habitats are species-rich in terms of wildlife use and as habituated for threatened and endangered amphibians and fishes. Water bodies occurred as a pond in Black Draw and a nearby pond supported by a flowing artesian well. Most water sources are ephemeral, flowing

following precipitation events of sufficient size to produce runoff and typically during the monsoon months of July through September. The bottom substrate of water bodies and ephemeral drainages is typically sand and fine sediments.

a. Creeks, Draws, and Desert Washes – Flowing water habitat was not present during the early spring survey corridor survey and unvegetated dry washes occurred on approximately 2.8 acres. In addition to many unnamed desert washes, arroyos, and gullies are Silver Creek, Black Draw, Guadalupe Canyon, and Hay Hollow Wash which are ephemeral and flow primarily during the monsoon season. Because of active seeps and springs, Black Draw maintains ponded water throughout the year. These open water habitats and their associated riparian and wetland vegetation are extremely valuable to local and seasonal vertebrate and invertebrate wildlife species of the survey corridor.

b. *Lakes and Ponds* – Ponds occur within Black Draw on the alignment and where artesian wells discharge north of the alignment within the SBNWR. The wetland and riparian vegetation surrounding the shoreline and the size of the water body can dictate the species using still open water, which include the American coot, a variety of ducks, passerine birds, Sonoran mud turtle, leopard frogs, bullfrogs, Mexican and checkered garter snakes, endangered and threatened fishes, and insects.

5. Land Use: Small acreages in the survey corridor are maintained on a regular basis, ranging from monthly to yearly maintenance of Geronimo Trail Road to less periodic maintenance on secondary access roads and trails. Even though subject to disturbance, these habitats are somewhat important to many species of resident and migratory wildlife which use them as movement corridors, foraging sites, and sunning sites.

   a. *Irrigated Agriculture* – One small irrigated pasture of Bermuda grass occurs on approximately 0.3 acre in the survey corridor. It is grazed by horses and mules but also provides habitat for local wildlife that forage and seek water in this nonnative shortgrass habitat.

   b. *Fallow or Go-Back Agriculture* – Fields on SBNWR have not been cultivated since 1979 and have been in a go-back status for nearly 30 years. Approximately 2.2 acres of this habitat support a large number of perennial grasses and annual forbs which range to 3 m tall and provide quantities of seed used by foraging wildlife. Seeds present on the go-back fields attract mule deer, desert cottontail rabbit, other small mammals, species of sparrows, and species of doves. Raptors and other predators regularly forage over or in this habitat.

   c. *Highways, Roads, and Trails* – Wildlife species use established transportation corridors to move and disperse rapidly across the landscape. As a result, low to moderately high death rates can be experienced depending on adjacent habitat importance to wildlife, population levels, and design speed and safety features of transportation corridors. The western diamondback rattlesnake and other snake species were observed sunning on Geronimo Trail Road in the survey corridor. Wildlife that forage on carrion or are omnivorous, including the turkey vulture, other raptors, and coyote, can benefit from the presence of road-killed animals. Transportation structures such as bridges can provide hiding and roosting cover for species including owls and bats or nesting sites for swallows. Approximately 47.1 acres of this land use type occur in the survey corridor.

4.8 Species Groups and Habitat Affinity

4.8.1 Mammals

Fifty-five species of mammals have been recorded in the SBNWR habitats and also use adjacent landscapes of the survey corridor (see **Attachment C**). The largest species groups include bats (14) and mice, including pocket mice (10). Most of the mammals are nocturnal (night-active) or crepuscular (dusk- and dawn-active), and with the exception of the bat species are year-round residents. Black bear may traverse the survey corridor in search of forage. The rugged mountains that surround the San Bernardino Valley may support the very rare and federally endangered jaguar and ocelot, which have been recorded southeast and west of the area.

4.8.2 Birds

SBNWR and the survey corridor support at least 268 bird species (see **Attachment C**) (USFWS 2008). Raptors that commonly use area habitats include American kestrel, peregrine falcon, red-tailed hawk, sharp-shinned hawk, Swainson's hawk, gray hawk, zone-tailed hawk, golden eagle, turkey vulture, and Chihuahuan raven (USFWS 2008). Aquatic birds and and shorebirds that have been observed in the refuge include American coot, great blue heron, green-backed heron, Virginia rail, ringneck duck, Mexican duck, and sandhill crane. Other species and groups of birds common to the survey corridor include doves, greater roadrunner, owls, nighthawks, hummingbirds, flycatchers, loggerhead shrike, vireos, swallows, verdin, wrens, northern mockingbird, thrashers, warblers, tanagers, towhees, sparrows, grosbeaks, eastern meadowlark, and Bullock's oriole.

Large numbers of birds migrate seasonally through the San Bernardino Valley using the natural and managed habitats for forage, roosting, and cover. The drainages and linear mountain ranges can serve as leading lines to guide raptors and neotropical migrants during migration.

The establishment of the SBNWR and Leslie Canyon National Wildlife Refuge in addition to other Federal, state, and private lands is important to migratory bird management. The primary function of lands managed under the National Wildlife Refuge System is to provide habitat for waterfowl and shorebirds in addition to other wildlife-related benefits. A focused list for species occurring in the survey corridor is presented in **Attachment C**.

The American peregrine falcon, a subspecies of the peregrine falcon, currently proposed for de-listing, is reported as a rare migratory visitor to the Project area (USFWS 1995). Under the *Peregrine Falcon Recovery Plan* the general goal is to restore a self-sustaining population of peregrine falcons in the western United States. The SBNWR, BLM, and private landowners contribute towards restoration goals by conserving wintering and migratory habitats, protecting peregrine falcons through law enforcement efforts, and promoting public support and understanding through education.

The bald eagle has been de-listed from federally endangered to the threatened status throughout the United States except in the Sonoran Desert. Bald eagles are still protected by the Bald Eagle Proteciton Act. The *Bald Eagle Recovery Plan* efforts are undertaken to recover the species and in the Project region are considered significant efforts (USFWS 1995). The SBNWR, BLM, and private landowners contribute towards restoration goals by ensuring that bald eagle habitats are protected and possibly enhanced. The refuge protects bald eagles through law enforcement efforts and promoting public support and understanding through education.

The northern aplamado falcon was a former resident of desert grasslands of southeastern Arizona that has been extirpated from the United States and contaminated by pesticides in Mexico (USFWS 1995). The *Aplomado Falcon Recovery Plan* included six objectives: (1) evaluate, monitor, and minimize all threats, including pesticides, to extant populations; (2) identify, maintain, and improve habitat; (3) re-establish the northern aplomado falcon in the United States and Mexico; (4) conduct studies of habitat requirements, physiological ecology, and behavior; (5) enhance public support for this recovery effort through educational programs; and (6) encourage national and international cooperation and coordination in carrying out these objectives. SBNWR was considered a possible re-introduction site for the northern aplomado falcon but further restoration of native grasslands and riparian woodlands/forests would be required. Northern aplomado falcons were planned to be released in Chihuahuan desert grassland habitats of southwestern New Mexico and were expected to spread into southeastern Arizona if releases were successful (Federal Register 2006, USFWS 2006). The goal of re-introduction would be to maintain a self-sustaining resident population of 60 breeding pairs between the years 2010 to 2030.

4.8.3 Reptiles and Amphibians

A species list of 39 reptiles and amphibians was compiled for SBNWR habitats (see **Attachment C**). During early spring wildlife surveys of the survey corridor, western diamondback rattlesnakes, coachwhips, the Gila monster, and lizard species were observed. Other reptile and amphibian species that could occur include the black-tailed rattlesnake, desert kingsnake, ringneck snake, Madrean alligator lizard, collared lizard, and horned toad in uplands and rock outcrops, while the wetland habitats support the Chiricahua leopard frog, Sonoran mud turtle, and checkered and Mexican garter snakes (USFWS 2008).

The federally threatened Chiricahua leopard frog population continues to decline due to habitat degradation, predation by nonnative bullfrogs and other wildlife species, and exposure to a lethal skin fungus (USFWS 2008). Management and protection of this rare leopard frog species in the Project area include efforts by the USFWS, AZGFD, University of Arizona, Douglas High School, and private landowners.

The rare Mexican garter snake is one of three species of garter snake that inhabit riparian and wetland habitat in the survey corridor. The population on SBNWR has been reduced by predation by the nonnative bullfrog, which forages on young snakes. Restoration of densely vegetated cienega wetland habitats on SBNWR and the adjacent Rancho San Bernardino in Mexico assist with the recovery of the Mexican garter snake.

4.8.4 Fish

SBNWR is one of the few units within the refuge system created specifically to protect native fish; there are eight fish species in the refuge (see **Attachment C**). Refuge staff is focused on preserving the remaining fisheries habitat, restoring degraded habitats, and maintaining native fish populations in appropriate habitats. In addition to physical effects due to construction, placement of a new vehicle barrier and construction staging could result in sedimentation into the refuge drainages. Soils of the former cienega are extremely fine silt and clay and are highly erodible both by water and wind action. The preferred crossing of Black Draw from a fisheries perspective would be a concrete low water crossing with a perpendicular downstream face high enough to impede fish from downstream from entering the refuge (Radke pers. comm. 2008).

Prior to drainage of wetlands and loss of permanent surface flows, the SBNWR drainages and cienega supported approximately one-fourth of the fish species native to Arizona (USFWS 2008). The more common species were Mexican stoneroller, longfin dace, roundtail chub, and Yaqui sucker. Endangered and threatened fish species that occurred historically through present include the Yaqui chub, Yaqui topminnow, beautiful shiner, and Yaqui catfish.

The federally threatened beautiful shiner was eliminated from the United States by 1970 due to the loss of suitable wetland and aquatic habitat (USFWS 2008).

The current populations on SBNWR were reintroduced from stock captured in the Sierra Madre of Mexico. The federally endangered Yaqui chub is confined to the upper Rio Yaqui Basin along the international border and populations occur in San Bernardino and Leslie Canyon National Wildlife Refuges, the Coronado National Forest, the Slaughter Ranch, El Coronado Ranch in Arizona, and the Rancho San Bernardino in Mexico. Most of the populations are threatened due to infestations of nonnative Asian tapeworms which are parasites of the digestive system. The federally threatened Yaqui catfish was eliminated from U.S. waters and reestablished with Mexican stocks in 1996. The species now occurs in SBNWR, on Slaughter Ranch, and on the El Coronado Ranch in Arizona. The federally endangered Yaqui topminnow was severely affected by the loss of wetland and aquatic habitat by vegetation encroachment and by the introduction of nonnative mosquitofish. It now occurs in SBNWR, Slaughter Ranch, and in Mexico in Rancho San Bernardino.

The *Fishes of the Rio Yaqui Recovery Plan* (USFWS 1994a) outlined the objectives required to recover the Yaqui chub, Yaqui topminnow, Yaqui catfish, and beautiful shiner as secure and stable elements of the native fish fauna of the river system where they once occurred. A combination of refuge protection strategies and habitat protection in Mexico is necessary for these rare fishes to be down-listed. There must be compliance with the following conditions for a period of five years before down-listing of the federally endangered Yaqui chub and Yaqui topminnow to federally threatened status can be considered: (1) all nonnative fish species must be eradicated from critical habitat; (2) secure and protect the San Bernardino aquifer so that all artesian flows maintain themselves year-round, secure and protect Leslie Creek watershed to ensure adequate flows for Leslie Creek; and (3) protect critical habitat from detrimental human disturbance including mining, introduction of nonnative fishes, water diversion, and removal.

4.8.5 Invertebrates

Southeastern Arizona has been described as an ecological crossroads due to intersecting geographies including the Chihuahuan and Sonoran deserts and southern Rocky Mountains and Sierra Madres. As a result, invertebrates are diverse, e.g., over 100 butterfly species occur in Cochise County. The SBNWR and adjacent survey corridor support an abundance of butterflies, damselflies, and other invertebrates, including several unique tropical species. Some species of invertebrates have been documented in the United States only within the refuge (USFWS 2008).

The San Bernardino springsnail occurs within a single small spring on Slaughter Ranch, adjacent to the refuge and at two locations on Rancho San Bernardino in Mexico. Research is currently being conducted to determine the species habitat requirements or its tolerances.

4.9 Prehistoric Humans, Spanish Settlement, and Current Land Conservation

This section briefly summarizes human use of the survey corridor. Generally, the survey corridor uplands were used sparingly by prehistoric humans and historically for grazing livestock and farming. However, the San Bernardino Valley, with several permanent water sources, has attracted humans both prehistorically and historically resulting in the basis for much of the discussion herein. Forms of farming within the valley occurred over the past 800 years, reaching an apex and level of disturbance to the natural landscape between about 1900 to 1979 (USFWS 1995).

The upper Rio Yaqui watershed has supported humans since prehistoric times, with evidence of use dating over 10,000 years ago to the Clovis culture (USFWS 1994a). The principal prehistoric periods represented in the survey corridor were the late Archaic (approximately 1500 BC–500 BC) and the late prehistoric pueblo occupation (approximately AD 1200–AD 1400) (USFWS 1995).

Archaic humans practiced a hunting-gathering lifestyle throughout the desert southwest; in the Project area artifacts included projectile points (Pinto, Chiricahua, and San Pedro styles), ground stone artifacts, hearths, and roasting pits with the absence of ceramics (USFWS 1995). Hay Hollow Wash within the refuge supported a large semipermanent campsite during the Archaic Period.

Pueblo-dwelling humans that occupied permanent settlements and practiced agriculture settled in the Project area from approximately 600 to 800 years ago (USFWS 1995). This occupation has been named by various researchers as the Animas Phase, Casas Grandes, or Salado cultures, people who possessed architectural and material cultures with strong ties to similar advanced societies in Chihuahua. The largest pueblo period site or pit house village in the Project area is located on the historic Slaughter Ranch; it consisted of approximately 100 rooms and one or more plazas located on a bench above Astin Spring Wash and Black Draw (USFWS 1995).

In approximately the early 1600s, the Apache Tribe frequented the Project region to hunt, gather food, and conduct raids (USFWS 2008). They frequented this region until 1886 when Geronimo and his forces surrendered in Skeleton Canyon, located north of the springs at San Bernardino.

The Coronado-led Spanish expedition passed near the survey corridor in search of the Seven Cities of Cibola during 1540 (USFWS 2008). European presence in the survey corridor dates to around 1694 when Jesuit Padre Eusabio Francisco Kino (an Italian priest) and Captain Juan Mateo Manje traveled through the San Bernardino Valley (Lanning 1981, NPS 2008). At that time there was an Opata Indian village on the location of the San Bernardino Ranch.

Padre Kino established good relations with the indigenous Piman groups and assisted them in resisting the Apache tribes. He was also credited with introducing agriculture and animal husbandry including wheat and domestic livestock, particularly cattle and sheep. Jesuit priests established a mission in the San Bernardino Valley during the 1700s and a Spanish Presidio was established there in 1774 (USFWS 2008).

Feral livestock were abundant by 1822, when the 73,000-acre San Bernardino Land Grant, created by decree of the Spanish Crown, was acquired by Lieutenant Ignacio de Perez (USFWS 1994). Large-scale cattle, mule, and horse grazing occurred for ten years (up to 100,000 head), until 1832, when Perez was driven from the valley by the Apache Tribe (USFWS 2008). This land grant included much of the survey corridor.

In 1846, the Mormon Battalion under Lieutenant Colonel Philip St. George Cooke passed through the San Bernardino Valley enroute to California. They encountered many wild cattle and one of the battalion noted that the grass was two feet high as far as the eye could see and there was plenty of water, but there was no wood barring mesquite (USFWS 1993). A monument to the Mormon Battalion stands adjacent to Geronimo Trail Road near the entrance to the SBNWR.

In 1853, the Gadsden Purchase placed the international boundary such that 2,383 acres of the original land grant/ranch lay within the United States and the remainder in Mexico. A total of 65,000 acres of the land grant were purchased by “Texas” John Slaughter (John Horton Slaughter, a Texas cattle rancher) in 1884 and was used to raise longhorn cattle (up to 50,000 head) and for farming (hay, barley, wheat, and vegetables) until 1937 (USFWS 1994). The center of a cattle ranching empire that straddled the U.S.-Mexico border, this ranch illustrated the continuity of Spanish and American cattle ranching in the Southwest. Until late in the nineteenth century, the San Bernardino Valley, a well-watered area occupying southern Arizona and northern Mexico, was not successfully occupied by Europeans due to the threat of Apache attack; in 1884, however, Slaughter leased a portion of the Mexican land grant and began the development of a ranch that would span up to 100,000 acres, supplying beef, fruits, and vegetables to the surrounding settlements and military posts.

In 1915, the Mexican Revolution included this area of the border and General Pancho Villa and his troops fought in nearby Agua Prieta (USFWS 2008). Between 1914 to 1919, U.S. cavalry encampments were established in the valley to protect settlers from raids conducted by General Villa. U.S. troops were stationed at the Slaughter Ranch during this period and remnants of the rock fortifications remain on the SBNWR.

Between 1937 and 1979, there were a number of owners who conducted cattle ranching and farming in the valley, until the Slaughter Ranch was purchased by The Nature Conservancy, transferred to the USFWS in 1982, and established as the SBNWR (USFWS 1994). Properties adjacent to the refuge and composing the remainder of the survey corridor are primarily privately owned ranch lands and lands managed by the State of Arizona (USFWS 1995).

Farming, mineral extraction, fire control, and livestock production altered and eliminated much of the natural wildlife habitat in the Rio Yaqui Basin over the past 100-plus years (USFWS 2008). Some wetlands were drained to increase cropland acreage and streams were diverted to irrigate fields and fill water impoundments. Grasslands were diminished by unsustainable grazing practices and many surface water flows were eliminated. The very large San Bernardino Cienega (described as marshy and spring-fed) once persisted on both sides of the international border, but has been reduced to isolated artesian wells and artificial ponds and it supports old field vegetation. Stands of honey mesquite trees and shrubs have become established across the former cienega.

4.10 Habitat Restoration and monitoring

Extensive habitat restoration has been undertaken on the SBNWR and on adjacent private lands (USFWS 2008). Eroded and incised stream channels are being elevated and armored using wire-basket gabions filled with rocks and by planting Fremont cottonwood and Goodding willow trees. Upland habitats are being replanted to native grass species and old farm fields are being returned to former cienega wetland conditions. Invasive, nonnative species are being controlled or removed from the habitats. Controlled fires are being used to burn the litter from native grasses, to return nutrients to the soil, and to control the spread of honey mesquite trees and shrubs across the former cienega.

Cooperative conservation between U.S. government and environmentally sensitive landowners in Mexico and the United States is protecting additional habitat and water sources, providing additional scientific research, and allowing introductions and maintenance of fish and wildlife populations. Restored wetlands support waterfowl, riparian gallery forests support raptors and migrating passerine bird species, and measures are being enacted to reduce erosion, protect groundwater levels, and to reclaim honey mesquite-dominated lowlands. Monitoring is being designed and conducted to record the results of management actions, guide future management decisions, and to learn more about the complex ecological relationships.

5. LIST OF PREPARERS

ShannonCauley
Graduate Studies, Natural Resources, USDA Graduate School, 1989-1992
Graduate Studies, Geology, 1983-86
B.S., Geology, 1976
Years of Experience: 25

Rod Dossey
B.S. Ecology, Behavior and Evolution
Years of Experience:15

Brent Eastty
B.S., Biology, 2003
Years of experience: 5

Sarah Spratlen
M.S. Masters of Engineering
Years of Experience: 5

Karen Stackpole
B.S. Biology
M.S. Environmental Science and Education
Years of Experience: 9

Jim Von Loh
B.S. Biology
M.S. Biology
Years of Experience: 32

THIS PAGE INTENTIONALLY LEFT BLANK

6. REFERENCES

AZDA 2008a	Arizona Department of Agriculture (AZDA). 2008a. *Article 1 – Dangerous Plant Pests and Diseases*. Accessed online at: http://www.azleg.state.az.us/ArizonaRevisedStatutes.asp.
AZDA 2008b	AZDA. 2008b. *New Native Plant Rules (May 3, 2008)*. Accessed online at: http://www.azda.gov/Main/NewNativePlantRules.html.
AZDA 2008c	AZDA. 2008c. *Protected Native Plant Lists A-D*. Accessed online at: http://www.azda.gov/ESD/protplantlst.htm.
AZGFD 2008a	Arizona Game and Fish Department (AZGFD). 2008a. *Status Definitions*. Accessed online at: http://www.azgfd.gov.
AZGFD 2008b	AZGFD. 2008b. *Special Status Species by County, Taxon, Scientific Name*. Heritage Data Management System. Phoenix, AZ. Available online at: http://www.azgfd.gov/w_c/edits/documents/ssspecies_bycounty_001.pdf.
Bailey 1995	Bailey, Robert F. 1995. *Ecoregions of the United States*. U.S. Department of Agriculture - Forest Service. Available online at: http://www.fs.fed.us/colormap/ecoreg.
Bennett et al. 2004	Bennett, Peter S., Michael R. Kunzmann, and Lee A. Graham. 2004. *Descriptions of Arizona Vegetation Represented on the GAP Vegetation Map*. USGS, Biological Resources Division. Phoenix, AZ.
Burgess 1995	Burgess, Tony. 1995. *Desert Grassland, Mixed Shrub Savannah, or Semidesert Scrub?* In: McClaran, M. and T. Van Devender, eds. *The Desert Grassland*. University of Arizona Press. Tucson, AZ.
Dimmitt 2000	Dimmitt, Mark. 2000. *Biomes and Communities of the Sonoran Desert Region.* In: Phillips, S. and P. Comus, eds., A Natural History of the Sonoran Desert. Arizona-Sonoran Desert Museum Press. Tucson, AZ.
Earman 2002	Earman, S., B.J.O.L. McPherson, F.M. Phillips, S. Ralser, and J.M. Herrin. 2002. *Hydrogeologic Framework and Groundwater Characteristics, San Bernardino Valley, Arizona and Sonora.* Earth and Environmental Science Department, New Mexico Institute of Mining and Technology. Socorro, NM.

Environmental Laboratory 1987	Environmental Laboratory. 1987. *Technical Report Y-87-1, Corps of Engineers Wetlands Delineation Manual*. Available online at: http://el.erdc.usace.army.mil/wetlands/pdfs/wlman87.pdf. Accessed 20 August 2008.
Epple 1995	Epple, Anne E. 1995. *A Field Guide to the Plants of Arizona*. The Globe Pequot Press. Guilford, CT.
Federal Register 2006	Federal Register. 2006. *Establishment of a Nonessential Experimental Population of Northern Aplomado Falcon in New Mexico and Arizona*. Volume 71, Number 143, July 26, 2006 - Rules and Regulations. 50 CFR, Part 17. RIN 1018-A180. Washington DC.
Kearney 1960	Kearney, Thomas H. and Robert H. Peebles. 1960. *Arizona Flora*. Second Edition with Supplement by J.T. Howell and E. McClintock. University of California Press. Berkely, CA.
Lanning 1981	Lanning, Dirk B. 1981. *Ther Vertebrates of San Bernardiona Ranch, Cochise County, Arizona*. Arizona Natural Heritage Program. Tucson, AZ.
NPS 2008	National Park Service (NPS). 2008. *Tumacacori National Historic Park: Father Eusabio Francisco Kino*. Accessed online at: http://www.nps.gov/archive/tuma/Father_Kino.html.
NatureServe and e²M 2007a	NatureServe and e²M. 2007a. *Element Occurrence Data Request Form, NatureServe Central Databases.* Arlington, VA and Englewood, CO.
NatureServe and e²M 2007b	NatureServe and e²M. 2007b. *License Agreement between NatureServe and engineering-environmental Management, Incorporated*. Arlington, VA and Englewood, CO.
NatureServe 2008	NatureServe Explorer. 2008. An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available online: http://www.natureserve.org/explorer. Accessed: June 3, 2008.
Neily and Beckwith 1985	Neily, Robert and Ronald Beckwith. 1985. *A Cultural Resource Inventory of the San Bernardino National Wildlife Refuge*. Arizona State Museum. University of Arizona.
New Mexico State University 2008	New Mexico State University. 2008. *The Chihuahuan Desert*. Accessed online at: http:horizon.nmsu.edu/chihuahua.html.

NRCS 2008	Natural Resources Conservation Service (NRCS). 2008. *Electronic Field Office Technical Guide, Cochise County, Arizona. Section II- Water Resources- Arizona Watershed-15080302 San Bernardino Valley*. Available online at: http://efotg.nrcs.usda.gov/treemenuFS.aspx. Accessed 4 September 2008.
Robinson et al. 2006	Robinson, Anthony T., Nick V. Paretti, and Gail E. Cordy. 2006. *Ecological Assessment of Arizona's Streams and Rivers*. AGFD and USGS, Arizona Water Science Center. Phoenix and Tucson, AZ.
U.S.C. 2004	United States Code (U.S.C.). 2004. Noxious Weed Control and Eradication Act of 2004. 118 Statute 2320; Public Law 108-412; 108th Congress. Washington. DC.
USACE 1987	U.S Army Corps of Engineers (USACE). 1987. *Wetland Delineation Manual.* Technical Report Y-87-1. 1987.
USDA 2008	U.S. Department of Agriculture (USDA). 2008a. *Natural Resources Conservation Service, PLANTS Database*. Accessed online at: http://plants.usda.gov/.
USDA 2008c	USDA. 2008c. *Federal Noxious Weed List and Arizona State-listed Noxious Weeds*. Accessed online at: http://www.aphis.usda.gov/ppq/weeds/.
USEPA 2008	U.S. Environmental Protection Agency (USEPA). 2008. *San Bernardino Valley Watershed – 15080302.* Available online at: http://cfpub.epa.gov/surf/huc.cfm?huc_code=15080302.
USFWS 1993	U.S. Fish and Wildlife Service (USFWS). 1993. *Cochise Pincushion Cactus (Coryphantha robbinsorum) Recovery Plan*. USFWS. Alberquerque, NM.
USFWS 1994a	USFWS. 1994a. *Fishes of the Rio Yaqui Recovery Plan: 1995*. Kevin S. Cobble. San Bernardino National Wildlife Refuge. Douglas, AZ. USDI Fish and Wildlife Service. Albuquerque, NM.
USFWS 1994b	USFWS. 1994b. *Lesser Long-nosed Bat Recovery Plan*. Theodore H. Fleming. USFWS Arizona Environmental Services State Office. Phoenix, AZ.
USFWS 1995	USFWS. 1995. *San Bernardino and Leslie Canyon National Wildlife Refuges, Comprehensive Management Plan, 1995-2015*. USFWS Region 2. Alberquerque, NM.
USFWS 2003	USFWS. 2003. *San Bernardino / Leslie Canyon National Wildlife Refuges Watchable Wildlife List*. Douglas, AZ.

USFWS 2006	USFWS. 2006. *Final Environmental Assessment for Reestablishment of the Northern Aplomado Falcon in New Mexico and Arizona*. USFWS, Region 2, New Mexico Ecological Field Office. Albuquerque, NM.
USFWS 2008a	USFWS. 2008a. *Threatened and Endangered Species System (TESS)*. Accessed online at: http://ecos.fws.gov/tess_public/StateListing.do.
USFWS 2008b	USFWS. 2008b. *San Bernardino / Leslie Canyon National Wildlife Refuges Pamphlet*. Douglas, AZ.
WRCC 2008	Western Regional Climate Center (WRCC). 2008. *Climate Summaries for Yuma WSO AP, Arizona (0296660)*. Available online at: http://www.wrcc.dri.edu/cgi-bin/.
WWF 2008	World Wildlife Fund (WWF). 2008. *Terrestrial Ecoregions of the World*. Accessed online at: http://www.worldwildlife.org.

BIOLOGICAL SURVEY
ATTACHMENT A

DESCRIPTION OF FEDERALLY LISTED SPECIES

Beautiful Shiner (*Cyprinella formosa*)

The beautiful shiner was designated as a federally Threatened species on August 31, 1984.

Historic range: Northern Mexico (Sonora, Chihuahua), southeastern Arizona (San Bernardino Creek and associated artesian wells and cienegas; extirpated by 1970), and southwestern New Mexico (Mimbres River; disappeared after 1951). Current range in Mexico: Guzman basin (including Rios Casas Grandes, Santa Maria, and del Carmen), and Yaqui, Bavicora, and Sauz basins (current status in Sauz Basin is unknown). Elevations in Mexico from 800-1700 m (2625-5580 ft), previously in Arizona at approximately 1,158 m (3,800 ft) (Arizona Game and Fish Department 1994). Reintroduced and thriving on the San Bernardino National Wildlife Refuge, Arizona (USFWS 1994). Stocks occur also at the Dexter National Fish Hatchery & Technology Center, Dexter, New Mexico. See USFWS (1994).

Basic Description: A 3-inch fish.

Reproduction Comments: Spawns probably in late spring.

Habitat Type: Freshwater

Non-Migrant: No

Locally Migrant: No

Long Distance Migrant: No

Riverine Habitat(s): CREEK, Moderate gradient, Pool, Riffle, SPRING/SPRING BROOK

Lacustrine Habitat(s): Shallow water

Special Habitat Factors: Benthic

Habitat Comments: A mid-water-column species; remains near but rarely within beds of plants or other cover along pond margins (USFWS 1994). Occupies riffles in small streams or pools of creeks with riffles during high water; also in large streams in rapids and in small tanks and spring-fed ditches. Streams typically are intermittent and subject to seasonal drying and sudden flooding; survives dry periods in permanent pools. Uncommon in large rivers. Small turbid pools over sand, gravel, or boulder substrates (Miller and Simon 1943). Thriving in pond habitats on the San Bernardino National Wildlife Refuge in Arizona (USFWS 1994). Eggs are laid in a nest scooped out of gravel by male in shallow, fast-flowing water.

Adult Food Habits: Herbivore, Invertivore

Immature Food Habits: Herbivore, Invertivore

Food Comments: Feeds mostly on terrestrial and aquatic insects; also eats algae and other plant matter.

Length: 7 centimeters

Management Requirements: Securing habitat and water sources is a major management need (USFWS 1994).

References:

- Arizona Game and Fish Department. 1994. *Cyprinella formosa mearnsi*. Unpublished abstact, Arizona Game and Fish Department, Phoenix, AZ. 4 pp.
- Chernoff, B., and R. R. Miller. 1982. *Notropis bocagrande*, a new cyprinid fish from Chihuahua, Mexico, with comments on *Notropis formosus*. Copeia 1982:514-522.
- Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. 1980. Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History. 867 pp.
- Matthews, J.R. and C.J. Moseley (eds.). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 + 33 pp. appendix + 6 pp. glossary + 16 pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.
- Mayden, R. L. 1989. Phylogenetic studies of North American minnows, with emphasis on the genus *Cyprinella* (Teleostei: Cypriniformes). Univ. Kansas Museum Natural History Miscellaneous Publication (80):1-189.
- Miller, R. R., and J. R. Simon. 1943. *Notropis mearnsi* from Arizona, an addition to the known fish fauna of the United States. Copeia 1943:253.
- Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, MD. 386 pp.
- Page, L. M., and B. M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Houghton Mifflin Company, Boston, MA. 432 pp.
- Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1991. Common and scientific names of fishes from the United States and Canada. American Fisheries Society, Special Publishing 20. 183 pp.
- Sublette, J. E., M. D Hatch, and M. Sublette. 1990. The fishes of New Mexico. University New Mexico Press, Albuquerque, NM. 393 pp.
- Texas Natural History Collections [University of Texas at Austin]. 1997. February 7-last update. North American Freshwater Fishes Index (Images, Maps and Information). Online. Available: http://www.utexas.edu/depts/tnhc/www.fish.tnhc/na/naindex.ht ml. Accessed 1997, April 4.
- U.S. Fish and Wildlife Service. 1990. Endangered and threatened species recovery program: report to Congress. 406 pp.
- U.S. Fish and Wildlife Service. 1994. Yaqui fishes recovery plan. USDI Fish and Wildlife Service, Albuquerque, NM. iv + 48 pp.
- U.S. Fish and Wildlife Service. 1995. San Bernardino and Leslie Canyon National Wildlife Refuges. Comprehensive management plan, 1995-2015. Includes the environmental assessment under seprate cover. Albuquerque, NM.

Desert Pupfish (*Cyprinodon macularius macularius*)

The desert pupfish was designated as a federally Endangered species on March 31, 1986.

Historic Range: Formerly in lower Colorado and Gila river drainages, southern Arizona to southeastern California, and in the Salton Sea and Laguna Salada basins, California and Mexico. Currently occurs in California in San Felipe Creek (lower reaches and associated wetlands; best non-native habitat in California) and San Sebastian Marsh (Imperial County) and Salt Creek (Riverside County; population there may not be viable); also in shoreline pools and irrigation drains in the Salton Sea area, where the species is scarce (Miller and Fuiman 1987). No native populations of *C. macularius* remain in Arizona (Minckley et al. 1991), but several reintroduced populations exist, and the species has been introduced in areas outside the native range. See Hendrickson and Varela (1989) for information on the status of several introduced populations in Arizona. Currently occurs in Sonora, Mexico, in Santa Clara Slough and several locations extending southeast from there, and in northeastern Baja California (notable is an apparently large population found at Cerro Prieto, Baja California) (Hendrickson and Varela 1989, Echelle et al. 2000). Several populations exist in artificial refugia.

Basic Description: A small chunky fish.

Reproduction Comments: Spawning: spring and summer, or year-round in warm constant temperature environments. Each female may lay 50-800 eggs or more/season, depending on her size (Moyle 1976). Males defend eggs. Eggs hatch in 10 days at 20 C (within about 3 days according to Matthews and Moseley 1990). Reproduces at age 2-3 months in constant warm temperatures; first breeds at about 1 year in variable temperatures. Up to 2-3 generations per year (Matthews and Moseley 1990).

Ecology Comments: Typically swims in loose schools, often in groups of similar size and age (Moyle 1976).

Habitat Type: Freshwater

Non-Migrant: Yes

Locally Migrant: No

Long Distance Migrant: No

Riverine Habitat(s): CREEK, Low gradient, MEDIUM RIVER, Pool, SPRING/SPRING BROOK

Lacustrine Habitat(s): Shallow water

Palustrine Habitat(s): HERBACEOUS WETLAND

Habitat Comments: Desert springs and outflow marshes, river-edge marshes, backwaters, saline pools, and streams. Original habitat probably was marshes and flood plain pools along the lower Colorado River and springs throughout the Salton Sink. Prefers areas with sand/silt substrates and aquatic plant life, limited surface flow, water less than 1 m in depth. Tolerates low oxygen levels, high temperatures, and high salinity. May forage in shallows in early morning, deeper water most of day. Often rests on bottom, especially at night. May dive into anoxic bottom mud. Male establishes territory prior to spawning, usually in water less than 1 meter deep (sometimes deeper). Territory is typically 1 to 2 square meters or more (Moyle 1976). Eggs are laid on substrate of sand, mud, or perhaps preferentially on algal mat (Schoenherr 1988).

Adult Food Habits: Herbivore, Invertivore

Immature Food Habits: Herbivore, Invertivore

Food Comments: Opportunistic. Feeds on algae, detritus, and small invertebrates. In the Salton Sea eats ostracods, copepods, and some insects and pile worms. In other areas feeds on aquatic crustaceans, aquatic insect larvae, and molluscs (Moyle 1976).

Phenology Comments: May burrow into loose substrate and become dormant in winter when temperatures are extreme.

Length: 6 cm

Management Requirements: Introductions into marginal, semi-natural, relatively stable habitats have not been especially successful; recovery planners should consider use of riverine habitat and manipulations of flows or other disturbances (Hendrickson and Varela 1989). See Meffe and Vrijenhoek (1988) for a discussion of conservation genetics.

Monitoring Requirements: San Felipe Creek and Salt Creek populations are regularly monitored by California Dept. of Fish and Game (California Department of Fish and Game 1990).

References:

- California Department of Fish and Game (CDF&G). 1990. 1989 annual report on the status of California's state listed threatened and endangered plants and animals. 188 pp.
- Echelle, A. A., R. A. Van Den Bussche, T. P. Malloy, Jr., M. L. Haynie, and C. O. Minckley. 2000. Mitochondrial DNA variation in pupfishes assigned to the species *Cyprinodon macularius* (Atherinomorpha: Cyprinodontidae): taxonomic implications and conservation genetics. Copeia 2000:353-364.
- Echelle, A. A., and A. F. Echelle. 1993. Allozyme perspective on mitochondrial DNA variation and evolution of the Death Valley pupfishes (Cyprinodontidae: Cyprinodon). Copeia 1993:275-287.
- Echelle, A. A., and T. E. Dowling. 1992. Mitochondrial DNA variation and evolution of the Death Valley pupfishes (Cyprinodon, Cyprinodontidae). Evolution 46:193-206.
- Hendrickson, D. A., and A. Varela Romero. 1989. Conservation status of the desert pupfish, *Cyprinodon macularius*, in Mexico and Arizona. Copeia 1989:478-483.
- Hendrickson, D. A., and J. E. Brooks. 1991. Transplanting short-lived fishes in North American deserts: review, assessment, and recommendations. Pages 283-98 in W. L. Minckley and J. E. Deacon (editors). Battle Against Extinction: Native Fish Management in the American West. University of Arizona Press, Tucson, AZ.
- Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. 1980. Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History. 867 pp.
- Matthews, J.R. and C.J. Moseley (eds.). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 + 33 pp. appendix + 6 pp. glossary + 16 pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.
- Meffe, G. K., and R. C. Vrijenhoek. 1988. Conservation genetics in the management of desert fishes. Conservation Biology 2:157-169.
- Miller, R. R., and L. A. Fuiman. 1987. Description and conservation status of Cyprinodon *macularius eremus*, a new subspecies of pupfish from Organ Pipe Cactus National Monument, Arizona. Copeia 1987:593-609.

- Minckley, W. L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ.
- Minckley, W. L., G. K. Meffe, and D. L. Soltz. 1991. Conservation and management of short-lived fishes: the cyprinodontoids. Pages 247-82 in W. L. Minckley and J. E. Deacon (editors). Battle Against Extinction: Native Fish Management in the American West. University of Arizona Press, Tucson, AZ.
- Minckley, W. L., and J. E. Deacon. 1991. Battle Against Extinction: Native Fish Management in the American West. University of Arizona Press, Tucson. xviii + 517 pp.
- Moyle, P. B. 1976. Inland fishes of California. University of California Press, Berkeley, CA. 405 pp.
- Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, MD. 386 pp.
- Page, L. M., and B. M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Houghton Mifflin Company, Boston, MA. 432 pp.
- Pister, E.P. (ed.). 1987. Proceedings of the Desert Fishes Council, Volume XIX, the Nineteenth Annual Symposium. Desert Fishes Council, Bishop, CA.
- Pister, E.P. (ed.). 1991. Proceedings of the Desert Fishes Council, Volumes XX and XXI, the Twentieth & Twenty-first Annual Symposia. Desert Fishes Council, Bishop, CA.
- Platania, S. P., K. R. Bestgen, M. A. Moretti, D. L. Propst, and J. E. Brooks. 1991. Status of Colorado squawfish and razorback sucker in the San Juan River, Colorado, New Mexico, and Utah. Southwestern Naturalist 36:147-150.
- Platania, S. P., K. R. Bestgen, M. A. Moretti, D. L. Propst, and J. E. Brooks. 1991. Status of Colorado Squawfish and razorback sucker in the San Juan River, Colorado, New Mexico, and Utah. Southwestern Naturalist 36:147-150.
- Platania, S.P. 1990. Biological summary of the 1987 to 1989 New Mexico-Utah ichthyofaunal study of the San Juan River. Prepared by Department of Biology, University of New Mexico, Albuquerque, for New Mexico Department of Game and Fish, Santa Fe, under contract 78-516.6-01, and U.S. Bureau of Reclamation, Salt Lake City, UT, under cooperative agreement 7-FC-40-05060.
- Roberts, B. and M. Moretti. 1989. Fisheries survey of the San Juan River, Utah, 1988. Final. Prepared by Utah Division of Wildlife Resources, Salt Lake City, UT, under U.S. Bureau of Reclamation Cooperative Agreement 7-FC-40-05050.
- Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1991. Common and scientific names of fishes from the United States and Canada. American Fisheries Society, Special Publishing 20. 183 pp.
- Schoenherr, A. A. 1988. A review of the life history and status of the desert pupfish, *Cyprinodon macularius*. Bull. Southern California Academy Science 87:104-134.
- Turner, B. J. 1984. Evolutionary genetics of artificial refugium populations of an endangered species, the desert pupfish. Copeia 1984:364-369.
- U.S. Fish and Wildlife Service (USFWS). 1986. Determination of endangered status and critical habitat for the desert pupfish. Federal Register 51(61):10642-50.
- U.S. Fish and Wildlife Service (USFWS). 1990. Endangered and threatened species recovery program: report to Congress. 406 pp.

Gila Chub (*Gila intermedia*)

The Gila chub was designated as a federally Endangered species on August 9, 2002.

Historic Range: Historically occurred in springs and small streams in the upper Gila River basin in southern Arizona, southwestern New Mexico, and northeastern Sonora, Mexico (Miller and Lowe 1964, Minckley 1973, USFWS 2002). In Arizona, Gila chub are known to have occupied portions of the Salt, Verde, Santa Cruz, San Pedro, San Carlos, San Simon, San Francisco, and Agua Fria drainages and smaller tributaries of the mainstem Gila River. Small remnant populations remain in most of these drainages with the exception of the Salt and San Simon Rivers, where all known populations have been extirpated. An observation of a Gila chub in Turkey Creek in the upper Gila River Basin in New Mexico was made in 2001 (Telles, pers. comm., 2001, cited by USFWS 2002). The current known distribution of Gila chub in Mexico has been reduced to two small spring areas, Cienega los Fresnos and Cienega la Cienegita, adjacent to the Arroyo los Fresnos (tributary of the San Pedro River), within 2 km (1.2 mi) of the Arizona-Mexico border (Varela-Romero et al. 1992). No Gila chubs remain in the Mexican portion of the Santa Cruz River basin (Weedman et al. 1996).

Basic Description: A fish (chub) that typically is about 15 cm long.

General Description: Fishes of the genus *Gila* that occur in the Colorado River basin range from the streamlined *Gila elegans* of large rivers, through *G. robusta* of intermediate-sized rivers, to the thick-bodied *G. intermedia* of creeks and marshes (cienegas) (Minckley 1973, DeMarais 1986). The following description of Gila chub is mainly from Minckley (1969, 1973) and Rinne (1976). The Gila chub is a robust, darkly colored minnow. A typical Gila chub would be approximately 150 mm in length. Gila chub from Redfield Canyon ranged in size from 45-222 mm TL (n=113) (Griffith and Tiersch 1989). At ages 1-4 years, based on scale analysis, calculated lengths averaged 90, 135, 160, and 183 mm TL. Minckley (1969) reported that males are typically smaller than females. Gila chubs usually have eight dorsal, anal, and pelvic fin rays. Scales are large and number less than 80 and more than 61 in the lateral line. Scales are also thick and broadly imbricate, and basal radii are usually present. Vertebrae number from 38 to 45. Barbels are absent and pharyngeal teeth are in two rows (2,5-4,2 with some variation). Head length divided by caudal peduncle depth is 3.0 or less. Both sexes possess breeding tubercles, although their distribution is less extensive on females. Minckley (1969) gave the following description of breeding coloration: "Breeding coloration in this fish may be far more intense than in other forms of the genus in Arizona. The axial and inguinal regions become a deep orange-red, which may develop further into a broken, orange-red band along the lower sides and caudal peduncle, extending forward to include the brancheostegal rays and cheeks. The eyes of males become yellow to yellow-orange and the body is blue-black dorsally. Fins of some individuals, especially the larger ones, may be washed with lemon yellow." Larvae were described by Winn and Miller (1954).

Diagnostic Characteristics: The Gila chub is most similar morphologically to the roundtail chub. The latter usually is lighter colored, less robust, and with scales that are relatively smaller, thinner, and only slightly embedded; basal radii on scales are absent to weakly developed; the number of dorsal, anal and pelvic fin rays in roundtail chubs usually is nine; there are usually 81 or more scales in the lateral line and 43 to 49 total vertebrae; the length of the head divided by the depth of the caudal peduncle is typically 3.3 to 4.3, rarely greater than 4.0. The Yaqui chub, *Gila purpurea*, and the Sonora chub, *Gila ditaenia*, have radii strongly developed on all fields of scales, the mouth is horizontal to oblique, and a basicaudal spot is present albeit possibly discrete or diffuse. *Gila elegans* is distinctive as adults and may be distinguished from the Gila chub using characteristics described by Douglas et al. (1989). *Gila elegans* has been extirpated from areas where the Gila chub occurs and, unless reintroductions of these species occur, these three species will not be taken in the same collections.

Reproduction Comments: In Monkey Spring, a relatively-constant spring-fed pond, reproduction may have last throughout late winter, spring, and summer, and perhaps into autumn (Minckley 1969, 1985). In other areas it occurs mostly in late spring and summer (Minckley 1973). Most Gila chub probably mature in their second or third year of life (Griffith and Tiersch 1989).

Ecology Comments: The Gila chub is associated with a native fish fauna that includes loach minnow (*Tiaroga cobitis*), spikedace (*Meda fulgida*), speckled dace (*Rhinichthys osculus*), longfin dace (*Agosia chrysogaster*), Sonora sucker (*Catostomus insignis*) and desert sucker (*Pantosteus clarki*). Historically, it also was associated with the woundfin (*Plagopterus argentissimus*), bonytail (*Gila elegans*), squawfish (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), and Gila topminnow (*Poeciliopsis occidentalis*), all of which are now extirpated from the Gila River basin. Gila chub and roundtail chub are sometimes found in the same stream systems, separated by only tens of meters; however, the two species have never been collected together at the same site (DeMarais 1990; Minckley 1985, 1990).

Habitat Type: Freshwater

Non-Migrant: No

Locally Migrant: No

Long Distance Migrant: No

Riverine Habitat(s): CREEK, MEDIUM RIVER, Moderate gradient, Pool, Riffle, SPRING/SPRING BROOK

Palustrine Habitat(s): HERBACEOUS WETLAND

Habitat Comments: Gila chubs commonly inhabit pools in smaller streams, springs, and cienegas, and they can survive in small artificial impoundments (Miller 1946, Minckley 1973, Rinne 1975). They are highly secretive, preferring quiet, deeper waters, especially pools, or remaining near cover including terrestrial vegetation, boulders, and fallen logs (Minckley 1973, Rinne and Minckley 1991). Minckley (1973) suggested that spawning may occur over beds of aquatic plants. Specific habitat associations are known to vary ontogenetically and likely vary seasonally and geographically. Young in Monkey Spring, Arizona (from which the species is now extirpated), 25-75 mm total length (TL), were found in swifter areas than were adults, which utilized undercut banks and heavily vegetated margins of the spring run (Minckley 1969). Griffith and Tiersch (1989) collected Gila chubs from both riffles and pools in Redfield Canyon, Arizona.

Adult Food Habits: Herbivore, Invertivore

Immature Food Habits: Herbivore, Invertivore

Food Comments: Feeds mainly on aquatic and terrestrial insects and filamentous and diatomaceous algae (Minckley 1973, Griffith and Tiersch 1989). Of 27 specimens examined for stomach contents in Redfield Canyon, four contained remains of fishes; three contained *Rhinichthys osculus* (Griffith and Tiersch 1989). Gila chubs were observed chasing Gila topminnows in Monkey Spring (Minckley 1969). No information is available on dietary differences between size or age classes. Larger individuals feed during evening and early morning hours, whereas young chubs feed during all daylight hours (Minckley 1973, Griffith and Tiersch 1989).

Phenology Comments: Young are active throughout the day; larger individuals tend to be most active in evening and early morning.

Stewardship Overview: Existing Gila chub populations need to be identified and carefully monitored. Protection would be enhanced by the elimination of detrimental water and land use practices and the removal of non-native fishes. Degraded habitats should be reclaimed and enhanced, and chubs should be reintroduced where chances for success are judged good. Research is needed to identify specific threats.

Restoration Potential: Lack of knowledge of the biology of Gila chub clearly is a deterrent to its recovery. Recovery potential is good only if critical habitat is vigorously protected. Remaining populations continue to be threatened by habitat modification and interactions with non-native fishes. Reestablishment in former range is problematic until the causes of the decline are corrected.

Preserve Selection & Design Considerations: Habitat in the form of headwater cienegas or spring-fed streams are critical for the continued existence of the Gila chub. Gila chub also does well in spring-fed ponds if non-native fish are excluded (Minckley 1969).

Management Requirements: Existing populations not infected by non-native fishes should be protected through the establishment of fish barriers if such is judged not to be detrimental to the Gila chub. Necessary habitat and landscape improvements (including removal of non-native fishes) need to be determined and implemented. Stream flows and temperatures should not be modified by activities such as damming or diversion that substantially alter natural regimes. State or other fish management agencies and private entities should discontinue stockings of non-native, warmwater sport, forage, or bait fishes into streams occupied by Gila chub; this protection should extend downstream at least to the first absolute barrier to upstream fish movement. Proper management and maintenance of riparian zones are essential to native fish populations. Changes in the riparian zone can affect leaf fall and energy flow, stream flow, natural cover, temperature, and deposition of eroded materials (Baltz and Moyle 1984). Of five riparian systems studied in Arizona, only Aravaipa Creek, where cattle have been excluded since 1973, showed successful reproduction and dominance of the broadleaf riparian community (Rucks 1984). Cattle-browsing is a major factor in the replacement of a broadleaf riparian community by a riparian scrub community (Rucks 1984). A change from a broadleaf to scrub riparian community can change energy flow, tree-fall cover and amount of shade, and temperature profiles of a stream. Fire would be a preferred method of watershed management when necessary. However, the choice of fire as a management tool must take into account the fuel levels present. A crown fire ("hot fire") can lead to increased runoff and result in the filling of riffle or other spawning areas. The effects of a crown fire and subsequent runoff were reversed in three years in the upper Carmel River, California (Hecht 1984). If watershed management is necessary, controlled burns, frequent enough to prevent build-up of high fuel levels, set during nonspawning periods or periods of decreased spawning activity (winter), should be employed. Populations should be reintroduced into selected streams within the historic range. Potential dispersal routes should be closed to preclude reinvasion of non-native fishes. Barrier design should not significantly alter stream flow and the potential impact on natural upstream and downstream movements of native fishes should be assessed. Habitat improvement should be implemented, which may include removal of non-native fishes by piscicide. Reintroduced stocks should have a genetic affinity with those formerly occupying target streams. Stockings should be done according to guidelines set up by the American Fisheries Society (Williams et al. 1988), consultants familiar with GILA taxonomy, and the U.S. Fish and Wildlife Service. Reintroduced populations should be monitored for success or failure. Populations that are rapidly declining should be secured in a hatchery facility such as the Dexter National Fish Hatchery, Dexter, New Mexico. Techniques for spawning and rearing *Gila* spp. are available (Hamman 1981, 1982, 1982, Muth et al. 1985).

Monitoring Requirements: Known populations should be monitored biannually in the spring during the breeding season and in late autumn to check recruitment. Standardized techniques should be adopted so that data will be comparable over locations and time. Data are needed to distinguish between natural fluctuations in abundance and population decline due to human-caused perturbation. Monitoring locations for Gila chub should be chosen so that all drainages and morphological variants represented. Techniques available for determination of absolute abundance for fishes are depletion sampling, mark-and-recapture, underwater censusing, and passive capture devices. These may be modified or others developed specifically for application to the Gila chub. Such techniques should be adjusted as dictated by experience, and uniformly applied. *Gila* species can be difficult to collect as they will flee when approached. They are often located under or next to objects, making seining difficult; as a result, electroshocking devices may provide more efficient sampling. Large areas must be sampled to determine presence/absence of Gila chub because certain areas are used, sometimes consistently over time, and others, which may be similar, are not (Minckley 1990). If resources are limited, a better strategy is to sample an entire headspring-cienega-stream system thoroughly every two to three years rather than sampling annually small areas of a stream or cienega system. DeMarais (1990) and Minckley (1990) stated that Gila chub occurrences are extremely spotty and localized. When chub populations are located, these data could be recorded on aerial photographs, and these photographs used to relocate chub populations. Recording these data on aerial photographs might also reveal clues about other stream reaches that have appropriate Gila chub habitat.

Biological Research Needs: The impact of flooding on nutrient cycling, substrate renewal, and availability of cover, with respect to native fishes, needs to be examined.

References:

- Arizona Game and Fish Commission. 1988. Threatened native wildlife in Arizona. Arizona Game and Fish Department Publication, Phoenix, AZ. 32 pp.
- Baltz, D. M., and P. B. Moyle. 1984. The influence of riparian vegetation on steam fish communities of California. Pp. 183-7 in R. E. Warner and K. M. Hendrix (eds.). California riparian systems. University of California Press, Berkeley, CA.
- Bestgen, K. R., and D. L. Propst. 1989. Distribution, status, and notes on the ecology of *Gila robusta* (Cyprinidae) in the Gila River drainage, New Mexico. Southwestern Naturalist 34:402-412.
- DeMarais, B. D. 1986. Morphological variation in Gila (Pisces: Cyprinidae) and geologic history: lower Colorado River Basin. Arizona State University, Tempe, AZ. M.S. Thesis.
- Deacon, J. E. and W. L. Minckley. 1974. Desert Fishes. Pp. 385-488 in G. W. Brown (ed.). Desert Biology, Vol. II. Academic Press, Inc., New York, NY.
- Douglas, M. E., W. L. Minckley, and H. M. Tyus. 1989. Qualitative characters, identification of Colorado River chubs (Cyprinidae: genus Gila) and the "art of seeing well." Copeia 1989:653-662.
- Griffith, J. S. and T. R. Tiersch. 1989. Ecology of fishes in Redfield Canyon, Arizona, with emphasis on *Gila robusta intermedia*. Southwestern Naturalist 34:131-4.
- Hamman, R. L. 1981. Hybridization of three species of chub in a hatchery. Prog. Fish-Cult. 43:140-1.
- Hamman, R. L. 1982. Induced spawning and culture of bonytail chub. Prog. Fish-Cult. 44:201-3.
- Hamman, R. L. 1982. Spawning and culture of humpback chub. Prog. Fish-Cult. 44:213-6.
- Hastings, J. R. 1959. Vegetation change and arroyo cutting in southeastern Arizona. J. Arizona Academy Science 1:60:67.
- Hecht, B. 1984. Sequential changes in bed habitat condidtions in the upper Carmel River following the Marble-Cone fire of August, 1977. Pp. 134-41 in R. E. Warner and K. M. Hendrix (eds.). California riparian systems. University of California Press, Berkeley, CA.

- Hendrickson, D. A. and W. L. Minckley. 1984. Cienegas--Vanishing climax communities of the American Southwest. Desert Plants. 6:141-75.
- Hubbs, C. L. 1954. Establishment of a forage fish, the red shiner (*Notropis lutrensis*), in the lower Colorado River system. California Fish and Game 40:287-94.
- Meffe, G. K. 1985. Predation and species replacement in American southwestern fishes: a case study. Southwestern Naturalist 30:173-187.
- Meffe, G. K., and W. L. Minckley. 1987. Persistence ans stability of fish and invertebrate assemblages in a repeatedly disturbed Sonoran desert stream. American Midland Naturalist 117:177-91.
- Miller, R. R. 1961. Man and the changing fish fauna of the American Southwest. Paper Michigan Academy Science, Arts, and Letters 46:365-404.
- Miller, R. R. and C. H. Lowe. 1964. Part 2: An annotated check-list of the fishes of Arizona. Pp. 133-51 in C. H. Lowe (ed.). The vertebrates of Arizona. University of Arizona Press, Tuscon, AZ.
- Minckley, W. L. 1969. Aquatic biota of the Sonoita Creek Basin, Santa Cruz County, Arizona. Ecological Studies Leaflet, No. 15. 8 pp.
- Minckley, W. L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ.
- Minckley, W. L. 1985. Native fishes and natural aquatic habitats in U.S. Fish and Wildlife Service Region II west of the Continental Divide. Report to U.S. Fish and Wildlife Service, Albuquerque, NM. 158 pp.
- Minckley, W. L., and G. K. Meffe. 1987. Differential selection by flooding in stream-fish communities of the arid American southwest. Pp. 93-104 in W. J. Matthews and D. E. Heins (eds.). The zoogeography of North American freshwater fishes. John Wiley and Sons, Incorporated, NY.
- Minckley, W. L., and J. E. Deacon. 1968. Southwestern fishes and the enigma of "endangered species." Science 159:1424-32.
- Muth, R. T., C. M. Haynes and C. A. Carlson, 1985. Culture of roundtail chubs, *Gila robusta robusta* (Cyprindidae), through the larval period. Southwestern Naturalist 30:152-4.
- Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, MD. 386 pp.
- Page, L. M., and B. M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Houghton Mifflin Company, Boston, MA. 432 pp.
- Propst, D. L., P. C. Marsh and W. L. Minckley. 1985. Arizona survey for spikedace (*Meda fulgida*) and loach minnow (*Tiaroga cobitis*): Fort Apache and San Carlos Apache Indian Reservations and Eagle Creek, 1985. Report to Office of Endangered Species, U.S. Fish and Wildlife Service, Albuquerque, NM. 8 pp.
- Rinne, J. N. 1976. Cyprinid fishes of the genus Gila from the lower Colorado River Basin. Wassman J. Biology 34:65-107.
- Robins, C. Richard, et. al. 1980. A List of Common and Scientific Names of Fishes from the United States and Canada. 4th edition. American Fisheries Society, Special Publication No. 12, Bethesda, MD.

- Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1991. Common and scientific names of fishes from the United States and Canada. American Fisheries Society, Special Publishing 20. 183 pp.
- Rucks, M. G. 1984. Composition and trend of riparian vegetation on five perennial streams in southeastern Arizona. Pp. 97-107 in R. E. Warner and K. M. Hendrix (eds.). California riparian systems. University of California Press, Berkeley, CA.
- Sublette, J. E., M. D Hatch, and M. Sublette. 1990. The fishes of New Mexico. University New Mexico Press, Albuquerque, NM. 393 pp.
- U.S. Fish and Wildlife Service. 9 August 2002. Listing the Gila chub as endangered with critical habitat. Federal Register 67(154):51948-51985.
- Vanicek, C. D., and R. H. Kramer. 1969. Life history of the Colorado squawfish, *Ptychocheilus lucius*, and the Colorado chub, *Gila robusta*, in the Green River in Dinosaur National Monument, 1964-1966. Trans. American Fish. Soc. 98:193-195.
- Varela-Romero, A., et al. [9 other authors]. 1990. Re-discovery of *Gila intermedia* and *Gila purpurea* in northern Sonora, Mexico. Proceedings of the Desert Fishes Council 22:33.
- Weedman, D. A., A. L. Girmendonk, and K. L. Young. 1996. Status review of Gila chub, *Gila intermedia*, in the United States and Mexico. Technical Report 91, Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix. 120 pp.
- Williams, J. E. and D. W. Sada. 1985. America's desert fishes: increasing their protection under the Endangered Species Act. Endangered Species Tech. Bull. 10:8-14.
- Williams, J. E., D. W. Sada, C. D. Williams, et. al. 1988. American Fisheries Society guidelines for introductions of threatened and endangered fishes. Fisheries. 13:5-11.
- Winn, H. E., and R. R. Miller. 1954. Native postlarval fishes of the lower Colorado River basin, with a key to their identification. California Fish and Game 40:273-85. 4 plates.

Yaqui Chub (*Gila purpurea*)

The Yaqui chub was designated as a federally Enangered species on August 31, 1984.

Historic range: Historically the Yaqui chub occurred in the Rio Yaqui drainage in Cochise County, extreme southeastern Arizona, USA, and in a short perennial reach of the Rio de San Bernardino (Black Draw) just south of the U.S./Mexico border in Sonora, Mexico. Current distribution in Mexico is unknown. The species was nearly extirpated in the United States, persisting only in one artesian well in San Bernardino Creek drainage (McNatt 1974). It was introduced and established in Leslie Creek, Swisshelm Mountains, Arizona, in 1969 (Minckley 1973). Records from Morse Canyon, northern Chiracahua Mountains, Arizona, are not supported by specimens (Willcox Playa basin; McNatt 1974). In the United States, populations are limited primarily to several sites in the San Bernardino National Wildlife Refuge and Leslie Canyon National Wildlife Refuge, Cochise County, Arizona. Populations from the drainages of the Rio Sonora, Rio Matape, and portions of the Rio Yaqui in Sonora, Mexico, formerly were included in *G. purpurea*; they were described as a new species (*Gila eremica*) by DeMarais (1991).

Basic Description: A fish less than six inches long.

Reproduction Comments: Spawning occurs throughout the warmer months, with greater activity in spring; matures often within the first summer; high reproductive potential (USFWS 1994).

Ecology Comments: Large populations develop quickly from a few adults.

Habitat Type: Freshwater

Non-Migrant: No

Locally Migrant: No

Long Distance Migrant: No

Riverine Habitat(s): CREEK, Moderate gradient, Pool

Habitat Comments: Habitat includes deep pools in creeks, springheads, scoured areas of cienegas, and other stream-associated quiet waters (USFWS 1994); this fish seeks shade, often near undercut banks or debris; it is often associated with higher aquatic plants (Lee et al. 1980). Similarly, in artificial ponds, adults tend to occupy the lower part of the water column and seek shade (USFWS 1994). Young occupy near-shore zones, often near the lower ends of riffles (USFWS 1994). Spawning occurs probably in deep pools where there is aquatic vegetation (Matthews and Moseley 1990).

Adult Food Habits: Herbivore, Invertivore, Piscivore

Immature Food Habits: Herbivore, Invertivore, Piscivore

Food Comments: Eats algae, terrestrial insects, and arachnids. Aquatic insects and small fishes (Poeciliopsis) are eaten when available; also detritus (Matthews and Moseley 1990).

Stewardship Overview: Actions needed (USFWS 1994): 1) Develop co-operative effort with Mexico for the recovery of Yaqui fishes; 2) Secure habitat and water sources for the Yaqui fishes in the USA and Mexico; 3) Conduct research on the biology and habitat requirements of Yaqui fishes; 4) Manage the fish and their essential habitats; 5) Introduce and maintain self-sustaining populations within their historic range; and 6) Monitor existing and established populations and habitats. Management needs: protect San Bernardino aquifers, and Leslie and San Bernardino watersheds, to ensure adequate perennial flow; ameliorate effects of non-native fishes within chub management streams; establish and maintain self-sustaining populations on San Bernardino and Leslie Canyon NWRs, and West Turkey Creek (Arizona Game and Fish Department 2001).

Management Requirements: Securing habitat and water sources are important management needs. See recovery plan (USFWS 1994).

References:

- Arizona Game and Fish Department. 2001. *Gila purpurea*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, AZ. 4 pp.
- DeMarais, B. D. 1991. *Gila eremica*, a new cyprinid fish from northwestern Sonora, Mexico. Copeia 1991:178-189.
- Hendrickson, D. A., and J. E. Brooks. 1991. Transplanting short-lived fishes in North American deserts: review, assessment, and recommendations. Pages 283-98 in W. L. Minckley and J. E. Deacon (editors). Battle Against Extinction: Native Fish Management in the American West. University of Arizona Press, Tucson, AZ.
- Hendrickson, D., W. L. Minckley, R. R. Miller, D. J. Siebert, and P. H. Minckley. 1980. Fishes of the Rio Yaqui Basin, Mexico and the United States. J. Ariz. Acad. Sci. 15(3):65-106.
- Kline, J., T. Archdeacon, A. C. Iles, and S. A. Bonar. 2007. Factors influencing distribution of introduced Asian tapeworm and effects on selected southwestern fishes (Yaqui topminnow and Yaqui chub). Arizona Cooperative Fish and Wildlife Research Unit Fisheries Research Report 01-07.
- Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. 1980. Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History. 867 pp.
- Matthews, J.R. and C.J. Moseley (eds.). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 + 33 pp. appendix + 6 pp. glossary + 16 pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.
- McNatt. R.M. 1974. Re-evaluation of the native fishes of the Rio Yaqui in the United States. Proc. Ann. Conf. West. Assoc. Game Fish Comm. 54:273-279.
- Minckley, W. L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ.
- Minckley, W. L., and J. E. Deacon. 1991. Battle Against Extinction: Native Fish Management in the American West. University of Arizona Press, Tucson. xviii + 517 pp.
- Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, MD. 386 pp.
- Page, L. M., and B. M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Houghton Mifflin Company, Boston, MA. 432 pp.
- Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1991. Common and scientific names of fishes from the United States and Canada. American Fisheries Society, Special Publishing 20. 183 pp.

- U.S. Fish and Wildlife Service. 1990. Endangered and threatened species recovery program: report to Congress. 406 pp.
- U.S. Fish and Wildlife Service. 1984. Final rule to determine the Yaqui chub to be an endangered species with critical habitat, and to determine the beautiful shiner and Yaqui catfish to be threatened species with critical habitat. Federal Register 49(171):34490-34497.
- U.S. Fish and Wildlife Service. 1994. Yaqui fishes recovery plan. USDI Fish and Wildlife Service, Albuquerque, NM. iv + 48 pp.
- U.S. Fish and Wildlife Service. 1995. San Bernardino and Leslie Canyon National Wildlife Refuges. Comprehensive management plan, 1995-2015. Includes the environmental assessment under seprate cover. Albuquerque, NM.
- Williams, J. E., J. E. Johnson, D. A. Hendrickson, S. Contreras-Balderas, J. D. Williams, M. Navarro-Mendoza, D. E. McAllister, and J. E. Deacon. 1989. Fishes of North America endangered, threatened, or of special concern: 1989. Fisheries 14:2-20.

Yaqui Catfish (*Ictalurus pricei*)

The Yaqui catfish was designated as a federally Threatened species on August 31, 1984.

Historic range: Originally described from the Rio San Bernardino, Sonora. Historical range most likely included the uppermost Rio Yaqui system, Arizona, and the basins of the Rio Yaqui and Rio Casas Grandes, Sonora and Chihuahua, Mexico (USFWS 1994). Now definitely known only from the Rio Yaqui basin, Mexico, though catfishes in other basins to the south may be this species. An introduced population existed in Arizona in the Santa Cruz River system (in a reservoir fed by Monkey Spring) from 1899 to the 1950s (Minkley 1973, Lee et al. 1980). As of the mid-1990s, stock was being held at Dexter National Fish Hatchery for future reintroduction onto the San Bernardino National Wildlife Refuge in Arizona.

Basic Description: A small catfish.

Ecology Comments: Little information on life history available but probably similar to channel catfish (Minckley 1973). Grows rapidly and attains large sizes in ponds at Dexter NFHTC.

Habitat Type: Freshwater

Non-Migrant: No

Locally Migrant: No

Long Distance Migrant: No

Riverine Habitat(s): CREEK, MEDIUM RIVER, Moderate gradient

Special Habitat Factors: Benthic

Habitat Comments: Small to medium rivers; most abundant in larger rivers in medium to slow currents over gravel/sand substrate.

Length: 50 cm

Management Requirements: Securing habitat and water sources is a major management need (USFWS 1994). Could be reintroduced in the San Bernardino NWR if sufficient habitat there can be secured and maintained. However, leases on geothermal resources granted by BLM on lands adjacent to the NWR possibly could result in a decrease in the already diminished water tables in the region, and the threat of pollution of groundwater could be increased. These threats are to be evaluated by BLM in consultation with the USFWS.

References:

- Hendrickson, D. A., et al. 1981. Fishes of the Rio Yaqui, Mexico and United States. J. Arizona-Nevada Academy Science 15(3; 1980):65-106.
- Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. 1980. Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History. 867 pp.
- Lundberg, J. G. 1992. The phylogeny of ictalurid catfishes: a synthesis of recent work. Pages 392-420 in R. L. Mayden, editor. Systematics, historical ecology, and North American freshwater fishes. Stanford Univ. Press, Stanford, CA. xxvi + 969 pp.
- Matthews, J.R. and C.J. Moseley (eds.). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 +

33 pp. appendix + 6 pp. glossary + 16 pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.

- Minckley, W. L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ.
- Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, MD. 386 pp.
- Page, L. M., and B. M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Houghton Mifflin Company, Boston, MA. 432 pp.
- Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1991. Common and scientific names of fishes from the United States and Canada. American Fisheries Society, Special Publishing 20. 183 pp.
- U.S. Fish and Wildlife Service. 1990. Endangered and threatened species recovery program: report to Congress. 406 pp.
- U.S. Fish and Wildlife Service. 1994. Yaqui fishes recovery plan. USDI Fish and Wildlife Service, Albuquerque, NM. iv + 48 pp.
- U.S. Fish and Wildlife Service. 1995. San Bernardino and Leslie Canyon National Wildlife Refuges. Comprehensive management plan, 1995-2015. Includes the environmental assessment under separate cover. Albuquerque, NM.

Spikedace (*Meda fuldgida*)

The spikedace was designated as a federally Threatened species on July 1, 1986.

Historic Range: Upper Gila River basin, Arizona and New Mexico; formerly common throughout much of the Verde, Agua Fria, Salt, San Pedro, San Francisco, and Gila (upstream from Phoenix) river systems; to elevations of 1800-1900 m; range and abundance are now much reduced. Restricted to approximately 445 km of stream in in portions of the upper Gila River (Grant, Catron, and Hidalgo counties, New Mexico), middle Gila River (Pinal County, Arizona), lower San Pedro River (Pinal County, Arizona), Aravaipa Creek (Graham and Pinal counties, Arizona), Eagle Creek (Graham and Greenlee counties, Arizona), and the Verde River (Yavapai County, Arizona) (USFWS 1999). Current abundance ranges from very rare to common in the occupied range; common only in Aravaipa Creek and some parts of the upper Gila River in New Mexico (USFWS 1999).

Basic Description: A small fish (spikedace) up to about 8 cm long.

General Description: Adult spikedace are typically less than 70 mm in total length (TL), slim, and slightly compressed laterally. Scales are present only as small plates deeply embedded in the skin. The dorsal fin has a short base with usually seven rays, the first two being spinose, the anterior one being grooved to receive the second. The first spinous ray of the dorsal fin is stronger than the second, almost as long, and sharply pointed. Anal fins usually have 9 rays. Medial edges of the pelvic fins are adnate to the belly. The eyes and mouth are both relatively large and barbels are absent. Pharyngeal teeth are typically 1,4-4,1. The sides are silvery with vertically elongated black specks. The dorsum is olive-gray to brownish, usually mottled with darker pigmentation while the belly is white. Breeding males have a golden or brassy sheen, especially on the head and at bases of fins (Girard 1857, Miller and Hubbs 1960, Minkley 1973). Gilbert and Scofield (1898) and Miller and Hubbs (1960) noted the presence of rose or reddish colors. Even in the nonbreeding season the sides have been described as appearing "...like burnished silver..." (Miller and Hubbs 1960). Both sexes have breeding tubercles, but they are better developed, and therefore more visible, in males. Abarca (1990) suggested the following method for distinguishing between sexes: for males the eye diameter is greater than the distance between the distal end of the pectoral fin (when folded back parallel with the long axis of the body) and the origin of the pelvic fins; for females the eye diameter is equal to or less than the distance between the distal end of the pectoral fin and origin of the pelvic fins. Larvae have a nearly vertical mouth that makes them relatively easy to distinguish from other cyprinid larvae of the lower Colorado River Basin (Winn and Miller 1954). The spikedace is a member of the tribe Plagopterini (Miller and Hubbs 1960). Other species of this tribe in Arizona are the woundfin (*Plagopterus argentissimus*), Little Colorado River spinedace (*Lepidomeda vittata*), and Virgin River spinedace (*Lepidomeda mollispinis mollispinis*). These fishes, plus the introduced carp (*Cyprinus carpio*) and goldfish (*Carassius auratus*), are the only cyprinid fishes in Arizona and New Mexico with fin rays modified as spines.

Diagnostic Characteristics: Characters that easily distinguish the spikedace from other Plagopterini in Arizona and New Mexico are the following: woundfin has a single barbel at each side of the upper jaw and an anal fin with 10 rather than 9 soft rays; Little Colorado River and Virgin River spinedace have visible scalation and the first spinose ray of the dorsal fin is weaker and obviously shorter than the second; carp and goldfish have long dorsal fins with more than 11 soft rays.

Reproduction Comments: Males evidently are not territorial but remain evenly spaced throughout a patrolled area. Females generally enter the area from downstream and are chased by males. The chase terminates when the female either strikes the bottom, or halts, in a group of males. Eggs are presumed to be spawned at this time (Barber et al. 1970, Minckley 1973). Breeding color and tubercles may appear as early as December and last until August (Minckley 1981). Breeding may be triggered by a combination of temperature and stream discharge (Propst et al. 1986), as also documented for *Rhinichthys osculus* (John 1963). Gonads generally increase in size in February. Spawning first occurs in March when water temperatures reach approximately 19 C and proceeds until June (Minckley 1973, Anderson 1978), but mature ovaries have been noted in September (Minckley 1981). Propst et al. (1986) identified April as the peak breeding period and stated that spawning was completed by mid-May. Older females spawn earlier than younger females (Anderson 1978). Number of eggs per female ranges from 80 to 300 or more depending on female size. Anderson (1978) examined a sample of 29 females from the Gila River, 10 km south of Cliff, New Mexico; these ranged in size from 38 to 70 mm TL, with 88 to 246 mature ova per female. Anderson (1978) computed the relationship between female body size and fecundity as follows: number of ova = -152.85 + 5.61 TL (r = 0.844). Ovum diameter at spawning is near 1.5 mm. Age II females spawn at least twice per season, but most reproductive effort is by age I females (Barber et al. 1970, Anderson 1978, Sublette et al. 1990). Young first appear in April and May and reach 41 to 47 mm TL by November. Standard length (tip of snout to end of hypural plate) is related to total length by the following equation: SL = 0.85 TL - 0.12, r X r = 0.99, n = 100 (Marsh 1988). Total length averages 47 mm TL at the end of the first year, and 59 to 74 mm at the end of the second year. Sexual maturity occurs at about 40 mm in both sexes (Barber et al. 1970), and most become sexually mature in their second summer of life. Longevity typically is one to two years. Few live through their fourth summer and the largest individuals rarely exceed 70 mm (TL?) (Minckley 1973). Anderson (1978) reported an 81 mm TL female. Growth continues in the winter in Aravaipa Creek (Barber et al. 1970) but not in the cooler Gila River in New Mexico (Anderson 1978).

Ecology Comments: The spikedace is associated with a native fish fauna that includes roundtail chub (*Gila robusta*), loach minnow (*Tiaroga cobitis*), speckled dace (*Rhinichthys osculus*), longfin dace (*Agosia chrysogaster*), Sonora sucker (*Catostomus insignis*), and desert sucker (*Pantosteus clarki*). Historically, it was also associated with the woundfin (*Plagopterus argentissimus*), bonytail (*Gila elegans*), squawfish (*Ptychocheilus lucius*), and razorback sucker (*Xyrauchen texanus*), all now extirpated from the Gila River basin. Due to difficulties in tagging small fishes, movement patterns of spikedace adults are unquantified. Minckley (1981) showed that populations of spikedace in Aravaipa Creek increased following years of relatively high flow.

Habitat Type: Freshwater

Non-Migrant: No

Locally Migrant: No

Long Distance Migrant: No

Riverine Habitat(s): CREEK, Low gradient, MEDIUM RIVER, Moderate gradient, Pool, Riffle

Special Habitat Factors: Benthic

Habitat Comments: Favors permanent, flowing, unpolluted water of low gradient streams having pool, riffle, run, and backwater areas; sand, gravel, and cobble substrates with low to moderate amounts of fine sediment and substrate embeddedness; abundant aquatic insects; natural hydrologic conditions, including recurrent flooding; few or no predatory or competitive non-native species present; a healthy riparian community; and moderate to high bank stability (USFWS, Federal Register, 8 March 1994; USFWS 1999). In larger rivers, spikedace often are found in the vicinity of tributary mouths. Adults favor slow to swift velocities (0-100 cm/sec) in shallow water (3-38 cm) with shear zones where rapid flow borders slower flow, areas of sheet flow at the upper ends of mid-channel sand/gravel bars, and eddies at downstream riffle edges. Juveniles favor slow to moderate flow (0-60 cm/sec) in shallow water (3-70 cm) with moderate amounts of instream cover; shallow stream margins and backwater areas, over silt, sand, or gravel bottoms, adjacent to pools. Periodic spates that scour and clean sands and gravels are essential to feeding and reproduction (Sublette et al. 1990). See Barber and Minckley (1966), Anderson (1978), Propst and Bestgen (1986), Propst et al. (1986), and Sublette et al. (1990) for further details. May partition habitat with red shiner in areas where the two species co-occur (Rinne 1991). Spawns over shallow (less than 15 cm deep), sand-gravel-bottomed riffles where water flow is moderate (Minckley 1973, Sublette et al. 1990). Eggs develop in sand or gravel at spawning site (Sublette et al. 1990). Stability of the substrate is likely important during times of egg deposition and hatching (Minckley 1981). Larvae occur in areas of slow to moderate flow (0-30 cm/sec) in shallow water (3-30 cm) with abundant instream cover. Habitat utilization in the Cliff-Valley reach of the Gila River was studied by Propst et al. (1986). Juveniles (26-35 mm TL) were found to occupy an average depth of 16.1 cm and average current speed of 16.8 cm/s. Adults (>36 mm TL) in the same reach occupied an average depth of 19.3 cm and current of 49.1 cm/s. Spikedace occupied swifter waters in the warmer months of June to November than in the cooler months of December to May. Although habitat availability was not recorded, Propst et al. (1986) believed this to be a real shift. Sixty-percent of larval spikedace were captured over sand-dominated substrate, 18% over gravel, and 18% over cobble substrates. Juveniles were found over gravel substrates (46%), sand-dominated substrates (45%), and cobble substrates (9%). Adults were captured over gravel substrates (47%), cobble substrates (32%), and sand-dominated substrates (19%). Rinne and Kroeger (1988) observed spikedace in Aravaipa Creek at an average depth of 20 cm and current speed of 35 cm/s over gravel and pebble substrates (3-64 mm diameter). Schools of 10 of more fish were found in deeper and slower water than solitary fish. Seasonal differences were documented in use of depths but not currents. Spikedace collected in December, February, and August occupied shallower depths than those collected in April, May, and September. Rinne and Kroeger stated these differences showed no discernible pattern and were probably related to availability.

Adult Food Habits: Invertivore, Piscivore

Immature Food Habits: Invertivore, Piscivore

Food Comments: Diet is mainly aquatic and terrestrial insects, such as larval baetid ephemeropterans, and secondarily other larval ephemeropterans, hydropsychid trichopterans, and chironomid and simuliid dipterans (Anderson 1978, Schreiber and Minckley 1981, Barber and Minckley 1983, Abarca 1989). Schreiber and Minckley (1981) reported that up to approximately 30% of the diet was made up of emerging or adult insects. Also eats (seasonally) some fry of other fish species. In pools, eats mayflies; diet is more diverse in riffles and runs. Dipteran larvae are most important for small individuals, mayfly adults and nymphs for adults.

Phenology Comments: Feeding activity peaks in late afternoon and early evening (Barber and Minckley 1983). Larval cyprinids in the Gila River of New Mexico were found to be primarily diurnal drifters; 87% of cyprinid larvae collected were in noon or dusk drift samples (Bestgen et al. 1987). Additionally, a ratio of 6.5:1, nearshore vs. midstream, in captured larvae was found in noon samples, but a 1:1 ratio was found in dawn samples.

Stewardship Overview: Existing populations must be carefully monitored and protected by eliminating detrimental water and land use and exposure to non-native fishes. Research is needed to identify specific aspects of these practices that result in the demise of spikedace. Spikedace are not the only native fish threatened, endangered, or extirpated from the Gila River Basin. An ecological approach that addresses the habitat needs of all native fish species is necessary to protect remaining populations of native fishes. Degraded habitat should be reclaimed and enhanced, and spikedace should be reintroduced where chances for success are judged good.

Restoration Potential: Recovery potential is good only if adequate suitable habitat within the present or historical range is vigorously protected. Remaining populations continue to be threatened by habitat modification, predation by and competition with non-native fishes, and continued introduction and dispersal of non-native fishes. Reestablishment of the spikedace into its former range is problematic until the causes of its demise are identified and corrected.

Preserve Selection & Design Considerations: Preserves should be in areas of designated Critical Habitat (see Federal Register, 8 March 1994, p. 10906).

Management Requirements: The following management needs were identified by Marsh (1988): protect existing populations not infected by non-native fishes by building fish barriers or enhancing natural barriers (barrier design should not significantly alter stream flow and the potential impact on natural upstream and downstream movements of native fishes should be assessed; barrier design must be approved by appropriate agencies and the Desert Fishes Recovery Team); identify target areas amenable to management; determine and implement necessary habitat and landscape improvements (including removal of non-native fishes); reintroduce populations to selected streams within historic range, ensuring that genetic considerations are addressed (local stocks with affinities to those formerly occupying target streams should be utilized for reintroduction; e.g., Aravaipa Creek for the San Pedro, Gila River for the San Francisco; stockings should be done according to guidelines set up by the American Fisheries Society, Desert Fishes Recovery Team, and the U.S. Fish and Wildlife Service); assure closure of potential immigration routes to preclude reinvasion of non-native fishes. Proper management and maintenance of riparian zones are essential to native fish populations. Changes in the riparian zone can affect leaf fall and energy flow, flow, natural cover, temperature, and deposition of eroded materials (Baltz and Moyle 1984). Of five riparian systems studied in Arizona, only Aravaipa Creek, where cattle have been excluded since 1973, showed successful reproduction and dominance of the broadleaf riparian community (Rucks 1984). Cattle-browsing is a major factor in the replacement of a broadleaf riparian community by a riparian scrub community (Rucks 1984). A change from a broadleaf to scrub riparian community can change energy flow, tree-fall cover, amount of shade, and stream temperature. Fire would be a preferred method of watershed management when necessary. However, the choice of fire as a management tool must take into account the fuel levels present. A crown fire ("hot fire") can lead to increased runoff and result in the filling of riffles or other spawning areas. The effects of a crown fire and subsequent runoff were reversed in three years in the upper Carmel River, California (Hecht 1984). Removal of spawning areas for a period of two to three years would cause local extinctions of spikedace due to their short lifespan. If watershed management is necessary, controlled burns, frequent enough to prevent build-up of high fuel levels, set during non-spawning periods or periods of decreased spawning activity (autumn), should be employed.

Monitoring Requirements: Known populations should be monitored biannually in the spring during the breeding season and in late autumn to check recruitment. Data are needed to distinguish natural fluctuations in abundance from population declines due to human-caused perturbation. Reintroduced populations should be monitored for success or failure. An immediate monitoring program is needed for Aravaipa Creek, Arizona, due to the recent discovery of red shiner in September 1990 (Minckley 1990). Additionally, the black bullhead has increased in abundance in Aravaipa Creek and may prey on spikedace (Marsh 1990); this situation should be monitored. Standardized monitoring techniques should be adopted so that data will be comparable over locations and time. Techniques could be those recommended by the Desert Fishes Recovery Team. Techniques available for determination of absolute abundance for fishes include depletion sampling, mark-and-recapture, passive capture devices, and underwater censusing. These may be modified or others developed specifically for application to spikedace. Such techniques should be adjusted as dictated by experience, and uniformly applied. Minckley (1981) found that 6 to 10 passes with an electroshocking device, in an area blocked off with nets, were required to capture 99% of the spikedace. Natural units of a stream should be sampled, i.e. riffles, pools, runs and channels, rather than predetermined distances. Then the natural units could be measured and the results reported as densities per habitat type.

References:

- Abarca, F. J. 1989. Potential food habit overlap between spikedace (*Meda fulgida*) and red shiner (*Cyprinella lutrensis*). Arizona State Univesity, Tempe. M.S. thesis.

- Anderson, R. M. 1978. The distribution and aspects of the life history of *Meda fulgida* in New Mexico. New Mexico State University, Las Cruces. M.S. thesis. 62 pp.
- Arizona Game and Fish Commission. 1988. Threatened native wildlife in Arizona. Arizona Game and Fish Department Publication, Phoenix, AZ. 32 pp.
- Baltz, D. M., and P. B. Moyle. 1984. The influence of riparian vegetation on steam fish communities of California. Pp. 183-7 in R. E. Warner and K. M. Hendrix (eds.). California riparian systems. University of California Press, Berkeley, CA.
- Barber, W. E., D. C. Williams, and W. L. Minckley. 1970. Biology of the Gila spikedace, *Meda fulgida*, in Arizona. Copeia 1970:9-18.
- Barber, W. E., and W. L. Minckley. 1966. Fishes of Aravaipa Creek, Graham and Pinal Counties, Arizona. Southwestern Nat. 11:313-24.
- Barber, W. E., and W. L. Minckley. 1983. Feeding ecology of a southwestern cyprinid fish, the spikedace, *Meda fulgida* Girard. Southwestern Naturalist 28:33-40.
- Bestgen, K. R. 1985. Results of identification of collections of larval fish made in the upper Salt and Gila Rivers, AZ. Report to U.S. Fish and Wildlife Service, September 10, 1985.
- Bestgen, K. R., D. L. Propst, and C. W. Painter. 1987. Transport Ecology of larval fishes in the Gila River, New Mexico. Proc. Desert Fishes Council 16-18:174.
- Bestgen, K. R., and D. L. Propst. 1987. Red shiner vs. native fishes: replacement or displacement? Proc. Desert Fishes Council 18:209.
- Bureau of Land Management. 1989. Fisheries habitat management on public land. Washington, D.C.
- Douglas, M. E., P. C. Marsh, and W. L. Minckley. 1994. Indigenous fishes of western North America and the hypothesis of competitive displacement: *Meda fulgida* (Cyprinidae) as a case study. Copeia 1994:9-19.
- Gilbert, C. H., and N. B. Scofield. 1898. Notes on a collection of fishes from the Colorado Basin in Arizona. Proc. U.S. Nat. Mus. 20:487-99.
- Girard, C. 1857. Researches upon the cyprinoid fishes inhabiting the fresh waters of the United States of America, west of the Mississippi Valley, from specimens in the museum of the Smithsonian Institution. Proc. Acad. Nat. Sci. Philadelphia. 8:165-213.
- Hardy, T. B., B. Bartz, and W. Carter. 1990. Instream flow recommendations for the fishes of Aravaipa Creek, Arizona. Submitted to the Nature Conservancy. Twelve-Nine, Inc., Logan, UT.
- Hecht, B. 1984. Sequential changes in bed habitat condidtions in the upper Carmel River following the Marble-Cone fire of August, 1977. Pp. 134-41 in R. E. Warner and K. M. Hendrix (eds.). California riparian systems. University of California Press, Berkeley, CA.
- Hubbs, C. L. 1954. Establishment of a forage fish, the red shiner (*Notropis lutrensis*), in the lower Colorado River system. California Fish and Game 40:287-94.
- John, K. R. 1963. The effect of torrential rains on the reproductive cycle of *Rhinichthys osculus* in the Chiricahua Mountians, Arizona. Copeia 1963:286-91.
- Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. 1980. Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History. 867 pp.
- Marsh, P. C. 1988. Spikedace (Meda fulgida) recovery plan draft. Center for Environmental Studies, Arizona State University, prepared for Region II, U.S. Fish and Wildlife Service, Albuquerque, NM. 55 pp.

- Marsh, P. C., F. J. Abarca, M. E. Douglas, and W. L. Minckley. 1989. Spikedace (*Meda fulgida*) and loach minnow (*Tiaroga cobitis*) relative to introduced red shiner (*Cyprinella lutrensis*). Final report to Arizona Game and Fish Dept., Phoenix, AZ.
- Matthews, J.R. and C.J. Moseley (eds.). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 + 33 pp. appendix + 6 pp. glossary + 16 pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.
- Meffe, G. K., and W. L. Minckley. 1987. Persistence ans stability of fish and invertebrate assemblages in a repeatedly disturbed Sonoran desert stream. American Midland Naturalist 117:177-91.
- Miller, R. R. 1961. Man and the changing fish fauna of the American Southwest. Paper Michigan Academy Science, Arts, and Letters 46:365-404.
- Miller, R. R., and C. L. Hubbs. 1960. The spiny-rayed cyprinid fishes (Plagopterini) of the Colorado River system. University of Michigan Museum of Zoology Miscellaneous Publication 115:1-39.
- Minckley, W. L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ.
- Minckley, W. L. 1981. Ecological studies of Aravaipa Creek, central Arizona, relative to past, present, and future uses. Final Report. U.S. Bureau of Land Management, Safford, Arizona. Contract Number YA-512-CT6-98. 362 pp.
- Minckley, W. L. 1985. Native fishes and natural aquatic habitats in U.S. Fish and Wildlife Service Region II west of the Continental Divide. Report to U.S. Fish and Wildlife Service, Albuquerque, NM. 158 pp.
- Minckley, W. L., and G. K. Meffe. 1987. Differential selection by flooding in stream-fish communities of the arid American southwest. Pp. 93-104 in W. J. Matthews and D. E. Heins (eds.). The zoogeography of North American freshwater fishes. John Wiley and Sons, Incorporated, NY.
- Minckley, W. L., and J. E. Deacon. 1968. Southwestern fishes and the enigma of "endangered species." Science 159:1424-32.
- Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, MD. 386 pp.
- New Mexico State Game Commission. 1985. Regulation Number 624, as amended 28 March 1985. New Mexico Department of Game and Fish, Santa Fe, NM.
- Page, L. M., and B. M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Houghton Mifflin Company, Boston, MA. 432 pp.
- Propst, D. 1986. Distribution, status and biology of the spikedace in the Gila River Basin, New Mexico. New Mexico Department of Game and Fish, Santa Fe.
- Propst, D. L., K. R. Bestgen, and C. W. Painter. 1986. Distribution, status, and biology of the spikedace (*Meda fulgida*) in New Mexico. Endangered Species Report, No. 15, U.S. Fish and Wildlife Service, Albuquerque, NM. 93 pp.
- Propst, D. L., and K. R. Bestgen. 1986. Microhabitat utilization patterns of spikedace in New Mexico. Proc. Desert Fishes Council 18 (1986).

- Rinne, J. N. 1991. Habitat use by spikedace, *Meda fulgida* (Pisces: Cyprinidae) in southwestern streams with reference to probable habitat competition by red shiner, *Notropis lutrensis* (Pisces: Cyprinidae). Southwestern Naturalist 36:7-13.
- Rinne, J. N., and E. Kroeger. 1988. Physical habitat use by spikedace, *Meda fulgida* in Aravaipa Creek, Arizona. Proc. Western Association of Fish and Wildlife Agencies 68:282-90.
- Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1991. Common and scientific names of fishes from the United States and Canada. American Fisheries Society, Special Publishing 20. 183 pp.
- Rucks, M. G. 1984. Composition and trend of riparian vegetation on five perennial streams in southeastern Arizona. Pp. 97-107 in R. E. Warner and K. M. Hendrix (eds.). California riparian systems. University of California Press, Berkeley, CA.
- Schreiber, D. C., and W. L. Minckley. 1981. Feeding interrelationships of native fishes in a Sonoran Desert stream. Great Basin Naturalist 41:409-26.
- Sublette, J. E., M. D Hatch, and M. Sublette. 1990. The fishes of New Mexico. University New Mexico Press, Albuquerque, NM. 393 pp.
- U.S. Fish and Wildlife Service (USFWS). 10 December 1999. Proposed designation of critical habitat for the spikedace and the loach minnow. Federal Register 64(237):69323-69355.
- U.S. Fish and Wildlife Service (USFWS). 1986. Determination of threatened status for the spikedace. Federal Register 51(126):23769-80.
- U.S. Fish and Wildlife Service (USFWS). 1990. Endangered and threatened species recovery program: report to Congress. 406 pp.
- U.S. Fish and Wildlife Service (USFWS). 1985. Proposal to determine the spikedace to be a threatened species and to determine its critical habitat. Federal Register 50:25390-25398.
- U.S. Fish and Wildlife Service (USFWS). 1986. Determination of threatened status for the spikedace. Federal Register 51:23769-81.
- Winn, H. E., and R. R. Miller. 1954. Native postlarval fishes of the lower Colorado River basin, with a key to their identification. California Fish and Game 40:273-85. 4 plates.

Gila Topminnow (*Poeciliopsis occidentalis occidentalis*)

The Gila topminnow is designated as a federally Endangered species.

Historic Range: Native range: Gila River system in Arizona and extreme western New Mexico; Rios de la Concepcion and Sonora, Sonora, Mexico. Currently occurs in the Gila river drainage, Arizona, particularly in the upper Santa Cruz River, Sonoita and Cienega creeks, and the middle Gila River; and in the Rio Sonora, Rio de la Concepcion, and Santa Cruz River (Weedman 1998). Extirpated in New Mexico; later reintroduced in New Mexico into a small pond on the Red Rock Wildlife Area, north of Lordsburg, in 1989; there is some question as to whether the fishes will be able to survive the cold winters of that area (Sublette et al. 1990).

Basic Description: A small fish (topminnow).

Reproduction Comments: In some areas reproduces throughout the year; in other areas breeding prolonged throughout spring and summer. Interval between broods apparently about 24 to 28 days. Depending on their size adults produce 1-15 young/brood (Minckley 1973). Life span apparently is about one year.

Habitat Type: Freshwater

Non-Migrant: Yes

Locally Migrant: No

Long Distance Migrant: No

Riverine Habitat(s): CREEK, Low gradient, MEDIUM RIVER, Moderate gradient, Pool, SPRING/SPRING BROOK

Palustrine Habitat(s): HERBACEOUS WETLAND

Habitat Comments: Lowland and some upland streams of desert and grasslands, and margins of large, lowland rivers. Typical inhabitant of vegetated springs, brooks, and margins and backwaters of larger bodies of water (Lee et al. 1980). Prefers shallow, warm, fairly quiet waters but also can be found in moderate currents and depths up to 1 m; permanent and intermittent streams, marshes; preferred habitat has dense mats of algae and debris (usually along stream margins or below riffles) and sandy substrate sometimes covered with mud and debris (Matthews and Moseley 1990).

Adult Food Habits: Herbivore, Invertivore

Immature Food Habits: Herbivore, Invertivore

Food Comments: Eats detritus and algae; also feeds opportunistically on aquatic invertebrates (Lee et al. 1980).

Length: 3 cm

Restoration Potential: In Arizona, attempts to eradicate *Gambusia* from sites with natural topminnow populations have been unsuccessful (*Gambusia* reinvaded); fencing to protect habitat from livestock resulted in vegetation encroachment and extirpation of the topminnow at another site.

Management Requirements: Minckley (1999) emphasized the need for protection of existing populations, establishment of populations in artifical refugia, and elimination, exclusion, or management against introduced piscivores. See Marsh and Minckley (1990) for recommendations on methods for eradicating *Gambusia* (poison fish, reintroduce topminnow, frequently monitor system) and removing vegetation (cattle grazing may be best method). See Minckley et al. (1991) for detailed information on management and reintroduction efforts. See also Hendrickson and Brooks (1991) for information on transplantation efforts. High levels of heterozygosity, which correlate with enhanced survivorship and fecundity, make the Sharp Spring population (Arizona) the best choice for source of fishes for the restocking effort in the Gila River system (Quattro and Vrijenhoek 1989). The captive stock at Dexter National Fish Hatchery was replaced by fishes from Sharp Spring in the mid-1980s (Minckley and Deacon 1991). Based on patterns of molecular variation, Parker et al. (1999) recommended that each of the four watersheds in which subspecies *occidentalis* is still naturally extant be managed and conserved separately (see also Sheffer et al. 1997). Weedman (1998) cited the following needed actions: protect remaining natural and long-lived established populations; reestablish and protect populations throughout historical range; monitor populations and their habitats; develop and implement genetic protocol for managing populations; study life history, genetics, ecology, habitat, and interactions with non-native aquatic species; inform and educate the public and resource managers.

References:

- Constantz, G. D. 1979. Life history patterns of a livebearing fish in contrasting environments. Oecologia (Berl.) 40:189-201.
- Echelle, A. A. 1991. Conservation genetics and genic diversity in freshwater fishes of western North America. Pages 141-153 in W. L. Minckley and J. E. Deacon, eds. Battle against extinction: native fish management in the American West. Univ. Arizona Press, Tucson, AZ.
- Hedrick, P. W., K. M. Parker, and R. N. Lee. 2001. Using microsatellite and MHC variation to identify species, ESUs, and MUs in the endangered Sonoran topminnow. Molecular Ecology 10:1399-1412.
- Hendrickson, D. A., and J. E. Brooks. 1991. Transplanting short-lived fishes in North American deserts: review, assessment, and recommendations. Pages 283-98 in W. L. Minckley and J. E. Deacon (editors). Battle Against Extinction: Native Fish Management in the American West. University of Arizona Press, Tucson, AZ.
- Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. 1980. Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History. 867 pp.
- Marsh, P. C., and W. L. Minckley. 1990. Management of endangered Sonoran topminnow at Bylas Springs, Arizona: description, critique, and recommendations. Great Basin Naturalist 50:265-272.
- Matthews, J.R. and C.J. Moseley (eds.). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 + 33 pp. appendix + 6 pp. glossary + 16 pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.
- Meffe, G. K. 1985. Predation and species replacement in American southwestern fishes: a case study. Southwestern Naturalist 30:173-187.
- Meffe, G. K., and F. F. Snelson, Jr., editors. 1989. Ecology and evolution of livebearing fishes (Poeciliidae). Prentice Hall, Englewood Cliffs, NJ. 453 pp.
- Meffe, G. K., and R. C. Vrijenhoek. 1988. Conservation genetics in the management of desert fishes. Conservation Biology 2:157-169.

- Minckley, W. L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ.
- Minckley, W. L. 1999. Ecological review and management recommendations for recovery of the endangered Gila topminnow. Great Basin Naturalist 59:230-244.
- Minckley, W. L., G. K. Meffe, and D. L. Soltz. 1991. Conservation and management of short-lived fishes: the cyprinodontoids. Pages 247-82 in W. L. Minckley and J. E. Deacon (editors). Battle Against Extinction: Native Fish Management in the American West. University of Arizona Press, Tucson, AZ.
- Minckley, W. L., J. N. Rinne, and J. E. Johnson. 1977. Status of the Gila topminnow and its co-occurrence with mosquitofish. USDA Forest Service Res. Pap. RM-198, Rocky Mountain Forest and Range Expt. Sta., Fort Collins. 8 pp.
- Minckley, W. L., and J. E. Deacon. 1991. Battle Against Extinction: Native Fish Management in the American West. University of Arizona Press, Tucson. xviii + 517 pp.
- Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, MD. 386 pp.
- Page, L. M., and B. M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Houghton Mifflin Company, Boston, MA. 432 pp.
- Parker, K. M., R. J. Sheffer, and P. W. Hecrick. 1999. Molecular variation and evolutionarily significant units in the endangered Gila topminnow. Conservation Biology 13:108-116.
- Quattro, J. M., and R. C. Vrijenhoek. 1989. Fitness differences among remnant populations of the endangered Sonoran topminnow. Science 245:976-978.
- Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1991. Common and scientific names of fishes from the United States and Canada. American Fisheries Society, Special Publishing 20. 183 pp.
- Sheffer, R. J., P. W. Hedrick, W. L. Minckley, and A. L. Velasco. 1997. Fitness of the endangered Gila topminnow. Conservation Biology 11:162-171.
- Simons, L. H., D. A. Hendrickson, and D. Papoulias. 1989. Recovery of the Gila topminnow: a success story? Conservation Biology 3:11-15.
- Sublette, J. E., M. D Hatch, and M. Sublette. 1990. The fishes of New Mexico. University New Mexico Press, Albuquerque, NM. 393 pp.
- U.S. Fish and Wildlife Service (USFWS). 1967. Native fish and wildlife: endangered species. Federal Register 32(48):4001.
- U.S. Fish and Wildlife Service (USFWS). 1990. Endangered and threatened species recovery program: report to Congress. 406 pp.
- Weedman, D. A. 1998. Gila topminnow, *Poeciliopsis occidentalis occidentalis*, revised recovery plan. U.S. Fish and Wildlife Service, Albuquerque, NM.
- Williams, J. E., J. E. Johnson, D. A. Hendrickson, S. Contreras-Balderas, J. D. Williams, M. Navarro-Mendoza, D. E. McAllister, and J. E. Deacon. 1989. Fishes of North America endangered, threatened, or of special concern: 1989. Fisheries 14:2-20.

Yaqui Topminnow (*Poeciliopsis occidentalis sonoriensis*)

The Yaqui topminnow has an implied federally Endangered species status because it is a subspecies of the federally endangered Gila topminnow (*Poeciliopsis occidentalis*).

Historic Range: Native range: Rio Yaqui basin in Arizona (Whitewater and Black draws) and several tributaries of the Rio Yaqui in Sonora, Mexico (Minckley et al. 1991, draft recovery plan). Hendrickson et al. (1980) found this fish to be widely distributed below elevations of 1300 m in the Rio Yaqui basin. Presently occurs in the U.S. at several locations within the San Bernardino and Leslie Canyon national wildlife refuges (draft recovery plan).

Basic Description: A fish (topminnow) that reaches a maximum length of about 6 cm.

Reproduction Comments: Breeds year-round where winter temperatures are ameliorated by spring flows, breeds mainly April-October otherwise; adult females produce broods of up to 20+ young at intervals of about 20 days; few live more than 1 year (USFWS 1994).

Habitat Type: Freshwater

Non-Migrant: Yes

Locally Migrant: No

Long Distance Migrant: No

Riverine Habitat(s): CREEK, Low gradient, MEDIUM RIVER, Moderate gradient, Pool, SPRING/SPRING BROOK

Palustrine Habitat(s): HERBACEOUS WETLAND

Habitat Comments: Lowland and some upland streams of desert and grasslands, and margins of large, lowland rivers. Typical inhabitant of vegetated springs, brooks, and margins and backwaters of larger bodies of water (Lee et al. 1980). Prefers shallow, warm, fairly quiet waters but also can be found in moderate currents and depths up to 1 m; permanent and intermittent streams, marshes; preferred habitat has dense mats of algae and debris (usually along stream margins or below riffles) and sandy substrate sometimes covered with mud and debris (Matthews and Moseley 1990). On the San Bernardino National Wildlife Refuge, occurs in shallows of artesian well outflows, ponds, and pool margins (draft recovery plan).

Adult Food Habits: Herbivore, Invertivore

Immature Food Habits: Herbivore, Invertivore

Food Comments: Detritus and algae; also feeds opportunistically on aquatic invertebrates such as amphipods and insect larvae (Minckley 1973, Lee et al. 1980).

Length: 3 cm

Management Requirements: Securing habitat and water sources are major management needs (USFWS 1994).

References:

- Hendrick, P. W., K. M. Parker, and R. N. Lee. 2001. Using microsatellite and MHC variation to identify species, ESUs, and MUs in the endangered Sonoran topminnow. Molecular Ecology 10:1399-1412.
- Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. 1980. Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History. 867 pp.
- Matthews, J.R. and C.J. Moseley (eds.). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 + 33 pp. appendix + 6 pp. glossary + 16 pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.
- Minckley, W. L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ.
- Minckley, W. L. 1999. Ecological review and management recommendations for recovery of the endangered Gila topminnow. Great Basin Naturalist 59:230-244.
- Minckley, W. L., G. K. Meffe, and D. L. Soltz. 1991. Conservation and management of short-lived fishes: the cyprinodontoids. Pages 247-82 in W. L. Minckley and J. E. Deacon (editors). Battle Against Extinction: Native Fish Management in the American West. University of Arizona Press, Tucson, AZ.
- Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, MD. 386 pp.
- Page, L. M., and B. M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Houghton Mifflin Company, Boston, MA. 432 pp.
- Quattro, J. M., P. L. Leberg, M. E. Douglas, and R. C. Vrijenhoek. 1996. Molecular evidence for a unique evolutionary lineage of endangered Sonoran Desert fish (genus Poeciliopsis). Conservation Biology 10:128-135.
- U.S. Fish and Wildlife Service (USFWS). 1994. Yaqui fishes recovery plan. USDI Fish and Wildlife Service, Albuquerque, NM. iv + 48 pp.
- U.S. Fish and Wildlife Service (USFWS). 1995. San Bernardino and Leslie Canyon National Wildlife Refuges. Comprehensive management plan, 1995-2015. Includes the environmental assessment under separate cover. Albuquerque, NM.

Loach Minnow (*Tiaroga cobitis*)

The loach minnow was designated as a federally Threatened species on October 28, 1986.

Historic Range: Once locally common throughout much of the Verde, Salt, San Pedro, San Francisco, and Gila (upstream from Phoenix) river systems, Arizona, New Mexico, and Sonora, occupying suitable habitat in both the mainstreams and perennial tributaries, at elevations up to about 2200 m. Extirpated throughout much of its former range in Arizona. Occurred historically in the San Pedro River, Sonora, Mexico, but habitat there has been largely destroyed by diversion of water for agriculture. Now restricted to about 645 km of stream in portions of the upper Gila River (Grant, Catron, and Hidalgo counties, New Mexico), the San Francisco and Tularosa rivers and their tributaries Negrito and Whitewater creeks (Catron County, New Mexico), the Blue River and its tributaries Dry Blue, Campbell Blue, Little Blue, Pace, and Frieborn creeks (Greenlee County, Arizona, and Catron County, New Mexico), Aravaipa Creek and its tributaries Turkey and Deer creeks (Graham and Pinal counties, Arizona), Eagle Creek (Graham and Greenlee counties, Arizona), the White River (Apache, Gila, and Navajo counties, Arizona), and the Black River (Apache and Greenlee counties, Arizona) (USFWS 1999). Common only in Aravaipa Creek, the Blue River, and limited portions of the San Francisco, upper Gila, and Tularosa rivers in New Mexico (USFWS 1999). Marsh et al. (2003) reported a new record from North Fork of East Fork Black River, Arizona, and a rediscovered population in Eagle Creek, Arizona; the species recorded in the latter location in 1950 and the mid-1990s but has not been seen there since 1997.

Basic Description: A small fish (minnow), up to 6 cm long.

Reproduction Comments: In New Mexico, most spawners were in their second summer (Propst and Bestgen 1991). Spawning occurs in Arizona mainly March-June, with some breeding December-February; nests with eggs found also in September (Vives and Minckley 1990). Spring (e.g., April) spawning recorded in New Mexico. Female produces between 250 to 1,200 ova (Minckley 1973). Eggs hatch in about 6 days at 21 C. Male may provide some care to developing eggs (female also?) (Vives and Minckley 1990).

Habitat Type: Freshwater

Non-Migrant: Yes

Locally Migrant: No

Long Distance Migrant: No

Riverine Habitat(s): CREEK, High gradient, MEDIUM RIVER, Moderate gradient, Riffle

Special Habitat Factors: Benthic

Habitat Comments: Lives on bottom in permanent, flowing, unpolluted creeks and small to medium rivers of low to moderate gradient, low amounts of fine sediment and substrate embeddedness, abundant aquatic insects, and a healthy, intact riparian community with moderate to high bank stability; typically on turbulent riffles, sometimes in association with filamentous algae; habitat resembles that of many eastern darters (Percidae) (Lee et al. 1980). Obligate riffle-dweller, occurs in shallow (<20 cm) water over gravel/ cobble substrate (Rinne 1989, Propst and Bestgen 1991) or in interstices between rocks, often in association with eddying currents (Sublette et al. 1990). Adults inhabit moderate to swift (15-100 cm/sec), shallow (3-40 cm) water with gravel, cobble, and rubble substrates; juvenile habitat is similar but includes also sand substrates (Federal Register, 8 March 1994). Persists mainly in streams having relatively natural flow regimes and a predominance of native species (Propst and Bestgen 1991). Recurrent flooding is important in keeping substrate free of sediments and in helping this species maintain a competitve edge over invading non-native fishes. Eggs are laid in cavities under flattened cobble (or uncemented cobble and rubble) in slow to swift (3-85 cm/sec), shallow (3-30 cm) water; eggs adhere to under surface (Sublette et al. 1990, Vives and Minckley 1990); males guard cavities and eggs. Larvae apparently use low velocity nursery areas: 0-30 cm/sec, 3-30 cm deep, with sand, gravel, and cobble substrates and abundant instream cover (Sublette et al. 1990; Propst and Bestgen 1991; Federal Register, 8 March 1994).

Adult Food Habits: Invertivore

Immature Food Habits: Invertivore

Food Comments: Restricted diet; feeds opportunistically on riffle-inhabiting insect larvae (e.g., simuliid dipterans and mayflies). Immatures feed pricipally on chironomids, adults eat various benthic insects (dipterans, mayflies, stoneflies, caddisflies) (Sublette et al. 1990, Propst and Bestgen 1991).

Length: 6 cm

References:

- Coburn, M. M., and T. M. Cavender. 1992. Interrelationships of North American cyprinid fishes. Pages 328-373 in R. L. Mayden, editor. Systematics, historical ecology, and North American freshwater fishes. Stanford Univ. Press, Stanford, CA. xxvi + 969 pp.
- Johnston, C. E., and L. M. Page. 1992. The evolution of complex reproductive strategies in North American minnows (Cyprinidae). Pages 600-621 in R. L. Mayden, editor. Systematics, historical ecology, and North American freshwater fishes. Stanford Univ. Press, Stanford, CA. xxvi + 969 pp.
- Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. 1980. Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History. 867 pp.
- Marsh, P. C., B. E. Bagley, G. W. Knowles, G. Schiffmiller, and P. A. Sowka. 2003. New and rediscovered populations of loach minnow, *Tiaroga cobitis* (Cyprinidae), in Arizona. Southwestern Naturalist 48:666-669.
- Matthews, J.R. and C.J. Moseley (eds.). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 + 33 pp. appendix + 6 pp. glossary + 16 pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.
- Minckley, W. L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ.
- Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, MD. 386 pp.
- Page, L. M., and B. M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Houghton Mifflin Company, Boston, MA. 432 pp.
- Probst, D. L. 1986. Distribution, status, and biology of the loach minnow in the Gila River basin. New Mexico Department of Game and Fish, Santa Fe.
- Propst, D. L., and K. R. Bestgen. 1991. Habitat and biology of the loach minnow, *Tiaroga cobitis*, in New Mexico. Copeia 1991:29-38.

- Rinne, J. N. 1989. Physical habitat use by loach minnow, *Tiaroga cobitus* (Pisces: Cyprinidae), in southwestern desert streams. Southwestern Naturalist 34:109-17.
- Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1991. Common and scientific names of fishes from the United States and Canada. American Fisheries Society, Special Publishing 20. 183 pp.
- Sublette, J. E., M. D Hatch, and M. Sublette. 1990. The fishes of New Mexico. University New Mexico Press, Albuquerque, NM. 393 pp.
- U.S. Fish and Wildlife Service (USFWS). 10 December 1999. Proposed designation of critical habitat for the spikedace and the loach minnow. Federal Register 64(237):69323-69355.
- U.S. Fish and Wildlife Service (USFWS). 1990. Endangered and threatened species recovery program: report to Congress. 406 pp.Vives, S. P., and W. L. Minckley. 1990. Autumn spawning and other reproductive notes on loach minnow, a threatened cyprinid fish of the American southwest. Southwestern Naturalist 35:451-454.
- Williams, J. E., J. E. Johnson, D. A. Hendrickson, S. Contreras-Balderas, J. D. Williams, M. Navarro-Mendoza, D. E. McAllister, and J. E. Deacon. 1989. Fishes of North America endangered, threatened, or of special concern: 1989. Fisheries 14:2-20.
- Woodman, D. A. 1992. Systematic relationships within the cyprinid genus Rhinichthys. Pages 374-391 in R. L. Mayden, editor. Systematics, historical ecology, and North American freshwater fishes. Stanford Univ. Press, Stanford, CA. xxvi + 969 pp.

Huachuca Springsnail (*Pyrgulopsis thompsoni*)

The Huachuca springsnail was designated as a Federal Candidate species on September 12, 2006.

Historic Range: Range is the upper portion of the Santa Cruz and San Pedro River basins in Arizona and Sonora, Mexico. Originally it covered only six sites in Santa Cruz County, Arizona and Sonora, Mexico. These sites were: Cottonwood Springs, Monkey Spring, Canelo Hills Cienega, Sheehy Spring, Peterson Ranch Springs, and Ojo Caliente, (Hershler and Landye, 1988). Since that time, Landye in 1992 examined sixteen springs on Fort Huachuca Military Base in the Huachuca Mountains and found occurrences at nine springs. The nine additional sites are Upper Garden Canyon Spring, Lower Garden Canyon Spring, McClure Spring, Broken Pipe Spring, Cave Spring, Sawmill Canyon Spring, Upper Water Supply Spring, Lower Water Supply Spring, Blacktail Spring (Landye, pers. comm.). An additional site in Mexico was reported at Cienega Los Fresnos (Stefferud, pers. comm.).

Basic Description: a snail

General Description: This is considered a medium to large species relative to other Hydrobiidae snails, with a shell 1.7 to 3.2 mm long. The shell is ovate-conic with "3.25 to 5 moderately convex, slightly shouldered whorls". The aperture may be fused or separate from the body whorl. The pigmentation of the snout and anterior part of the foot tends from light to dark with the remaining portion and the head generally unpigmented. There appears to be some sexual dimorphism in two of four populations studied, in one case the males being larger than the females and vice versa in the other population. The identification is based upon characteristics of the reproductive organs. The penis which is considered moderate in size may be "squat to elongate". The ventral penial lobe surface has a glandular ridge, this is generally located at the tip of the lobe. The penial filament may be 35 to 103 per cent of the penis length and centered at 80 to 93% of the penis length. The whole of the penis exhibits a dark pigmentation. The testis and prostrate make up 37 to 54% and 7 to 8% of the body length, respectively. Between 55 and 85% of the bursa length is posterior to the albumen gland (Hershler and Landye 1988).

Ecology Comments: Little is known about the life history, biology or ecology of this small snail, but Landye (1993) suggested that it may be similar to another Hydrobiidae species, *P. morrisoni*, the Page Spring snail. The Page Spring snail experiences what appears to be a population crash in December and young appear in January.

Habitat Type: Freshwater

Non-Migrant: No

Locally Migrant: No

Long Distance Migrant: No

Riverine Habitat(s): SPRING/SPRING BROOK

Palustrine Habitat(s): HERBACEOUS WETLAND

Habitat Comments: Habitat is restricted to springs and cienega wetland habitats. Within these habitats it is commonly found in shallow water on rocks around the spring sources.

Stewardship Overview: This snail occurs in cienegas and isolated springs in the upper Santa Cruz and San Pedro River drainages; a range-wide survey to determine the distribution is critically needed as is basic information on ecology, life-cycle, and population dynamics. Currently, the only management strategy is to maintain inhabited cienega and spring-fed wetland habitat by (i) reducing the impacts of livestock on wetland vegetation, and ensuring bank stability and water quality; (ii) protecting the aquifer sources of these wetlands from groundwater pumping, water diversion, and pollution; and (iii) preventing erosion and incision of the stream channel through good land-use practices or construction of erosion-control structures.

Restoration Potential: Given the lack of knowledge about biology and ecology, including response to disturbance, recovery potential is unknown.

Preserve Selection & Design Considerations: Protection requires protection of wetland habitats, protection of the aquifer sources of these wetlands from groundwater pumping, maintaining channel stability upstream and downstream in the watershed (i.e., discouraging channel incision and erosion) and assuring high standards of water quality upstream. Within the site, protection requires maintenance of suitable firm (rocky) substrates, which seems to be a component of preferred habitat.

Management Requirements: With so little information, it is difficult to prescribe management directives. As a default, management should be targeted at maintaining the inhabited cienega and spring fed wetland habitat by (i) reducing the impacts of livestock on wetland vegetation, and ensuring bank stability and water quality; (ii) protecting the aquifer sources of these wetlands from groundwater pumping, water diversion, and pollution; and (iii) preventing erosion and incision of the stream channel through good land-use practices or construction of erosion-control structures.

Monitoring Requirements: It would be useful to assess the numbers of sites within the San Pedro and Santa Cruz River drainages. Based on the Landye 1992 survey, additional populations are likely to be found. Once a range-wide survey is completed, then one can begin to assess the nature and severity of threats. An important need is the development of a monitoring protocol to assess population size.

References:

- Arizona Game and Fish Department. 1992. Status Summary. Huachuca Springsnail (*Pyrgulopsis thomsoni*).
- Hendrickson, D. A. and W. L. Minckley. 1984. Cienegas--Vanishing climax communities of the American Southwest. Desert Plants. 6:141-75.
- Hershler, R. and J.J. Landye. 1988. Arizona Hydrobiidae (Prosobranchia: Rissoacea). Smithsonian Contributions to Zoology, 459: 1-58.
- Turgeon, D.D., J.F. Quinn, Jr., A.E. Bogan, E.V. Coan, F.G. Hochberg, W.G. Lyons, P.M. Mikkelsen, R.J. Neves, C.F.E. Roper, G. Rosenberg, B. Roth, A. Scheltema, F.G. Thompson, M. Vecchione, and J.D. Williams. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: Mollusks. 2nd Edition. American Fisheries Society Special Publication 26, Bethesda, MD: 526 pp.
- U.S. Fish and Wildlife Service (USFWS). 1997. Category and Listing Priority Forms.

Sonoran Tiger Salamander (*Ambystoma tigrinum stebbinsi*)

The Sonoran tiger salamander was designated as a federally Endangered species on January 6, 1997.

Historic Range: Santa Cruz and San Pedro river drainages, Santa Cruz and Cochise counties, Arizona, including sites in the San Rafael Valley (SRV) and adjacent foothills of the Patagonia and Huachuca Mountains. The range of the subspecies and its occupied and potentially occupied habitat is thought to extend from the crest of the Huachuca Mountains west to the crest of the Patagonia Mountains, including the SRV and adjacent foothills from its origins in Sonora north to the Canelo Hills (USFWS 2002). Salamanders suspected of being Sonora tiger salamanders have been collected from Los Fresnos cienega in the School Canyon drainage approximately 3 km south of the border (Varela-Romero *et al.* 1992). Genetic testing showed that some SRV ponds contain salamanders with genetic characteristics similar to barred tiger salamanders. Salamanders with these "*mavortiu*m-like" sequences are more common on the outskirts of the SRV and ponds close to Parker Canyon Lake, which, because of prior use of imported waterdogs as fish bait, is where introduced barred tiger salamanders are expected to be found (Ziemba *et al.* 1998). Tiger salamanders have also been found in areas just outside the SRV, such as Fort Huachuca, Harshaw Canyon, Copper Canyon, and Coronado Memorial. Of these localities, genetic testing has only been performed on salamanders from the Fort, and with the exception of one pond within a kilometer of the SRV, salamanders on the Fort appear to be barred tiger salamanders (Andrew Storfer, University of Florida, pers. comm.) (USFWS 2002).

Basic Description: A robust salamander.

General Description: Metamorphosed terrestrial Sonora tiger salamanders have a color pattern ranging from "a reticulate pattern with an irregular network of light coloration, often coupled with light spots, on a dark background color", to a pattern of large, well-defined light or yellow spots or transverse bars, some of which encroach on the dark venter (Jones *et al.* 1988). Metamorphosed Sonora tiger salamanders measure from about 45 to 150 mm snout to vent length (SVL). Branchiate adults are gray to olive on the dorsum, head, and tail, and off-white to yellow on the ventral side. They have three external gills on each side of their head, and measure between 65 and 165 mm SVL. Male and female adult salamanders can be distinguished by the presence of two black folds of tissue (cloacal folds) on the caudal side of a male's vent. Larvae are gray on the dorsum, head, and tail, with little pigment on the ventral surface. They have external gills and hatch without legs, but grow hind and fore-limbs early in development (USFWS 2002).

Reproduction Comments: Breeds as early as January or as late as early May; breeding after monsoon rains in July and August is rare (Synder, cited by USFWS 2002). Some larvae hatched in spring metamorphose into terrestrial form from late July to early September; other individuals become sexually mature in the larval form or overwinter as immature larvae (USFWS 2002).

Non-Migrant: Yes

Locally Migrant: Yes

Long Distance Migrant: No

Mobility and Migration Comments: Movement patterns not thoroughly documented; most likely stay within a few hundred meters of their natal pond, but some may move 1.5-2.0 km or more between breeding and nonbreeding habitats or between ponds (see USFWS 2002).

Riverine Habitat(s): SPRING/SPRING BROOK

Palustrine Habitat(s): HERBACEOUS WETLAND, TEMPORARY POOL

Special Habitat Factors: Benthic, Burrowing in or using soil, Fallen log/debris

Habitat Comments: Cienegas, impounded cienegas, springs, livestock tanks; breeds mainly in cattle ponds or tanks (USFWS 2002). Adult, metamorphosed salamanders inhabit adjacent grassland and oak woodland terrestrial habitat when not in ponds (USFWS 2002). Mammal burrows or loosened soils outside the pond likely provide refugia for metamorphosed salamanders in the terrestrial environment, enabling them to burrow underground to avoid extreme environmental conditions (USFWS 2002).

Adult Food Habits: Carnivore, Invertivore

Immature Food Habits: Carnivore, Invertivore

Stewardship Overview: Recovery Criteria: The Sonora tiger salamander may be reclassified to threatened status when approximately 90 percent of salamander's currently-occupied range and approximately 90 percent of current breeding ponds are protected and maintained to prevent habitat loss and degradation, predator introductions, barred tiger salamander introductions, and collection of salamanders for bait. Scientifically credible monitoring over a five year period must indicate that the number of Sonora tiger salamander populations is not in decline and that there are no new factors that threaten the persistence of Sonora tiger salamanders (USFWS 2002). The Sonora tiger salamander will be considered for delisting when quantitative criteria in terms of number of breeding populations and amount, distribution, and type of available habitat are defined and met. Criteria will be based on research, continued monitoring, and population viability analysis. In addition, regulatory mechanisms and land management commitments must be implemented that provide for adequate long-term protection of the Sonora tiger salamander and its habitat. These commitments and mechanisms should address habitat maintenance and protection, management of non-native predators, disease transmission, introduction and collection of salamanders, interbreeding with non-native salamanders, and public education. Finally, the Sonora tiger salamander must be unlikely to need protection under the Endangered Species Act in the foreseeable future (USFWS 2002).

Actions Needed (USFWS 2002):

1. Maintain and enhance habitat where salamanders have been found, and create new habitat, if deemed necessary.
2. Control non-native predators (fish, bullfrogs, and crayfish) by enforcing and enhancing existing policies prohibiting the introduction and pond to pond transport of these taxa and by removing populations of non-native fish, bullfrogs, and crayfish.
3. Control introduction, transport, and collection of tiger salamanders in the San Rafael Valley by enforcing existing policies prohibiting these acts and by removing populations of barred tiger salamanders.
4. Create and enforce policies to minimize frequency of die-offs.
5. Monitor salamander populations and their habitat on public and, if permitted, private land, to observe threats as they arise and fulfill research objectives.
6. Conduct research to acquire demographic and dispersal information and develop a population viability analysis, better understand salamander disease, conduct genetic analyses, investigate reports of low pH, and determine distribution of crayfish and methods of crayfish removal.
7. Develop public education and information programs.
8. Practice adaptive management.

References:

- Collins, J. T. 1990. Standard common and current scientific names for North American amphibians and reptiles. 3rd ed. Society for the Study of Amphibians and Reptiles. Herpetological Circular No. 19. 41 pp.
- Jones, T. R., E. J. Routman, D. J. Begun, and J. P. Collins. 1995. Ancestry of an isolated subspecies of salamander, *Ambystoma tigrinum stebbinsi* Lowe: the evolutionary significance of hybridization. Molecular Phylogenetics and Evolution 4:194-202.
- Jones, T.R., Collins, J.P., Kocher, T.D. and Mitton, J.B. 1988. Systematic status and distribution of *Ambystoma tigrinum stebbinsi* Lowe (Amphibia: Caudata). Copeia. 1988:621-635.
- Snyder, J. D. 1998. Ecology, management, and intellectual history of native and introduced species. Masters Thesis, Arizona State University.
- Storfer, A., S. G. Mech, M. W. Reudink, R. E. Ziemba, J. Warren, and J. P. Collins. 2004. Evidence for introgression in the endangered Sonora tiger salamander, *Ambystoma tigrinum stebbinsi* (Lowe). Copeia 2004:783-796.
- U.S. Fish and Wildlife Service. 2002. Sonora tiger salamander *(Ambystoma tigrinum stebbinsi*) recovery plan. U.S. Fish and Wildlife Service, Phoenix, AZ. iv + 67 pp.
- U.S. Fish and Wildlife Service. 6 January 1997. Determination of endangered status for three wetland species found in southern Arizona and northern Sonora, Mexico. Federal Register 62(3):665-689.
- Varela-Romero, A., C. Galindo-Duarte, E. Saucedo-Monarque, L. S. Anderson, P. Warren, S. Stefferud, J. Stefferud, S. Rutman, T. Tibbits, and J. Malusa. 1992. Re-discovery of *Gila intermedia* and *G. purpurea* in northern Sonora, Mexico. In D. A. Hendrickson, editor. "Proceedings of the Desert Fishes Council. Volumes XXII and XXIII, 1990 and 1991 Annual Symposia, and Index for Volumes XVI Through XXIII" p. 33, Desert Fishes Council, Bishop, CA.
- Ziemba, R. E., A. T. Storfer, J. Warren, and J. P. Collins. 1998. A survey of genetic variation among populations of the Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*). Report to Arizona Game and Fish Department Heritage Program, Phoenix, AZ.

Ramsey Canyon Leopard Frog *(Rana subaquavocalis)*

A conservation agreement among landowners and state and Federal agencies regarding the Ramsey Canyon leopard frog was implemented in 1997. It provides for captive breeding and reintroduction, acquisition of habitat, and habitat and population surveys (Federal Register, 19 September 1997).

Historic Range: Known from areas within a 10-km radius in the Huachuca Mountains; current known range is limited to aquatic habitats in Tinker, Brown, Ramsey, and Miller canyons and several residential ponds in the area, Cochise County, Arizona (Platz 1993, Platz and Grudzien 1993, Platz et al. 1997, Arizona Game and Fish Department 2001, Platz and Grudzien 2003). Currently exists in several canyons on the east side of the Huachuca Mountains (Goldberg et al. 2004). Ranges from 4,925 to 6,001 ft. (1502 - 1830 m) (Sredl et al. 1997).

Basic Description: A 3-4-inch frog.

General Description: A frog of the *Rana pipiens* complex, with prominent dorsal spots, dorsolateral folds, and extensive webbing on the hind feet. Snout-vent length 81-85 mm in adult males, 86-116 mm in adult females, and 60-62 mm in juveniles (type series, Platz 1993).

Diagnostic Characteristics: Differs from other members of the *Rana pipiens* complex by the following combination of chracters: "dorsolateral folds interrupted posteriorly and deflected medially; incomplete supralabial stripe (diffuse anterior to eye); enhanced melanism on venter; yellowish pigmentation on groin, which may extend onto posterior venter; numerous white papillae around cloacal aperture and adjacent dorsum and thighs; stocky body proportions; knob-like terminal swellings on toes in large adults; a long (average length 2.1 sec at 17 C), snore-like mating call consisting of 28-54 pulses of moderate pulse rate (averaging 19.6 pulses/sec at 17 C). The call is given entirely underwater (at a depth of 1.0-1.3 m) and is therefore inaudible in air" (Platz 1993). Differs from *R*. *yavapaiensis*, *R*. *pipiens*, and *R*. *blairi* by the presence of extensive mottling in the chin region. Differs from *R*. *pipiens* and *R*. *blairi* by lacking a well-defined, light-colored, complete supralabial stripe. Differs from *R*. *pipiens* also by lacking continuous dorsolateral folds and green axillary pigmentation, and by having external vocal sacs. Differs from *Rana berlandieri* by the stockier build of adults and by the yellow pigmentation in the groin region (occasionally present to a limited extent in *berlandieri*). Differs from *R*. *chiricahuensis* in larger adult size and expanded, knob-like toe tips in large adults.

Reproduction Comments: Males vocalize from at least mid-March through mid-July (Platz 1993). Egg masses have been recorded from mid-March through early October (AGFD, unpublished data). Mating seems to begin once water temperatures have reached at least 10 C (50 F), and oviposition may be correlated with temperatures rather than rainfall. Eggs hatch in about 14 days in the wild (Platz 1997). In captivity, eggs hatch in about 10 days when held at 23-25 C (73-77 F) (M. Demlong, unpublished data). Larvae metamorphose in the year they were oviposited or may overwinter as tadpoles (Platz and Grudzien 1993, Platz et al. 1997). Larvae metamorphose in as few as 100 days in captivity, but frequently take 160 to 200 days (M. Demlong, unpublished data). Platz (1997) suggested that sexual maturity is reached rather late in life, at approximately 6 years postmetamorphosis, but captive-reared frogs at the Phoenix Zoo and released in Miller Canyon produced egg masses one year after metamorphosis. Some individuals live at least 10 years after metamorphosis (Platz and Grudzien 1993, Platz et al. 1997). May have a lek breeding system, but further study is needed (Platz and Grudzien 1993).

Non-Migrant: No

Locally Migrant: No

Long Distance Migrant: No

Mobility and Migration Comments: Although detailed study of movements has not been done, marked frogs have moved several hundred meters within Ramsey Canyon (M. Sredl, unpublished data) (Arizona Game and Fish Department 2001).

Riverine Habitat(s): CREEK, Low gradient, Moderate gradient, Pool

Palustrine Habitat(s): TEMPORARY POOL

Special Habitat Factors: Benthic

Habitat Comments: Habitats are found in pine-oak, oak woodland, and semi-desert grassland areas of the Huachuca Mountains. Vegetation at sites is variable but includes horsetail (*Equisetum* spp.), spikerush (*Eleocharis* spp.), cattail (*Typha* spp.), watercress (*Roripp*a), monkey flower (*Mimulu*s), and grasses. Emergent vegetation and root masses provide cover sites (M. Sredl unpublished data) (Arizona Game and Fish Department 2001). Most occupied habitats are modified or artificial aquatic systems (Sredl et al. 1997). Ponds, streams, plunge pools are occupied. Adults and several tadpoles in upper Brown Canyon were found in a plunge pool (elev. 1675 m). Most of the frogs in Ramsey Canyon occupy a ground-level concrete tank (14 m X 14 m) approximately 1.3 m deep, fed by the natural stream adjacent to the tank; frogs also occur at various plunge pools along a 1000 m length of the stream, starting with plunge pools adjacent to the visitors' center and continuing above the tank population. Adults and larvae were observed at a small excavation in rock (a water pocket 2 m in diameter) 2 km below the entrance to Ramsey Canyon (Platz 1993). Occurs also in an earthen stock tank (Platz and Grudzien 1993). Males call while submerged, as may males of certain other RANA species. Eggs are laid in spherical masses, attached to submerged vegetation, so that the egg mass is held near the surface of the water (Arizona Game and Fish Department 2001).

Length: 10 cm

Management Requirements: Management needs include habitat restoration and removal of non-native species; captive rearing of larvae and release of juveniles began in 1995. Arizona Game and Fish Department (AGFD) is attempting to mitigate threats and enhance populations of Ramsey Canyon leopard frogs through captive rearing programs and translocations in the Huachuca Mountains of southeastern Arizona (Sredl et al. 2002). Eggs and larvae have been collected and reared in captivity to increase initial survival rates. The captive-reared frogs and larvae have been released at several sites including Ramsey Canyon, the Barchas Ranch, and Miller Canyon (Arizona Game and Fish Department 2001). An attempt to eradicate bullfrogs from Lower Garden Canyon Pond was unsuccessful (Sredl et al. 2002).

Biological Research Needs: Studies focusing on factors that may play a role in population declines, including the disease caused by chytridfungus, would be valuable (Arizona Game and Fish Department 2001).

References:

- Arizona Game and Fish Department. 2001. *Rana subaquavocali*s. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, AZ. 4 pp.
- Berger, L., et al. 1998. Chytridiomycosis causes amphibian mortality associated with population declines in the rain forests of Australia and Central America. Proceedings of the National Academy of Science 95:9031-9036.
- Blackburn, L., P. Nanjappa, and M. J. Lannoo. 2001. An Atlas of the Distribution of U.S. Amphibians. Copyright, Ball State University, Muncie, IN, USA.

- Field, K.J., Beatty, Sr, T.L. and Beatty, Jr, T.L. 2003. *Rana subaquavocalis* (Ramsey Canyon leopard) frog diet. Herpetological Review. 34:235.
- Goldberg, C. S., K. J. Field, and M. J. Sredl. 2004. Mitochondrial DNA sesquences do not support species status of the Ramsey Canyon leopard frog (*Rana subaquavocalis*). Journal of Herpetology 38:313-319.
- Goldberg, C.S., Field, K.J. and Sredl, M.J. 2003. Ramsey Canyon leopard frog identity crisis: mitochondrial DNA analyses support designation as Chiricahua leopard frog. Arizona Game and Fish Department, Nongame and Endangered Wildlife Program Technical Report 218. Phoenix, AZ.
- Platz, J. E. 1993. Rana subaquavocalis, a remarkable new species of leopard frog (*Rana pipiens complex*) from southeastern Arizona that calls under water. Journal of Herpetology 27:154-62.
- Platz, J. E. 1997. Status survey of the Ramsey Canyon leopard frog, *Rana subaquavocali*s. Arizona Game and Fish contract report, Phoenix, AZ.
- Platz, J. E., A. Lathrop, L. Hofbauer, and M. Vradenburg. 1997. Age distribution and longevity in the Ramsey Canyon leopard frog, *Rana subaquavocalis*. Journal of Herpetology 31:552-557.
- Platz, J. E., and T. A. Grudzien. 2003. Limited genetic heterozygosity and status of two populations of the Ramsey Canyon leopard frog: *Rana subaquavocalis*. Journal of Herpetology 37:758-761.
- Platz, J. E., and T. Grudzien. 1993. Geographic distribution and genetic variability assessment of the Ramsey Canyon leopard frog. Final report.
- Sredl, M. J., J. E. Wallace, and V. Miera. 2000. Aquatic herpetofauna inventory of Fort Huachuca and vicinity. Nongame and Endangered Wildlife Program Technical Report 167. Arizona Game and Fish Department, Phoenix, AZ.
- Sredl, M. J., J. M. Howland, J. E. Wallace, and L. S. Saylor. 1997. Status and distribution of Arizona's native ranid frogs. Pages 37-89 in M. J. Sredl, editor. Ranid frog conservation and management. Arizona Game and Fish Department, Nongame and Endangered Wildlife Program, Technical Report 121.
- Sredl, M. J., K. J. Field, and A. M. Peterson. 2002. Mitigating threats and managing the Ramsey Canyon leopard frog in Arizona. Nongame and Endangered Wildlife Program Technical Report 207. Arizona Game and Fish Department, Phoenix, AZ.
- Sredl, M.J. In press Rana subaquavocalis Platz 1993, Ramsey Canyon leopard frog. Status and Conservation of U.S. Amphibians. Volume 2: Species Accounts. Lannoo, M.J.,editor. University of California Press. Berkeley, CA.
- Sredl, M.J. and Saylor, L.S. 1998. Conservation and Management Zones and the role of earthen cattle tanks in conserving Arizona leopard frogs on large landscapes. Environmental, Economic, and Legal Issues Related to Rangeland Water Developments. Feller, J.M. and Strouse, D.S.,editor. 211-225. The Center for the Study of Law, Science and Technology, Arizona State University. Tempe, AZ.

Chiricahua Leopard Frog (*Rana chiricahuensis*)

The Chiricahua leopard frog was designated as a federally Threatened species on June 13, 2002.

Historic Range: This species occurs from southeastern Arizona (drainages of the Madrean Archipelago and surrounding desert grasslands, south of the Gila River in Cochise, Santa Cruz, Pima, and Graham counties) and extreme southwestern New Mexico (Hidalgo County) in the United States, south along the eastern slope of the Sierra Madre Occidental in Sonora and Chihuahua, Mexico. It occurs at elevations of 1,060-2,010m in Arizona (Arizona Game and Fish Department 1995, Degenhardt et al. 1996, Sredel et al. 1997). Its southern range limit is poorly defined due to taxonomic uncertainties. See RANA SP 1 for information on the distribution of northern montane populations that may represent a different species.

Basic Description: A leopard frog.

Non-Migrant: No

Locally Migrant: No

Long Distance Migrant: No

Riverine Habitat(s): CREEK, Pool, SPRING/SPRING BROOK

Lacustrine Habitat(s): Shallow water

Palustrine Habitat(s): Riparian

Special Habitat Factors: Benthic, Fallen log/debris

Habitat Comments: This species occurs in a wide variety of habitats at a wide range of altitudes in pine and pine-oak forests with permanent water ponds of moderate depth as well as montane streams. It is highly aquatic. It breeds in a wide variety of aquatic habitats, ranging from stock ponds, reservoirs, and lakes to spring-fed streams (Jennings and Scott 1993, USFWS 2000).

Adult Food Habits: Invertivore

Immature Food Habits: Herbivore

Food Comments: Adults mainly invertivorous. Larvae eat algae, organic debris, plant tissue, and minute organisms in water.

Phenology Comments: Inactive in cold temperatures.

Length: 14 cm

Management Requirements: See USFWS (2000) for information on management programs.

References:

- Anonymous. 1993. Postmetamorphic death syndrome. Froglog No. 7.
- Arizona Game and Fish Department 1996. Wildlife of special concern in Arizona (public review draft). Nongame and Endangered Wildlife Program. 40 pp.
- Arizona Game and Fish Department. 1992. *Bufo retiformis*. Unpublished abstract. 3 pp.

- Arizona Game and Fish Department. 1996. Wildlife of special concern in Arizona (public review draft). Nongame and Endangered Wildlife Program, Phoenix, AZ. 40 pp.
- Blackburn, L., P. Nanjappa, and M. J. Lannoo. 2001. An Atlas of the Distribution of U.S. Amphibians. Copyright, Ball State University, Muncie, IN, USA.
- Bradley, G.A., Rosen, P.C., Sredl, M.J., Jones, T.R. and Longcore, J.E. 2002. Chytridiomycosis in native Arizona frogs. Journal of Wildlife Diseases. 38:206-212.
- Clarkson W.R. and Rorabaugh, J.C. 1989. Status of leopard frogs (*Rana pipiens complex*:Ranidae) in Arizona and southeastern California. Southwestern Naturalist 34:531-538.
- Clarkson, R. W., and J. C. Rorabauch. 1989. Status of leopard frogs (*Rana pipiens complex*: Ranidae) in Arizona and southeastern California. Southwest. Nat. 34:531-538.
- Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. Amphibians and reptiles of New Mexico. University of New Mexico Press, Albuquerque, NM. xix + 431 pp.
- Fernandez, P.J 1996. A facility for captive propagation of Chiricahua leopard frogs (*Rana chiricahuensis*). Herpetoculture. 7-12. International Herpetological Symposium.
- Frost, D. R. 1985. Amphibian species of the world. A taxonomic and geographical reference. Allen Press, Inc., and The Association of Systematics Collections, Lawrence, KS. v + 732 pp.
- Frost, J. S., and J. E. Platz. 1983. Comparative assessment of modes of reproductive isolation among four species of leopard frogs (*Rana pipiens complex*). Evolution 37:66-78.
- Frost, J. S., and J. T. Bagnara. 1977. Sympatry between *Rana blairi* and the southern form of leopard frog in southeastern Arizona (Anura: Ranidae). Southwestern Naturalist 22:443-453.
- Goldberg, C.S., Field, K.J. and Sredl, M.J. 2003. Ramsey Canyon leopard frog identity crisis: mitochondrial DNA analyses support designation as Chiricahua leopard frog. Arizona Game and Fish Department, Nongame and Endangered Wildlife Program Technical Report 218. Phoenix, AZ.
- Green, D. M., and D. M. Delisle. 1985. Allotriploidy in natural hybrid frogs, *Rana chiricahuensis* x *R. pipiens*, from Arizona: chromosomes and electrophoretic evidence. Journal of Herpetology 19:385-390.
- Hillis, D.M. 1988. Systematics of the Rana pipiens complex: puzzle and paradigm. Annual Review of Ecology and Systematics. 19:39-63.
- Hillis, D.M., Frost, J.S. and Wright, D.A. 1983. Phylogeny and biogeography of the *Rana pipiens complex*: a biochemical evaluation. Systematic Zoology. 32:132-143.
- Jennings, R. D. 1995. Investigations of recently viable leopard frog populations in New Mexico: *Rana chiricahuensis* and *Rana yavapaiensis*. Report submitted to New Mexico Department of Game and Fish, Endangered Species Program, Santa Fe, NM. 36 pp.
- Jennings, R. D., and N. J. Scott, Jr. 1993. Ecologically correlated morphological variation in tadpoles of the leopard frog, *Rana chiricahuensis*. Journal of Herpetology 27:285-293.
- Jennings, R.D ND. Activity and reproductive phenologies and their ecological correlates among populations of the Chiricahua leopard frog, *Rana chiricahuensis*. Unpublished report for New Mexico Department of Game and Fish Santa Fe, NM.
- Jennings, R.D. 1988. Ecological studies of the Chiricahua leopard frog, *Rana chiricahuensis*, in New Mexico. Report to Share with Wildlife, New Mexico Department of Game and Fish. Santa Fe, NM.

- Jennings, R.D. 1995. Investigations of recently viable leopard frog populations in New Mexico: *Rana chiricahuensis* and *Rana yavapaiensis*. 36 p.
- Mecham, J.S. 1968. Evidence of reproductive isolation between two populations of the frog, *Rana pipiens*, in Arizona. Southwestern Naturalist. 13:35-44.
- New Mexico Department of Game and Fish. 1996. October 1-last update. Fish and Wildlife Information Exchange-VA Tech. Online. Available: http//www.fw.vt.edu/fishex/nm.html. Accessed 1997, April 8.
- Platz, J. E. and J. S. Mecham. 1979. *Rana chiricahuensis*, a new species of leopard frog (*Rana pipiens complex*) from Arizona. Copeia 1979:383-90.
- Platz, J.E. and Mecham, J.S. 1984. Rana chiricahuensis. Catalogue of American Amphibians and Reptiles. 347:1-2.
- Rosen, P.C., Schwalbe, C.R., Parizek, D.A.J., Holm, P.A. and Lowe, C.H. 1995. Introduced aquatic vertebrates in the Chiricahua region: effects on declining ranid frogs. Biodiversity and management of the Madrean Archipelago: the sky islands of southwestern United States and northwestern Mexico. DeBano, L.F., Gottfried, G.J., Hamre, R.H. and Edmi, C.B.,editor. Rocky Mountain Forest and Range Experimental Station. Fort Collins, CO.
- Schwalbe, C. R. 1993. Status of amphibians in Arizona. Park Science 13(4):10.
- Scott, N.J. and R.D. Jennings 1985. The tadpoles of five species of New Mexican leopard frogs. Occasional papers the Museum of Southwest Biology. No. 3, Dec. 9, 1985. 21Pp.
- Sredl, M. 1993. Global amphibian decline: have Arizona's amphibians been affected? Sonoran Herpetologist 6(2):14-21.
- Sredl, M. J., J. M. Howland, J. E. Wallace, and L. S. Saylor. 1997. Status and distribution of Arizona's native ranid frogs. Pages 37-89 in M. J. Sredl, editor. Ranid frog conservation and management. Arizona Game and Fish Department, Nongame and Endangered Wildlife Program, Technical Report 121.
- Sredl, M.J. and Jennings, R.D. In press *Rana chiricahuensis* (Platz and Mecham, 1979) Chiricahua Leopard Frogs. Status and Conservation of U.S. Amphibians. Volume 2: Species Accounts. Lannoo, M.J.,editor. University of California Press. Berkeley, CA.
- Sredl, M.J. and Saylor, L.S. 1998. Conservation and Management Zones and the role of earthen cattle tanks in conserving Arizona leopard frogs on large landscapes. Environmental, Economic, and Legal Issues Related to Rangeland Water Developments. Feller, J.M. and Strouse, D.S.,editor. 211-225. The Center for the Study of Law, Science and Technology, Arizona State University. Tempe, AZ.
- Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Second edition. Houghton Mifflin Company, Boston, MA. xiv + 336 pp.
- U.S. Fish and Wildlife Service (USFWS). 13 June 2002. Listing of the Chiricahua leopard frog (*Rana chiricahuensis*). Federal Register 67(114):40790-40811.
- U.S. Fish and Wildlife Service (USFWS). 14 June 2000. Proposal to list the Chiricahua leopard frog as threatened with a special rule. Federal Register 65:37343-37357.
- Wood, T. 1991. Results of 1991 amphibian monitoring on the Coronado National Forest. The Nature Conservancy and U.S. Forest Service.

New Mexico Ridgenose Rattlesnake (*Crotalus willardi obscures*)

The New Mexico ridge-nosed rattlesnake was designated as a federally Threatened species on August 4, 1978.

Historic Range: This snake occurs locally in Animas Mountains (New Mexico), Peloncillo Mountains (Arizona and New Mexico), and Sierra de San Luis (Sonora and Chihuahua, Mexico) (Campbell et al. 1989, Holycross and Smith 1997, Campbell and Lamar 2004).

Basic Description: A rattlesnake.

Reproduction Comments: Viviparous. Bears 2-9 young, August-September.

Non-Migrant: No

Locally Migrant: No

Long Distance Migrant: No

Palustrine Habitat(s): Riparian

Terrestrial Habitat(s): Bare rock/talus/scree, Woodland - Conifer, Woodland - Hardwood, Woodland - Mixed

Special Habitat Factors: Burrowing in or using soil, Fallen log/debris

Habitat Comments: Primarily at high elevations in pine-oak woodland and pine-fir forest but also found in foothill canyons in pinyon-juniper woodland. Inhabits canyon bottoms with canopies of alder, box elder, maple, etc. (Stebbins 1985). Hides in leaf litter among cobbles and rocks; frequently climbs into trees and shrubs (Matthews and Moseley 1990).

Adult Food Habits: Carnivore, Invertivore

Immature Food Habits: Carnivore, Invertivore

Food Comments: Preys on scorpions, centipedes, lizards, small mammals and birds.

Adult Phenology: Diurnal, Hibernates/aestivates

Immature Phenology: Diurnal, Hibernates/aestivates

Phenology Comments: Inactive in cold temperatures and extreme heat. Mainly diurnal but probably at least partially nocturnal during hot summer weather; in summer, most active on warm humid mornings; rains may stimulate late afternoon activity; in fall, active mainly in afternoon (Ernst 1992). Most active during daylight hours from July through September.

Length: 61 cm

References:

- Armstrong, B. L., and J. B. Murphy. 1979. The natural history of Mexican rattlesnakes. Univ. Kansas Museum Natural History Special Publication. No. 5. vii + 88 pp.
- Campbell, J. A., and E. D. Brodie, Jr., editors. 1992. Biology of the pit vipers. Selva, Tyler, TX.

- Campbell, J. A., and W. W. Lamar. 1989. The venomous reptiles of Latin America. Comstock Publ. Associates, Division of Cornell Univ. Press, Ithaca, NY. xii + 425 pp.
- Campbell, J. A., and W. W. Lamar. 2004. The venomous reptiles of the Western Hemisphere. 2 volumes. Cornell University Press, Ithaca, NY.
- Collins, J. T. 1990. Standard common and current scientific names for North American amphibians and reptiles. 3rd ed. Society for the Study of Amphibians and Reptiles. Herpetological Circular No. 19. 41 pp.
- Ernst, C. H. 1992. Venomous reptiles of North America. Smithsonian Institution Press, Washington, D.C. ix + 236 pp.
- Gloyd, H. 1940. The rattlesnakes. Chicago Academy Science, Special Publication No. 4.
- Holycross, A. T., and S. W. Smith. 1997. Geographic distribution: Crotalus willardi obscurus. Herpetological Review 28:97.
- Klauber, L. M. 1972. Rattlesnakes: their habits, life histories, and influence on mankind. Second edition. Two volumes. Univ. California Press, Berkeley, CA.
- Lowe, C. H., C. R. Schwalbe, and T. B. Johnson. 1986. The venomous reptiles of Arizona. Arizona Game and Fish Department. ix + 115 pp.
- Matthews, J.R. and C.J. Moseley (eds.). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 + 33 pp. appendix + 6 pp. glossary + 16 pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.
- Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Second edition. Houghton Mifflin Company, Boston, MA. xiv + 336 pp.

Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*)

The western yellow-billed cuckoo was designated as a Federal Candidate species on September 12, 2006.

Historical Range: BREEDING: interior California to southern Idaho, southeastern Montana, the Dakotas, southern Manitoba (rarely), Minnesota, and New Brunswick, south to southern Baja California, southern Arizona, Coahuila, Chihuahua, Nuevo Leon, Tamaulipas, Gulf Coast, and Florida Keys; sporadically farther south in Mexico and in the Greater Antilles (AOU 1998). Uncommon on Cuba, Hispaniola, and Puerto Rico; rare in Virgin Islands, Jamaica, and northern Lesser Antilles (Saint Martin); possibly in Bahamas and Lesser Antilles (Raffaele et al. 1998). Bred formerly in British Columbia, Washington, and Oregon. NONBREEDING: southern Central America (rare and local in Costa Rica) and northern South America (and Trinidad and Tobago) south to eastern Peru, Bolivia, and northern Argentina (AOU 1998); rare in West Indies (Raffaele et al. 1998).

Basic Description: A bird (cuckoo).

Reproduction Comments: Breeding often coincides with the appearance of massive numbers of cicadas, caterpillars, or other large insects (Ehrlich et al. 1992). Clutch size is one to five (commonly two to three), largest when prey is abundant. Clutch sizes greater than six attributable to more than one female laying in nest (Hughes 1999). Incubation lasts 9-11, shared by male and female during day; male incubates at night (Hamilton and Hamilton 1965, Potter 1980, Potter 1981). Young are tended by both parents, climb in branches at seven-nine days. Sometimes lays eggs in the nests of Black-billed Cuckoo (*Coccyzus erythropthalmus*) or (rarely) other species (Ehrlich et al. 1992).

Ecology Comments: Territory size averages 20-24 hectares (S. Laymon, in Riparian Habitat Joint Venture 2000). Known predators of adults include Aplomado Falcon (*Falco femoralis*), Red-shouldered Hawk (*Buteo lineatus*), and other raptors; of eggs and young include Blue Jay (*Cyanocitta cristata*), Common Grackle (*Quiscalus quiscula*), Black Racer (*Coluber constrictor*) and Eastern Chipmunk (*Tamias striatus*) (Hughes 1999). Occasional host for Brown-headed Cowbird (*Molothrus ater*), Bronzed Cowbird (*Molothreus aeneus*), and Black-billed Cuckoo (*Coccyzus erythropthalmus*) (Hughes 1999).

Non-Migrant: No

Locally Migrant: No

Long Distance Migrant: Yes

Mobility and Migration Comments: Migrates regularly through the southern U.S., Middle America, and West Indies (sometimes large numbers in fall in Puerto Rico, Raffaele 1983). Birds from North America may migrate through Puerto Rico, but a small breeding population may be resident all year (Kepler and Kepler 1978). Migrants noted in April-May in Jamaica (Lack 1976). Migrates through Costa Rica mid-August to early November and late April-early June (Stiles and Skutch 1989). Arrives in California breeding grounds usually in early June (Biosystems Analysis 1989).

Estuarine Habitat(s): Scrub-shrub wetland

Palustrine Habitat(s): Riparian

Terrestrial Habitat(s): Forest - Hardwood, Forest - Mixed, Old field, Shrubland/chaparral, Suburban/orchard, Woodland - Hardwood, Woodland – Mixed

Habitat Comments: BREEDING: Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland; in the West, nests in tall cottonwood and willow riparian woodland. Nests in deciduous woodlands, moist thickets, orchards, overgrown pastures; in tree, shrub, or vine, an average of 1-3 meters above ground (Harrison 1979). Subspecies *occidentalis* requires patches of at least 10 hectares (25 acres) of dense riparian forest with a canopy cover of at least 50 percent in both the understory and overstory; nests typically in mature willows (Biosystems Analysis 1989). NON-BREEDING: forest, woodland, and scrub. Also mangroves in Puerto Rico (Raffaele 1983).

Adult Food Habits: Invertivore

Immature Food Habits: Invertivore

Food Comments: Eats mainly caterpillars; also other insects, some fruits, sometimes small lizards and frogs and bird eggs (Terres 1980). Gleans food from branches or foliage, or sallies from a perch to catch prey on the wing (Ehrlich et al. 1992).

Adult Phenology: Diurnal

Immature Phenology: Diurnal

Length: 31 cm

Weight: 64 grams

Stewardship Overview: Summer distribution throughout much of the eastern and Midwestern United States. Once common in the west, now rare and local, extirpated from British Columbia, Washington, Oregon, possibly Nevada. Winters primarily in South America east of the Andes, may breed in the tropics. Blue listed by Tate (1981). Western population currently under review for federal listing by USFWS; does not yet receive adequate federal due primarily to controversy surrounding the validity of its subspecies status. Listed as endangered in California, listed as threatened or endangered in every western state in which it occurs. From 1980 to 1994 eastern populations declined in all states except Louisiana and South Carolina. Highly significant declines in Alabama, Georgia, Illinois, Indiana, Michigan, New Jersey, New York, Ohio, Pennsylvania, Texas and Wisconsin, with the greatest decline in Connecticut. Main threats are habitat fragmentation, degradation of riparian woodland due to agricultural and residential development (Dobkin 1994), stochastic extinctions and low colonization rates, flood control (Laymon and Halterman 1987, 1989), riparian habitats invaded by less desirable salt cedar (TAMARIX spp.; Hughes 1999). Highly vulnerable to continued tropical deforestation (Morton 1992), but direct effects on population numbers not quantified. Preserves in the west should include riparian areas with dense stands of cottonwood and willow with an average tree height of 10-15 meters (Anderson and Laymon 1989). Preserves in the east should have open woodlands with clearings and low, dense, shrubby vegetation, associated with watercourses. Management should focus on acquiring and improving riparian habitats, and eliminating pesticide spraying near habitats.

Restoration Potential: May recolonize if suitable habitat is restored. On experimentally replanted sites (11 hectares) in southern California, foraged in second year and nested in third year following replanting, provided that cottonwood growth averaged 3 meters per year. Sites with growth of 2 meters per year or less not used for foraging or nesting by third year (Anderson and Laymon 1989).

Preserve Selection & Design Considerations: In California, Gaines (1974) defined habitat as willow and cottonwood forests below 1300 meters elevation, greater than 10 hectares in extent, and wider than 100 meters. Laymon and Halterman (1989) concluded that sites greater than 80 hectares (200 acres) in extent and wider than 600 meters (1950 feet) were optimal (100 percent occupancy), sites 41-80 hectares (101-200 acres) in extent and wider than 200 meters (650 feet) were suitable (58.8 percent), sites 20-40 hectares (50-100 acres) in extent and 100-200 meters (325-650 feet) in width were marginal (9.5 percent), and sites less than 15 hectares (38 acres) in extent and less than 100 meters (325 feet) in width were unsuitable. During a four-year study on the Sacramento River, Halterman (1991) found that habitat patch area, the extent of habitat in a 8 kilometer (5 mile) section of river, and presence of low woody vegetation were the most important variables in explaining the distribution of cuckoos. These variables combined explained 46 percent of the variation observed in the distribution of breeding pairs. Microhabitat requirements are also important. Nesting groves at the South Fork Kern River are characterized by higher canopy closure, higher foliage volume, intermediate basal area, and intermediate tree height when compared to random sites (Laymon et al. 1997). Sites with less than 40 percent canopy closure are unsuitable, those with 40 - 65 percent are marginal to suitable, and those with greater than 65 percent are optimal (Laymon 1998). Lower nesting success for open-cup nesting birds near edges in large habitats and in smaller habitat fragments (Chasko and Gates 1982, Gates and Gysel 1978), and increased nest predation reaching up to 600 meters into forest interior (Wilcove 1985) indicate that reserves less than 100 hectares are less valuable than larger reserves (Wilcove et al. 1986). Simulation modeling demonstrates that populations of fewer than 10 pairs are very unstable and always become extinct in a short period of time (Richter-Dyn and Goel 1972, Roth 1974); a minimum number of 25 pairs in a subpopulation with interchange to other subpopulation should be reasonably safe from extinction by stochastic events (Hughes 1999). In the northeast and central U.S., and southern Canada, preserves should include woodland, abandoned farmland, overgrown fruit orchards, successional shrubland, dense thickets along streams and marshes (Johnsgard 1979, Peck and James 1983, Eaton 1988, Jauvin 1996), shade trees, gardens (Oberholser 1974). In midwest U.S., also uses willow-dogwood shrub wetlands, and successional hardwood forest with dense stands of small trees 1-7 meters in height; e.g., American Elm and or continuous stands of dense Hawthorn (Nolan 1963, Eastman 1991). In southeastern U.S. occupies hammocks and hardwood forest, particularly those crossed by streams, thickets, swamps, and fencerows (Stevenson and Anderson 1994).

Management Requirements: See California Department of Fish and Game (1990) for a listing of management needs in California. In the west, conservation recommendations summarized in Laymon (1980) include: determine numbers and locations of remnant populations; improve existing, and acquire new riparian habitats; eliminate pesticide spraying in orchards adjacent to riparian areas; and investigate feasibility of captive breeding and reintroduction to naturally regenerated or reforested habitat. Riparian vegetation propagation and site management techniques are outlined in Anderson and Laymon (1989). Grazing should be removed to allow natural regeneration and encourage increased density of cottonwoods and willows.

Monitoring Requirements: Population densities may be highly variable locally (Eaton 1988) depending on food availability; large localized influxes during times of insect abundances (Veit and Petersen 1993). Estimates made over 1-2 year period must be assessed with caution (Groschupf 1987). Population density may be underestimated due to quiet demeanor and skulking behavior, easily overlooked when silent. Conventional observation, mist netting (Rappole et al. 1993), or listening-post techniques are inadequate for estimating density; counting responses to playback is preferable (Hamilton and Hamilton 1965). Overlapping territories increase difficulty in monitoring and the only way to get a complete survey is to locate all or most of the nests which is a very time-consuming and difficult task (Laymon, pers. comm.).

Management Programs: On the South Fork Kern River, an experimental study using riparian restoration showed that the number of pairs is closely related to the amount of available habitat. This site had a restoration program which began in 1996 and has established 125 hectares (310 acres) of willow-cottonwood habitat on the Kern River Preserve, all of which was being used by cuckoos by the summer of 1996. An additional 510 hectares (1275 acres) of habitat was established by natural regeneration in the South Fork Wildlife Area and the Isabella Reservoir Draw-Down Zone between 1987 and 1992 (Laymon 1998).

Biological Research Needs: Need to determine cause(s) of declines in eastern and central populations.

References:

- Allen, Craig R., Stephen DeMarais, and R. Scott Lutz. 1994. Red Imported Fire Ant Impact on Wildlife: an Overview. Texas J. Sci. 46(1):51-59.
- American Ornithologists' Union (AOU). 1983. Check-list of North American Birds, 6th edition. Allen Press, Inc., Lawrence, KS. 877 pp.
- American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
- American Ornithologists' Union. 1957. Checklist of North American Birds. 5th edition. Baltimore: Lord Baltimore Press. 691 pp.
- Anderson, B.W., and S.A. Laymon. 1989. Creating habitat for the Yellow-billed Cuckoo (*Coccyzus americanus*). Pages 468-472 in USDA Forest Service, General Technical Report PSW-110.
- Aquin, P. 1999. Évaluation de la situation des groupes taxonomiques des oiseaux du Québec. Ministère de l'Environnement et de la Faune. 13 pages.
- Arnett, John H. Jr., E.A. Choat, R.T. Darby, P.W. Schwalbe, Andm. Weiss. 1954. A Field List of Birds of the Philadelphia Region. Delaware Valley Ornithological Club. 45 pp.
- Audubon Society. 1981-1985. Breeding Bird Atlas of New Hampshire. (unpublished).
- Baicich, P. J., and C. J. O. Harrison. 1997. A guide to the nests, eggs and nestlings of North American birds. Second edition. Academic Press, NY.
- Bancroft, G. T., A. M. Strong, and M. Carrington. 1995. Deforestation and its effects on forest-nesting birds in the Florida Keys. Conservation Biology 9: 835-844.
- Banks, R. C. 1988. Geographic variation in the yellow-billed cuckoo. Condor 90:473-477.
- Behle, W. H., E. D. Sorensen, and C. M. White. 1985. Utah birds: a revised checklist. Occas. Publ. No. 4, Utah Museum of Natural History, Univ. of Utah, Salt Lake City, UT. xv + 108 pp.
- Bent, A.C. 1940. Life histories of North American cuckoos, goatsuckers, hummingbirds, and their allies. Part I. U.S. National Museum Bulletin 176. 244 pp.
- Bierly, M.L. 1980. Bird Finding in Tennessee. 3825 Bed- ford Ave., Nashville, TN 37125.
- Biosystems Analysis, Inc. 1989. Endangered Species Alert Program Manual: Species Accounts and Procedures. Southern California Edison Environmental Affairs Division.
- BirdLife International. 2004. Threatened birds of the world 2004. CD ROM. BirdLife International, Cambridge, UK.
- Braun, M. J., D. W. Finch, M. B. Robbins, and B. K. Schmidt. 2000. A field checklist of the birds of Guyana. Smithsonian Institution, Washington, D.C.
- Burleigh, T. D. 1972. Birds of Idaho. The Caxton Printers, Ltd., Caldwell, Idaho. 467 pp.
- Cadman, M. D., P. F. J. Eagles, and F. M. Helleiner. 1987. The Atlas of Breeding Birds of Ontario. University of Waterloo Press, Waterloo, Canada. 617pp.
- California Department of Fish and Game. 1990. 1989 annual report on the status of California's state listed threatened and endangered plants and animals. 188 pp.
- Cannings, S. 2001. EO Specifications for Yellow-billed Cuckoo (*Coccyzus americanus*). NatureServe, Unpublished. 1 pp.

- Carter, M., G. Fenwick, C. Hunter, D. Pashley, D. Petit, J. Price, and J. Trapp. 1996. Watchlist 1996: For the future. Field Notes 50(3):238-240.
- Chasko, G. G., and J. E. Gates. 1982. Avian habitat suitability along a transmission-line corridor in an oak-hickory forest region. Wildlife Monographs, Vol. 82.
- Dicinson, Mary B., ed. 1999. Field Guide to the Birds of North America, 3rd ed. National Geographic Society, Washington, D.C. 480 pp.
- DeGraaf, R.M., and J.H. Rappole. 1995. Neotropical migratory birds: natural history, distribution, and population change. Comstock Publishing Associates, Ithaca, NY.
- Decalesta, D. S. 1994. Effect of white-tailed deer on songbirds within managed forests in Pennsylvania. Journal of Wildlife Manage. 58: 711-718.
- Desrosiers A., F. Caron et R. Ouellet. 1995. Liste de la faune vertébrée du Québec. Les publications du Québec. 122 pp.
- Dionne C. 1906. Les oiseaux de la province de Québec. Dussault et Proulx.
- Dobkin, D.S. 1994. Conservation and management of neotropical migrant landbirds in the Northern Rockies and Great Plains. University of Idaho Press, Moscow, ID.
- Droege, S., and J.R. Sauer. 1990. North American Breeding Bird Survey, annual summary, 1989. U.S. Fish and Wildlife Service, Biological Report 90(8). 22 pp.
- Dunn, E. H., C. M. Downes, and B. T. Collins. 2000. The Canadian Breeding Bird Survey, 1967-1998. Canadian Wildlife Service Progress Notes No. 216. 40 pp.
- Eastman, J. 1991. Yellow-billed Cuckoo. Pages 234-245 in R. Brewer, G.A. McPeek, and R.J. Adams, Jr., editors. The atlas of breeding birds of Michigan. Michigan State University Press, East Lansing, MI.
- Eaton, S. W. 1988. Yellow Billed Cuckoo. Pages 198-199 in: The Atlas of Breeding Birds of New York State. Cornell Univ. Press, Ithaca, NY.
- Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The birder's handbook: a field guide to the natural history of North American birds. Simon and Shuster, Inc., New York. xxx + 785 pp.
- Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1992. Birds in Jeopardy: the Imperiled and Extinct Birds of the United States and Canada, Including Hawaii and Puerto Rico. Stanford University Press, Stanford, CA. 259 pp.
- Erskine, A. J. 1992. Atlas of breeding birds of the Maritime Provinces. Nimbus Publishing and the Nova Scotia Museum, Halifax, Nova Scotia.
- Franzreb, K. E. and S. A. Laymon. 1993. A reassessment of the taxonomic status of the Yellow-billed Cuckoo. Western Birds 24:17-28.
- Gaines, D. 1974. Review of the status of the Yellow-billed Cuckoo in California: Sacramento Valley populations. Condor 76:204-209.
- Gaines, D., and S.A. Laymon. 1984. Decline, Status and Preservation of the Yellow-billed Cuckoo in California. Western Birds 15(2):49-80.
- Gates, J.E., and L.W. Gysel. 1978. Avian nest dispersion and fledgling success in field-forest ecotones. Ecology 59:871-883.
- Godfrey, Earl W. 1986. Birds of Canada. National Museums of Canada, Ottawa, Ontario, Canada. 595 p. + plates.
- Groschupf, K. 1987. Status of the Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) in Arizona and west Texas. USFWS Rep. 20181-86-00731. Phoenix, AZ.

- Hagan, J. M., III, and D. W. Johnston, editors. 1992. Ecology and conservation of neotropical migrant landbirds. Smithsonian Institution Press, Washington, D.C. xiii + 609 pp.
- Halterman, M.D. 1991. Distribution and habitat use of the Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) on the Sacramento River, California, 1987-1990. Masters Thesis, California State University, Chico.
- Hamilton, W.J., III, and M.E. Hamilton. 1965. Breeding characteristics of Yellow-billed Cuckoos in Arizona. Proc. Calif. Acad. Sci. 32:405-432.
- Harrison, H. H. 1979. A field guide to western birds' nests. Houghton Mifflin Company, Boston, MA. 279 pp.
- Hayward, C. L., C. Cottam, A. M. Woodbury, and H. H. Frost. 1976. Birds of Utah. Great Basin Naturalist Memoirs 1: 229 pp.
- Heritage database. Washington Department of Fish and Wildlife. October 30, 2002.
- Howell, S. N. G., and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, Oxford, UK.
- Hughes, J. M. 1999. Yellow-billed Cuckoo (*Coccyzus americanus*). Birds of North America 418: 1-27.
- Hughes, J.M. 1999. Yellow-billed Cuckoo (*Coccyzus americanus*). In A. Poole and F. Gill, editors, The Birds of North America, No. 418. The Birds of North America, Inc., Philadelphia, PA. 28 pp.
- Hughes, J.M. 1999. Yellow-billed cuckoo (Coccyzus americanus). No. 318 IN A. Poole and F. Gill, editors. The birds of North America. The Birds of North America, Inc., Philadelphia, PA. 28 pp.
- Hunter, W. C., R. D. Ohmart, and B. W. Anderson. 1988. Use of exotic saltcedar (*Tamarix chinesis*) by birds in arid riparian systems. Condor 90:113-123.
- Jewett, S.G., W.P. Taylor, W.T. Shaw, and J.W. Aldrich. 1953. Birds of Washington State. U. Washington Press. 767 pp.
- Johnsgard, P. A. 1979. Birds of the Great Plains: breeding species and their distribution. Univ. Nebraska Press, Lincoln, NE. 539 pp.
- Johnsgard, P. A. 1986. Birds of the Rocky Mountains with particular reference to national parks in the Northern Rocky Mountain region. Colorado Associated University Press, Boulder, CO. xi + 504 pp.
- Johnson, D.H. and T.A. O'Neil. 2001. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press. Corvallis. 736 pp.
- Juavin, D. 1996 Yellow-billed Cuckoo. Pages 582-583 in The Breeding birds of Quebec: atlas of breeding birds of southern Quebec. Association Quebecoise des Groupes d' Ornithologues, Province of Quebec Society for the Protection of Birds, Can. Wildl. Serv., Environ. Can./ Montreal.
- Kepler, C. B., and A. K. Kepler. 1978. Status and nesting of the yellow-billed cuckoo in Puerto Rico. Auk 95:417-419.
- Lack, D. 1976. Island biology illustrated by the land birds of Jamaica. Studies in Ecology, Vol. 3. Univ. California Press, Berkeley, CA. 445 pp.
- Larrison, E. J., J. L. Tucker, and M. T. Jollie. 1967. Guide to Idaho birds. Journal of the Idaho Academy of Science 5: 1-220.

- Laughlin, S.B. and D.P. Kibbe, eds. 1985. The Atlas of Bre eding Birds of Vermont. Univ. Press of New England. 456pp.
- Laymon, S. A. 1998. Partners in Flight Bird Conservation Plan for Yellow-billed Cuckoo, website.
- Laymon, S. A., and M. D. Halterman. 1987b. Can the western subspecies of Yellow-billed Cuckoo be saved from extinction? Western Birds 18:19-25.
- Laymon, S.A. and M.D. Halterman. 1987. Can the Western Subspecies of the Yellow-billed Cuckoo be Saved from Extinction? Western Birds 18:19-25.
- Laymon, S.A., P.L. Williams, and M.D. Halterman. 1997. Breeding status of the Yellow-billed Cuckoo in the South Fork Kern River Valley, Kern County, California: Summary report 1985 - 1996. Administrative Rep. U.S.D.A Forest Service, Sequoia National Forest, Cannell Meadow Ranger District, Challenge Cost-Share Grant #92-5-13.
- Laymon, S.A., and M.D. Halterman. 1989. A proposed habitat management plan for Yellow-billed Cuckoos in California. USDA Forest Service, Gen. Tech. Rep. PSW-110.
- Lowery, George H. 1974. The Birds of Louisiana. LSU Press. 651pp.
- McAtee W.L. 1959. Folk - names of candian birds. National Museum of Canada. Folk - names of candian birds. National Museum of Canada. 74 pages.
- Montana Bird Distribution Online Database. 2001. Helena, Montana, USA. April-September 2003. http://nhp.nris.state.mt.us/mbd/.
- Morton, E.S. 1992. What do we know about the future of migrant landbirds? Pages 579-589 in J.M. Hagan III and D.W. Johnston, editors. Ecology and conservation of neotropical migrant landbirds. Smithsonian Institution Press, Washington, DC.
- National Geographic Society (NGS). 1999. Field guide to the birds of North America. Third edition. National Geographic Society, Washington, DC. 480 pp.
- Nicholson, C.P. 1997. Atlas of the breeding birds of Tennessee. The University of Tennessee Press. 426 pp.
- Nolan, V., Jr. 1963. Reproductive success of birds in a deciduous scrub habitat. Ecology 44:305-313.
- Oberholser, H.C. 1974. The bird life of Texas. 2 vols. Univ. of Texas Press, Austin, TX.
- Ouellet H., M. Gosselin et J.P. Artigau. 1990. Nomenclature française des oiseaux d'Amérique du Nord. Secrétariat d'État du Canada. 457 p.
- Parker III, T. A., D. F. Stotz, and J. W. Fitzpatrick. 1996. Ecological and distributional databases for neotropical birds. The University of Chicago Press, Chicago, IL.
- Parks Canada. 2000. Vertebrate Species Database. Ecosystems Branch, 25 Eddy St., Hull, PQ, K1A 0M5.
- Peck, G. K., and R. D. James. 1983. Breeding birds of Ontario, nidology and distribution, volume 1: nonpasserines. Royal Ontario Museum, Toronto, Canada.
- Pennsylvania Breeding Bird Atlas Project. 1984-1987. Unpublished.
- Poole, A. F. and F. B. Gill. 1992--. The birds of North America. The American Ornithologists' Union, Washington, D.C. and The Academy of Natural Sciences, Philadelphia, PA.
- Potter, E. F. 1980. Notes on nesting Yellow-billed Cuckoos. Journal of Field Ornithology 51:17-29.

- Potter, E. F. 1981. Effects of cool weather on nesting behavior and development in the Yellow-billed Cuckoo. Chat 45:15-16.
- Price, J., S. Droege, and A. Price. 1995. The summer atlas of North American birds. Academic Press, NY. x + 364 pp.
- Raffaele, H. A. 1983. A guide to the birds of Puerto Rico and the Virgin Islands. Fondo Educativo Interamericano, San Juan, Puerto Rico. 255 pp.
- Raffaele, H., J. Wiley, O. Garrido, A. Keith, and J. Raffaele. 1998. A guide to the birds of the West Indies. Princeton University Press, Princeton, NJ. 511 pp.
- Rappole, J.H., W.J. McShea, and J. Vega-Rivera. 1993. Evaluation of two survey methods in upland avian breeding communities. Journal of Field Ornithology 64(1):55-70.
- Richter-Dyn, N. and N.S. Goel. 1972. On the extinction of a colonizing species. Theoretical Population Biology 3:406-433.
- Ridgely, R. S. 2002. Distribution maps of South American birds. Unpublished.
- Ridgely, R. S. and J. A. Gwynne, Jr. 1989. A Guide to the Birds of Panama. 2nd edition. Princeton University Press, Princeton, USA.
- Riparian Habitat Joint Venture. 2000. Version 1.0. The riparian bird conservation plan: a strategy for reversing the decline of riparian associated birds in California. California Partners in Flight.
- Riparian Habitat Joint Venture. 2000. Version 1.0. The riparian bird conservation plan: a strategy for reversing the decline of riparian associated birds in California. California Partners in Flight. Available at: http://www.prbo.org/CPIF/Riparian/ripariandl.html.
- Roth, D.A. 1974. The analysis of a population model demonstrating the importance of dispersal in a heterogeneous environment. Oecologia 15:259-275.
- Ryke, N., D. Winters, L. McMartin and S. Vest. 1994. Threatened, Endangered and Sensitive Species of the Pike and San Isabel National Forests and Comanche and Cimarron National Grasslands. May 25, 1994.
- Sauer, J.R., J.E. Hines, G. Gough, I. Thomas, and B.G. Peterjohn. 1997. The North American Breeding Bird Survey Results and Analysis. Version 96.3. Online. Patuxent Wildlife Research Center, Laurel, MD. Available: http://www.mbr.nbs.gov/bbs/bbs.html.
- Sauer, J.R., and S. Droege. 1992. Geographical patterns in population trends of Neotropical migrants in North America. Pages 26-42 in J.M. Hagan, III, and D.W. Johnston, editors. Ecology and conservation of Neotropical migrant landbirds. Smithsonian Institution Press, Washington, DC.
- Sibley, C.G., and B.L. Monroe, Jr. 1990. Distribution and Taxonomy of Birds of the World. Yale University Press, New Haven, CT. xxiv + 1111 pp.
- Smith, M.R., P.W. Mattocks, Jr., and K.M. Cassidy. 1997. Breeding birds of Washington State. Vol. 4. IN Washington State Gap analysis - Final report (K.M. Cassidy, C.E. Grue., M.R. Smith, and K.M. Dvornich, eds.). Seattle Audubon Society Publications in Zoology No. 1, Seattle, 538 pp.
- Stevenson, H.M., and B.H. Anderson. 1994. The Birdlife of Florida. University Press of Florida, 891 pp.
- Stiles, F. G. and A. F. Skutch. 1989. A guide to the birds of Costa Rica. Cornell University Press, Ithaca, New York, USA. 511 pp.
- Tate, J. 1981. The Blue List for 1981: the first decade. American Birds 35:3-10.

- Taylor, D. 1985. Candidate threatened or endantered molluscs in Box Canyon ACEC. Gooding County, ID. Report to Bureau of Land Management, Shoshone, ID, under Order ID-050-PH5-0093. 19 pp.
- Terres, J. K. 1980. The Audubon Society encyclopedia of North American birds. Alfred A. Knopf, NY.
- U. S. Fish and Wildlife Service (USFWS). 2000. Endangered and threatened wildlife and plants; notice of 90-day finding for a petition to list the yellow-billed cuckoo as endangered and commencement of a status review. Notice of 90-day petition finding. Federal Register 65(33): 8104-8107.
- U. S. Fish and Wildlife Service (USFWS). 2000. Notice of 90-day finding for a petition to list the Yellow-billed Cuckoo as Endangered and commencement of a status review. Federal Register 65(33): 8104-8107.
- U. S. Fish and Wildlife Service (USFWS). 2000. Notice of 90-day finding for a petition to list the Yellow-billed Cuckoo as Endangered and commencement of a status review. Federal Register 65(33):8104-8107.
- U. S. Fish and Wildlife Service (USFWS). 2001. Endangered and Threatened Wildlife and Plants; Re-opening of the Public Comment Period for Status Review of the Yellow-Billed Cuckoo in the Western United States. Federal Register 66(6): 1633-1634.
- USGS. 2002. Yellow-billed cuckoo breeding bird survey results. www.mbr-pwrc.usgs.gov/cgi-bin/atlasa01.pl?03870.
- Veit, R. R., and W. R. Peterson. 1993. Birds of Massachusetts. Massachusetts Audubon Society, Lincoln, MA. xv + 514 pp.
- Walters, R. E., and E. Sorensen (eds.). 1983. Utah bird distribution: latilong study. Publ. No. 83-10, Utah Division of Wildlife Resources, Salt Lake City. 97 pp.
- Wilcove, D.S. 1985. Nest predation in forest tracts and the decline of migratory songbirds. Ecology, 66:1211-1214.
- Wilcove, D.S., C.H. McLellan, and A.P. Dobson. 1986. Habitat fragmentation in the temperate zone. Pages 237-256 in M.E. Soule, editor. Conservation biology: the science of scarcity and diversity. Sinauer Associates, Sunderland, MA.
- Wood, Merrill. 1979. Birds of Pennsylvania. Pennsylvania State Univ., University Park, PA. 133pp.
- Woodbury, A. M., C. Cottam, and J. W. Sugden. 1949. Annotated check-list of the birds of Utah. Bull. Univ. Utah 39(16) [Biol. Ser. 11(2)]: 1-40.
- Zook, J. L. 2002. Distribution maps of the birds of Nicaragua, Costa Rica, and Panama. Unpublished.

Southwestern Willow Flycatcher (*Empidonax traillii extimus*)

The southwestern willow flycatcher was designated as a federally Endangered species on February 27, 1995.

Historic Range: BREEDS: southwestern U.S. (southern California north to Independence, Arizona, southwestern New Mexico, southern Utah, and, at least formerly, southern Nevada) and possibly northern Baja California and Sonora (very rare if present). Sedgwick (2001) studied distributional limits using distinctive song types of *E.T. extimus* and *E.T. adastus*, and found intergradation or overlap in southwestern Colorado and northwestern New Mexico. In areas of intergradation, there was some sorting of song types by elevation; birds with songs attributable to *E.T. extimus* were found as far north as 37 deg N at low elevation, whereas birds attributable to *E.T. adastus* were found as far south as 33.7 deg N at high elevation. The latter population occurred at over 2,400 meters in eastern Arizona. Occurred at least formerly in western Texas (current status uncertain) and northern Sonora. Some isolated remnant populations in southern California were allocated to subspecies *extimus* by Unitt (1987), but not by Phillips (1948). Population along the lower Colorado River now limited to about 20 pairs at Havasu National Wildlife Refuge (M. Romich, pers. comm. 2003). Formerly widespread in Arizona; now persist only in several small, widely scattered locations. Unitt (1987) noted that there was little recent information from Nevada and Utah. Unitt (1987) and USFWS (1993, 1995) included populations in areas of intergradation in the range of *E.T. extimus*. Winters: probably central Mexico to northwestern Colombia (Stiles and Skutch 1989). Migrates: in southern California, migrates through desert regions and sometimes along the coast and onto the Channel Islands (Biosystems Analysis 1989).

Basic Description: A small bird (flycatcher).

General Description: A flycatcher with brownish-olive upperparts, a whitish throat that contrasts with the pale olive breast, a pale yellow belly, and two light wing bars; generally lacks a conspicuous eye ring; as in other flycatchers, the bill is depressed and wide at the base (NGS 1983).

Diagnostic Characteristics: The palest subspecies of *E. traillii*; adults most closely resemble subspecies *adastus* but are even paler above, especially on the head, and *extimus* has a less pronounced chest band and the belly and crissum are paler yellow (Phillips 1948). Song differs from that of other subspecies by being a more protracted, slurred "fit-a-bew" with a burry "bew" syllable rather than a crisp, sneezy "fitz-bew" (USFWS 1995).

Reproduction Comments: Nesting occurs usually from early June through the end of July, peak in mid-June (Unitt 1987); sometimes may lay eggs as early as late May. In Grand Canyon, Arizona, breeds from early June to mid-July or perhaps early August (Brown 1988). Clutch size usually is 3-4 (2-3 along Colorado River). Incubation lasts 12-15 days, by female. Young are tended by both parents, leave nest at 12-15 days, usually in early to mid-July. Typically raises one brood per year. May incur a high rate of cowbird parasitism, especially in low elevation populations (e.g., Harris 1991, Brown 1988). Sometimes polygynous.

Ecology Comments: Breeding territories are about 1.5 acres. Densities may be on the order of 9-14 pairs/100 acres.

Non-Migrant: No

Locally Migrant: No

Long Distance Migrant: Yes

Mobility and Migration Comments: Present in California from late April to September (Biosystems Analysis 1989), in southern Arizona from early May to early or mid-September (Phillips et al. 1964). Arrives in Grand Canyon, Arizona, in mid-May (Brown, in Unitt 1987). Spring migration peaks in mid-May; fall migration extends from mid-August to early September (Biosystems Analysis 1989).

Palustrine Habitat(s): FORESTED WETLAND, Riparian

Terrestrial Habitat(s): Old field, Shrubland/chaparral, Woodland - Hardwood, Woodland - Mixed

Habitat Comments: Thickets, scrubby and brushy areas, open second growth, swamps, and open woodland (AOU 1983). Restricted to riparian habitat in Arizona (Brown 1988). Nests primarily in swampy thickets, especially of willow, sometimes buttonbush (Phillips et al. 1964, AOU 1983), tamarisk (Brown 1988), vines, or other plants, where vegetation is 4-7 m or more in height. Tamarisk is commonly used in the eastern part of the range. Habitat patches as small as 0.5 ha can support one or two nesting pairs (see USFWS 1995). Nests in fork or on horizontal limb of small tree, shrub, or vine, at height of 0.6-6.4 m (mean usually about 2-3 m) (Harris 1991), with dense vegetation above and around the nest.

Adult Food Habits: Invertivore

Immature Food Habits: Invertivore

Food Comments: Eats mainly insects caught in flight, sometimes gleans insects from foliage; occasionally eats berries. In breeding range, forages within and occasionally above dense riparian vegetation.

Adult Phenology: Diurnal

Immature Phenology: Diurnal

Length: 15 cm

Weight: 11 grams

Management Requirements: In Oregon, willow flycatcher populations increased after reduction in cattle grazing and cessation of poisoning and removal of riparian willows (Taylor and Littlefield 1986). Harris (1991) recommended habitat restoration and reduction in grazing as the best long-term management strategies for reducing the rate of cowbird parsitism; trapping of cowbirds or removal of cowbird eggs may be useful short-term strategies to provide immediate reflief to critical populations. Brown (1988) cautioned against activities that would reduce or eliminate tamarisk (nesting habitat) in Grand Canyon, Arizona, and recommended that water releases from Glen Canyon dam be managed in such a way as to minimize streambank erosion and consequent reduction in riparian breeding habitat. See USFWS (1995) for further information.

Monitoring Requirements: Those doing field surveys should be aware that subspecies *brewsteri* is present (in migration) in the range of *extimus* during most of the latter's breeding season; surveys should encompass the period June 20 to July 15 and include repeated visits to verify that observed birds are resident and territorial (Unitt 1987).

References:

- American Ornithologists' Union (AOU). 1983. Check-list of North American Birds, 6th edition. Allen Press, Inc., Lawrence, KS. 877 pp.

- Behle, W. H. 1943. Birds of Pine Valley Mountain region, southwestern Utah. Bull. Univ. Utah 34(2), Biol. Ser. 7(5); 1-85.
- Behle, W. H. 1985. Utah birds: geographic distribution and systematics. Utah Mus. Natur. Hist., Occas. Pap. 5: 1-147.
- Bent, A.C. 1942. Life histories of North American flycatchers, larks, swallows, and their allies. U.S. National Museum Bulletin 179. Washington, DC.
- Biosystems Analysis, Inc. 1989. Endangered Species Alert Program Manual: Species Accounts and Procedures. Southern California Edison Environmental Affairs Division.
- Brown, B. T. 1988. Breeding ecology of a willow flycatcher population in Grand Canyon, Arizona. Western Birds 19:25-33.
- Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1992. Birds in Jeopardy: the Imperiled and Extinct Birds of the United States and Canada, Including Hawaii and Puerto Rico. Stanford University Press, Stanford, CA. 259 pp.
- Grinnell, J. 1914. An account of the mammals and birds of the lower Colorado valley, with especial reference to the distributional problems presented. Univ. California Publication Zoology 12:51-294.
- Harris, J. H. 1991. Effects of brood parasitism by brown-headed cowbirds on willow flycatcher nesting success along the Kern River, California. Western Birds 22:13-26.
- Harrison, C. 1978. A Field Guide to the Nests, Eggs and Nestlings of North American Birds. Collins, Cleveland, OH.
- Harrison, H. H. 1979. A field guide to western birds' nests. Houghton Mifflin Company, Boston, MA. 279 pp.
- Johnson, M.J. and M.K. Sogge. 1997. Southwestern Willow Flycatcher surveys along portions of the San Juan River, Utah (Montezuma Creek-Mexican Hat and Clay Hills Crossing): 1997. Final report to the Utah Division of Wildlife Resources. Colorado Plateau Research Station/Northern Arizona University, Flagstaff, AZ. 40 pp.
- Koronkiewicz, T., M. K. Sogge, and C. A. Drost. 1998. A preliminary survey for wintering willow flycatchers in Costa Rica. USGS Forest and Rangeland Ecosystem Science Center, Colorado Plateau Field Station, Northern Arizona University, Flagstaff. 47 pp.
- LaRue, C.T. 1994. Birds of northern Black Mesa, Navajo County, Arizona. Great Basin Naturalist 54(1):1-63.
- Lowther, P. E. 1993. Brown-headed cowbird. North Amer. Birds 47: 1-24.
- Marshall, R. M. 2000. Population status on breeding grounds. Chapter 3 *In*: D. Finch and S. Stoleson, editors. Status, ecology, and conservation of the southwestern willow flycatcher. USDA Forest Service, Rocky Mountain Research Station, Albuquerque, NM.
- McCabe, R. A. 1991. The little green bird: ecology of the willow flycatcher. Rusty Rock Press, Madison, WI. xv + 171 pp.
- McDonald, K. P., J. Snider, L. C. Peterson, M. St. Germain, and S. Staats. 1995. Results of 1995 southwestern willow flycatcher surveys in the Virgin River drainage and southern Utah. Utah Division of Wildlife Resources Publ. No. 95-17.
- McDonald, K. P., L. C. Peterson, and M. St. Germain. 1997. Results of 1996 surveys for southwestern willow flycatchers in the upper Virgin River drainage and southern Utah. Utah Division of Wildlife Resources Publ. No. 97-3. iii + 29 pp + 2 appendices.
- National Geographic Society. 1983. Field guide to the birds of North America. National Geographic Society, Washington, DC.

- New Mexico Department of Game and Fish. 1995. Recommended Changes: List of Endangered Species in New Mexico. pp. 1-12.
- Ohmart, R. D., B. W. Anderson, and W. C. Hunter. 1988. The ecology of the lower Colorado River from Davis Dam to the Mexico-United States international boundary: a community profile. U.S. Fish and Wildlife Service, Biological Report 85(7.19). xvi + 296 pp.
- Paxton, E. H. 2000. Molecular genetic structuring and demographic history of the willow flycatcher *(Empidonax trailli*i). Master's Thesis. Northern Arizona University, Flagstaff. 42 pp.
- Phillips, A. R. 1948. Geographic variation in *Empidonax traillii*. Auk 65:507-514.
- Phillips, A., J. Marshall, and G. Monson. 1964. The birds of Arizona. The University of Arizona Press, Tucson, AZ.
- Rosenberg, K.V., R.D. Ohmart, W.C. Hunter, and B.W. Anderson. 1990. Birds of the lower Colorado River valley. University of Arizona Press, Tucson, AZ. 464 pp.
- Schreier, W. 1996. Bryce Canyon National Park 1996 endangered avian species survey report--southwestern willow flycatcher. National Park Service, Colorado Plateau System Support Office, Intermountain Field Area, Bryce canyon, UT. 21 pp.
- Sedgwick, J. A. 2001. Geographic variation in the song of Willow Flycatchers: differentiation between *Empidonax traillii adastus* and *E. T. extimus*. Auk. 118:366-379.
- Sogge, M. K. 1995. Southwestern willow flycatcher surveys along the San Juan River, Utah[:] 1994-1995. Final report to the Bureau of Land Management, San Juan Resource Area. National Biological Service Colorado Plateau Research Station/Northern Arizona University report. ii + 27 pp.
- Sogge, M. K., R. M. Marshall, S. J. Sferra, and T. J. Tibbets. 1997. A southwestern willow flycatcher natural history summary and survey protocol. USDI National Park Service, Colorado Plateau Research Station, Technical Report NPS/NAUCPRS/NRTR-97/12, Flagstaff, AZ.
- Sogge, M. K., S. J. Sferra, T. D. McCarthey, S. O. Williams, III, and B. E. Kus. 2001. Summary of southwestern willow flycatcher breeding site and territory characteristics - 1999. Prepared for the Southwestern Willow Flycatcher Recovery Team, U.S. Fish and Wildlife Service, Region 2, Albuquerque, NM.
- Sogge, M. K., S. J. Sferra, T. McCarthey, S. O. Williams and B. E. Kus. 2002. Southwestern W illow Flycatcher breeding site and territory summary - 2001. USGS Forest and Rangeland Ecosystem Science Center, Colorado Plateau Field Station report to the U.S. Fish and Wildlife Service Southwestern Willow Flycatcher Recovery Team.
- Sogge, M.K., et.al. 1995. Status of the southwestern willow flycatcher along the Colorado River in Grand Canyon National Park - 1995. Summary Report. National Biological Service Colorado Plateau Research Station/Northern Arizona University. 26 p.
- Spahr, R., L. Armstrong, D. Atwood, and M. Rath. 1991. Threatened, endangered, and sensitive species of the Intermountain Region. U.S. Forest Service, Ogden, UT.
- Stiles, F. G. and A. F. Skutch. 1989. A guide to the birds of Costa Rica. Cornell University Press, Ithaca, NY, USA. 511 pp.
- Taylor, D. M., and C. D. Littlefield. 1986. Willow flycatcher and yellow warbler response to cattle grazing. American Birds 40:1169-1173.
- Terres, J. K. 1980. The Audubon Society encyclopedia of North American birds. Alfred A. Knopf, NY.

- Tibbits, T.J. et.al. 1994. A Survey Protocol for the Southwestern Willow Flycatcher (*Empidonax traillii extimus*). U.S. National Park Service Technical Report NPS/NAUCPRS/NRTR-94/04, Colorado Plateau Research Station at Northern Arizona University. 24 p.
- U.S. Fish and Wildlife Service. 1993. Proposed rule to list the southwestern willow flycatcher as endangered with critical habitat. Federal Register 58(140):39495-39522. 23 July 1993.
- U.S. Fish and Wildlife Service (USFWS). 1989. Endangered and threatened wildlife and plants; animal notice of review. Federal Register, Department of the Interior 54(4): 554-579.
- U.S. Fish and Wildlife Service (USFWS). 2002. Southwestern Willow Flycatcher (*Empidonax traillii extimus*). Final recovery plan. Prepared by Southwestern Willow Flycatcher Recovery Team Technical Subgroup. U.S. Fish and Wildlife Service, Division of Ecological Services, Albuquerque, NM.
- Unitt, P. 1987. *Empidonax traillii extimus*: an endangered subspecies. Western Birds 18:137-162.
- Woodbury, A. M., and H. N. Russell, Jr. 1945. Birds of the Navajo country. Univ. Utah Bull. 35(14), Biol. Ser. 9(1): 1-157.
- Yeager, B. and B. Masslich. 1995. Biological assessment for the St. George road projects. Prepared for Utah Department of Transportation. Bio/West, Inc., 1063 West 1400 North, Logan, UT 84321.

Northern Aplomado Falcon (*Falco femoralis*)

The northern aplomado falcon was designated as a federally Threatened species with a nonessential experimental population on February 25, 1986.

Historic Range: Historic breeding range: southeastern Arizona, southern New Mexico, and southern Texas south through Mexico (Tamaulipas, Chiapas, Campeche, Tabasco, Chihuahua, Coahuila, Sinaloa, Jalisco, Guerrero, Veracruz, Yucatan, and San Luis Potosi) to Guatemala (Pacific slope of Central American cordillera). Last verified breeding in the U.S. was in New Mexico in 1952 and in Texas in 1941 and 1995; unconfirmed report from Arizona in the late 1960s (AOU 1983); reintroduction is underway. Nests regularly only along Gulf Coast of Mexico in portions of northern and central Veracruz, northern Chiapas, western Campeche, and eastern Tabasco (Matthews and Moseley 1990). Unbanded individuals were recorded in New Mexico and Texas in the early 1990s. Historic winter range: Sinaloa, Chihuahua, and southern Tamaulipas south to southern Mexico; casual in Guatemala (AOU 1957).

Basic Description: A falcon.

Reproduction Comments: Egg-laying: January-June (mainly March-May, peak in April). Clutch size typically is 2-3. Both parents (mainly female) incubate, about 31-32 days (Cade 1982, Evans 1982). Young can fly at 4-5 weeks, may remain in nest area for several weeks more. Pairs remain together throughout the year (Palmer 1988).

Non-Migrant: Yes

Locally Migrant: Yes

Long Distance Migrant: No

Palustrine Habitat(s): Riparian

Terrestrial Habitat(s): Grassland/herbaceous, Savanna, Woodland – Conifer

Habitat Comments: Open rangeland and savanna, semiarid grasslands with scattered trees and shrubs; in U.S., was found in coastal prairies along sand ridges, in woodlands along desert streams, and in desert grasslands with scattered mesquite and yucca; has been found in open pine woodland in central Mexico (Matthews and Moseley 1990, Johnsgard 1990). Encroachment of thick tall grass of brush degrades habitat. Nests in old stick nests of other bird species (e.g., hawks, caracaras, ravens); in sites such as bromeliads in tropics. May sometimes nest on cliff.

Adult Food Habits: Carnivore, Invertivore

Immature Food Habits: Carnivore, Invertivore

Food Comments: Feeds primarily on birds (up to rock dove size), to a lesser extent on insects (moths, beetles, cicadas, orthopterans); uncommonly on small mammals, lizards, and snakes (Terres 1980, Cade 1982). Pairs often hunt together. Birds comprise most of diet biomass in eastern Mexico, but insects also are commonly consumed. Hunts from perch or air. See Palmer (1988) for further details. In eastern Mexico, hunted mainly within 1 km of nest site (Hector 1988).

Adult Phenology: Crepuscular, Diurnal

Immature Phenology: Crepuscular, Diurnal

Phenology Comments: Decidedly crepuscular in hunting habits, often catching prey after sunset; not very active in middle of day (Cade 1982). In eastern Mexico, preyed on birds mainly in the early morning, hawked insects later in the day (see Johnsgard 1990).

Length: 45 cm

Weight: 410 grams

References:

- Allen, Craig R., Stephen Demarais, and R. Scott Lutz. 1994. Red imported fire ant impact on wildlife: an overview. Texas J. Sci. 46(1):51-59.
- American Ornithologists' Union (AOU). 1957. The A.O.U. Check-list of North American Birds, 5th ed. Port City Press, Inc., Baltimore, MD. 691 pp.
- American Ornithologists' Union (AOU). 1983. Check-list of North American Birds, 6th edition. Allen Press, Inc., Lawrence, KS. 877 pp.
- Cade, T.J. 1982. The falcons of the world. Cornell University Press, Ithaca, NY. 192 pp.
- Campbell, L. 1995. Endangered and Threatened Animals of Texas: Their Life History and Management. Texas Parks and Wildlife Department, Endangered Resources Branch, Austin, TX. ix + 129 pp.
- Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1992. Birds in Jeopardy: the Imperiled and Extinct Birds of the United States and Canada, Including Hawaii and Puerto Rico. Stanford University Press, Stanford, CA. 259 pp.
- Evans, D. L. 1982. Status reports on twelve raptors. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report No. 238. 68 pp.
- Hector, D. P. 1987. Decline of the aplomado falcon, U.S.A. American Birds 41:381-389.
- Hector, D. P. K. 1988. Vegetative cover, small bird abundance and patterns of aplomado falcon habitat quality in eastern Mexico. Pages 157-164 in Glinski et al., eds. Proc. Southwest raptor management symposium and workshop. Nat. Wildl. Fed. Sci. and Tech. Ser. No. 11.
- Johnsgard, P. A. 1990. Hawks, eagles, and falcons of North America. Smithsonian Inst. Press, Washington, D.C. xvi + 403 pp.
- Matthews, J.R. and C.J. Moseley (eds.). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 + 33 pp. appendix + 6 pp. glossary + 16 pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.
- Palmer, R. S., ed. 1988. Handbook of North American birds. Vol. 5. Yale Univ. Press, New Haven. 465 pp.
- Terres, J. K. 1980. The Audubon Society encyclopedia of North American birds. Alfred A. Knopf, NY.

American Peregrine Falcon (*Falco peregrinus anatum*)

Historic Range: BREEDS: Across interior Alaska, south of the Brooks Range southeastward across Canada to Labrador, and south to Baja California and northern Mexico (Palmer 1988, Ambrose et al. 1988, Rowell 2002). Replaced on the coast of Alaska and outer coast of British Columbia by *F. p. pealei*. WINTERS: Those breeding in the boreal subarctic winter in South America; those at more southern latitudes exhibit variable migration behavior, and some are nonmigratory (USFWS 1999).

Basic Description: A medium-sized falcon.

General Description: A falcon with long pointed wings, a dark crown and nape, and a dark wedge extending below the eye; forehead is pale in immature, which are mainly brownish above rather than black or gray as in adults (NGS 1983).

Diagnostic Characteristics: Intermediate in coloration between the pale birds of the arctic (subspecies *tundrius*) and the very dark pergrines of the northwest coast of North America (subspecies *pealei*).

Reproduction Comments: Clutch size averages 4 at mid-latitudes, 3 in far north. Incubation lasts 32-35 days, mainly by female (male brings food). Young fledge at 39-49 days, gradually become independent. First breeds usually at 2-3 years, occasionally as yearling. Usually lifelong pair bond. Replaces lost clutches, usually at alternate site. Brood losses apparently caused mainly by bad weather. See many further details in Palmer (1988). In northwestern Arizona, mean distance between centers of nesting areas was around 6-8 km (Brown et al. 1992).

Ecology Comments: Great-horned Owl may be a serious nest predator in the U.S. Severe weather may result in high mortality in far north. Foraging range up to 27 kilometers (Martin 1979); home ranges in Great Britain varied from 44-65 square kilometers, and averaged 52 square kilometers (Brown and Amadon 1968). In Utah, home range radii varied from 0.3 to 29.8 kilometers, average 12.2 km (n = 19; Porter and White 1973).

Non-Migrant: No

Locally Migrant: No

Long Distance Migrant: Yes

Mobility and Migration Comments: Populations nesting in northern latitudes are highly migratory; those nesting in northern maritime climates, at mid-latitudes, and in the Southern Hemisphere much less so (Cade 1982). Tundra breeders migrate farthest, bypassing those farther south; a few winter in Florida, some in Caribbean, perhaps some in Central America, most in southern South America (Palmer 1988). Breeders from central Alaska migrated through central North America and wintered in southern Mexico, Central America, the Caribbean region, and South America (Britten et al. 1995). Two breeders from southern Utah migrated through western Mexico, and one continued to a wintering site in Nicaragua (Britten et al. 1995). In the U.S., the Atlantic coast from New Jersey to South Carolina and the barrier islands of the Texas Gulf Coast are important feeding areas for long-distance migrants. Arrives in northern breeding areas late April-early May; departure begins late August-early September (Johnson and Herter 1989). See Palmer (1988) for further information on timing of migration. From Padre Island, Texas, a northbound migrant reached south-central Canada in four days, and a southbound migrant passed through Mexico and reached Guatemala in six days (Chavez-Ramirez et al. 1994).

Estuarine Habitat(s): Bay/sound, Herbaceous wetland, Lagoon, River mouth/tidal river, Tidal flat/shore

Terrestrial Habitat(s): Bare rock/talus/scree, Cliff, Shrubland/chaparral, Urban/edificarian, Woodland - Conifer, Woodland - Hardwood, Woodland - Mixed

Habitat Comments: Various open situations from tundra, moorlands, steppe, and seacoasts, especially where there are suitable nesting cliffs, to mountains, open forested regions, and human population centers (AOU 1983). When not breeding, occurs in areas where prey concentrate, including farmlands, marshes, lakeshores, river mouths, tidal flats, dunes and beaches, broad river valleys, cities, and airports. Often nests on ledge or hole on face of rocky cliff or crag. River banks, tundra mounds, open bogs, large stick nests of other species, tree hollows, and man-made structures (e.g., ledges of city buildings) are used locally (Cade 1982). Nests typically are situated on ledges of vertical rocky cliffs, commonly with a sheltering overhang (Palmer 1988, Campbell et al 1990). Tundra populations nests typically on rocky cliffs, bluffs, or dirt banks. Ideal locations include undisturbed areas with a wide view, near water, and close to plentiful prey. Substitute man-made sites include tall buildings, bridges, rock quarries, and raised platforms. See Grebence and White (1989) for information on nesting along the Colorado River system.

Adult Food Habits: Carnivore

Immature Food Habits: Carnivore

Food Comments: Feeds primarily on birds (medium-size passerines up to small waterfowl); rarely or locally, small mammals (e.g., bats, lemmings), lizards, fishes, and insects (by young birds) may be taken. Prey pursuit initiated from perch or while soaring. May hunt up to several km from nest site (Skaggs et al. 1988). See Rosenfield et al. (1995) for information on food habits in Greenland.

Adult Phenology: Diurnal

Immature Phenology: Diurnal

Phenology Comments: In general, much hunting occurs in morning, and to lesser extent toward evening, but may hunt anytime during day.

Length: 51 cm

Weight: 1500 grams

References:

- Allen, Craig R., Stephen Demarais, and R. Scott Lutz. 1994. Red imported fire ant impact on wildlife: an overview. Texas J. Sci . 46(1):51-59.
- Ambrose, R.E., R.J. Ritchie, C.M. White, P.F. Schempf, T. Swem and R. Dittrick. 1988. Changes in the status of peregrine falcon populations in Alaska. Pp. 73-82. In: Cade, T.J., J.H. Enderson, C.G. Thelander and C.M. White (eds.). Peregrine falcon populations: their management and recovery. The Peregrine Fund, Inc., Boise, ID.
- Ambrose, S. 1993. Phone conversation with E. West, AKNHP zoologist regarding population level of F.P. Anatum. 4 October 1993. Ecological Services, U.S. Fish and Wildlife Service, Fairbanks AK.
- American Ornithologists' Union (AOU). 1957. The A.O.U. Check-list of North American Birds, 5th ed. Port City Press, Inc., Baltimore, MD. 691 pp.
- American Ornithologists' Union (AOU). 1983. Check-list of North American Birds, 6th edition. Allen Press, Inc., Lawrence, KS. 877 pp.

- Andrews, R. R. and R. R. Righter. 1992. Colorado Birds. Denver Museum of Natural History, Denver. 442 pp.
- Audubon Society. 1981-1985. Breeding Bird Atlas of New Hampshire. (unpublished).
- Banasch, U., J. P. Goossen, A. E. Riez, C. Casler, and R. D. Barradas. 1992. Organochlorine contaminants in migrant and resident prey of peregrine falcons, *Falco peregrinu*s, in Panama, Venezuela, and Mexico. Canadian Field-Naturalist 106:493-498.
- Bechard, M. J., D. Beig, and R. P. Howard. 1987. Historical nest sites of the peregrine falcon (*Falco peregrinus anatum*) in Idaho. Unpublished report for U. S. Fish and Wildlife Service. 34 pp.
- Berger, D.D., C.R. Sindelar, JR. and K.E. Gamble. 1969. The Status of Breeding Peregrines in the Eastern United States. P.165-173. In: J.J. Hickey (Ed.). Peregrin Falcon Populations Their Biology and Decline. University of Wisconsin Press, Madison. 596 p.
- Bollengier, R.M., JR. (Team Leader). 1979. Eastern Peregrine Falcon Recovery Plan. U.S. Fish and Wildlife Service. 147 pp.
- Brown, B. T., et al. 1992. Density of nesting peregrine falcons in Grand Canyon National Park, Arizona. Southwestern Naturalist 37:188-193.
- Brown, L. and D. Amadon. 1968. Eagles, Hawks, and Falcons of the World. McGraw-Hill, NY.
- Burleigh, T. D. 1972. Birds of Idaho. The Caxton Printers, Ltd., Caldwell, Idaho. 467 pp.
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). n.d. Status Report on Endangered Wildlife in Canada: Peregrine Falcon. COSEWIC. 48 pp.
- Cade, T. J., et al., eds. 1988. Peregrine falcon populations: their management and recovery. The Peregrine Fund, Inc., Boise, ID. 949 pp.
- Cade, T.J. 1982. The falcons of the world. Cornell University Press, Ithaca, NY. 192 pp.
- California Department of Fish and Game (CDF&G). 1990. 1989 annual report on the status of California's state listed threatened and endangered plants and animals. 188 pp.
- Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser, and M.C.E. McNall. 1990. The Birds of British Columbia. Vol. 1. Nonpasserines: introduction and loons through waterfowl. Royal British Columbia Museum, Victoria, British Columbia, Canada. 514 pp.
- Cannings, S. 2001. EO Specifications for Peregrine Falcon (*Falco peregrinus*). NatureServe, Unpublished. 1 pp.
- Colorado Bird Observatory. 1997. 1996 Reference Guide to the Monitoring and Conservation Status of Colorado's Breeding Birds. Colorado Bird Observatory, Colorado Division of Wildlife, Great Outdoors Colorado Trust Fund, and Partners, March 21, 1997.
- Court, G.S. 1993. A toxicological assessment of the American peregrine falcon *(Falco peregrinus anatum)* breeding in Alberta, Canada - 1968 to 1992. Occasional Paper Number 10, Department of Environmental Protection, Wildlife Management Division, Fish and Wildlife Services, Government of Alberta. 28 pp.
- Craig, Gerald R. 1997. Recommended buffer zones and seasonal restrictions for Colorado raptor nests. Unpublished report for Colorado Division of Wildlife. Updated January 6, 1997.
- DeGraaf, R. M. and D. R. Rudis. 1986. New England wildlife: habitat, natural history, and distribution. Univ. Mass. Press. Amherst, MA. 491 pp.

- Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1992. Birds in Jeopardy: the Imperiled and Extinct Birds of the United States and Canada, Including Hawaii and Puerto Rico. Stanford University Press, Stanford, CA. 259 pp.
- Ehrlich, P.R., D.S. Dobkin, and D. Wheye. 1992. Birds in jeopardy: the imperiled and extinct birds of the United States and Canada, Including Hawaii and Puerto Rico. Stanford University Press, Stanford, CA. 259 pp.
- Fuller, M. R., C. J. Henny, and P. B. Wood. 1995. Raptors. Pages 65-69 in E. T. LaRoe, G. S. Farris, C. E. Puckett, P. D. Doran, and M. J. Mac, editors. Our living resources: A report to the nation on the distribution, abundance, and health of U.S. plants, animals and ecosystems. U.S. Department of Interior, National Biological Service, Washington, D.C.
- Godfrey, W.E. 1986. The Birds of Canada. Revised edition. National Museum of Natural Sciences, Ottowa, Canada. 595 pp.
- Grebence, B. L., and C. M. White. 1989. Physiographic characteristics of peregrine falcon nesting habitat along the Colorado River system in Utah. Great Basin Naturalist 49:408-418.
- Hayes, G.E. and J.B. Buchanan. 2002. Washington State status report for the peregrine falcon. Washington Dpt. Fish and Wildlife. Olympia, WA. 77 pp.
- Hickey, J. J. No date. Natural History of the Peregrine Falcon East of the Rockies. Unpublished Manuscript. 178 pp.
- Holroyd, G. 1993. Phone conversation with E. West, AKNHP zoologist, regarding population estimated for Falco peregrinus tundrius and F.p. anatum in Canada. 8 October 1993. Canadian Wildlife Service, Edmonton, Alberta.
- Holroyd, G. L., and U. Banasch. 1990. The reintroduction of the peregrine falcon, *Falco peregrinus anatum*, into southern Canada. Canadian Field-Naturalist 104:203-208.
- Hubbard, J. P., and C. G. Schmitt. 1988. Organochlorine residues in avian prey of peregrine falcons breeding in New Mexico. Pages 176-181 in Glinski et al., eds. Proc. Southwest raptor management symposium and workshop. Nat. Wildl. Fed. Sci. and Tech. Ser. No. 11.
- Jarvis, W. 1871. The Duck Hawk. Amer. Nat., 5:662.
- Jewett, S.G., W.P. Taylor, W.T. Shaw, and J.W. Aldrich. 1953. Birds of Washington State. U. Washington Press. 767 pp.
- Johnsgard, P. A. 1986. Birds of the Rocky Mountains with particular reference to national parks in the Northern Rocky Mountain region. Colorado Associated University Press, Boulder. xi + 504 pp.
- Johnsgard, P. A. 1990. Hawks, eagles, and falcons of North America. Smithsonian Inst. Press, Washington, D.C. xvi + 403 pp.
- Johnson, S. R. and D. R. Herter. 1989. The Birds of the Beaufort Sea. BP Exploration (Alaska) Inc., Anchorage, AK. 372 pp.
- Johnson, T. H. 1988. Responses of breeding peregrine falcons to human stimuli. Pages 301-305 in Glinski et al., eds. Proc. Southwest raptor management symposium and workshop. Nat. Wildl. Fed. Sci. and Tech. Ser. No. 11.
- Johnstone, R.M. 1997. Update of Status Report on the American Peregrine Falcon (*Falco peregrinus anatum*). Department of Veterinary Anatomy, Western College of Veterinary Medicine, University of Saskatchewan, Saskatoon, SK. 42 pp.
- Johnstone, R.M. 1999. Update COSEWIC Status Report on Anatum Peregrine Falcon (*Falco peregrinus anatum*). Unpublished Report Prepared for the Committee on the Status of Endangered Willdife in Canada. 31 pp.

- King, W. B., compiler. 1979. Endangered birds of the world. The International Council for Bird Preservation. Smithsonian Institution Press, Washington, D.C. [Reprinted in handbook form in 1981.]
- Larrison, E. J., J. L. Tucker, and M. T. Jollie. 1967. Guide to Idaho birds. Journal of the Idaho Academy of Science 5: 1-220.
- Lefranc, M. N., Jr., and R. L. Glinski. 1988. Southwest raptor management issues and recommendations. Pages 375-392 in Glinski et al., eds. Proc. Southwest raptor management symposium and workshop. National Wildlife Federation Science and Tech. Ser. No. 11.
- Martin, M. 1979. Status report on peregrine falcon (*Falco peregrinus*) in Canada. COSEWIC Report. B.C. Fish and Wildlife Branch, Victoria, B.C.
- National Geographic Society (NGS). 1983. Field guide to the birds of North America. National Geographic Society, Washington, DC.
- National Geographic Society, 1987. Field Guide to the birds of North America, second edition. The National Geographic Society, Washington, D.C.
- Nelson, D. 1993. Colorado Bird Atlas: Manual on Use of Breeding Codes. Denver Museum of Natural History, Denver. 27 pp.
- New Hampshire Natural Heritage Inventory. Element File. Contact the New Hampshire Natural Heritage Inventory: 603/271-3623.
- Palmer, R. S. (ed.). 1988. Handbook of North American Birds. Vol. 5, Diurnal raptors, Part 2. Yale Univ. Press, New Haven, CT. 465 pp.
- Palmer, R. S., ed. 1988. Handbook of North American birds. Vol. 5. Yale Univ. Press, New Haven. 465 pp.
- Peakall, D. B. 1990. Prospects for the peregrine falcon, Falco peregrinus, in the nineties. Canadian Field-Naturalist 104:168-173.
- Porter, R. D. and C. M. White. 1973. Peregrine Falcon in Utah, emphasizing ecology and competition with the Prairie Falcon. Brigham Young University Science Bulletin, Biol. Series 18:1-74.
- Ratcliff, B. 2000. Peregrine Falcon Site Records. Unpublished Report Prepared by Ontario Ministry of Natural Resources, North West Region. n.p.
- Rowell, P. A. 2002. Update COSEWIC status report on Anatum Peregrine Falcon (*Falco peregrinus anatum*). Report submitted to the Committee on the Status of Endangered Wildlife in Canada. Environment Canada, Ottawa. 23 pages + appendices.
- Rowell, Petra A. 2002. Update COSEWIC Status Report on Anatum Peregrin Falcon, Falco peregrinus anatum (interim report 2nd draft, submitted April 2002). Committee on the Status of Endangered Wildlife in Canada (COSEWIC) interim draft, unpublished. 29 pp.
- Sherrod, S. K., et al. 1982. Hacking: a method for releasing peregrine falcons and other birds of prey. Secondedition. The Peregrine Fund, Cornell Univ., Ithaca, NY. vi + 61 pp.
- Skaggs, R. W., et al. 1988. Peregrine falcon. Pages 127-136 in Glinski et al., eds. Proc. Southwest raptor management symposium and workshop. Natural Wildlife Fed. Science and Tech. Ser. No. 11.
- Smith, M.R., P.W. Mattocks, Jr., and K.M. Cassidy. 1997. Breeding birds of Washington State. Vol. 4. IN Washington State Gap analysis - Final report (K.M. Cassidy, C.E. Grue., M.R. Smith, and K.M. Dvornich, eds.). Seattle Audubon Society Publications in Zoology No. 1, Seattle, 538 pp.

- The Peregrine Fund. 1992. Peregrine falcon recovery program: status and reommendations. Unpublished report.
- U. S. Fish and Wildlife Service. 1999. Final rule to remove the American Peregrine Falcon from the federal list of endangered and threatened wildlife, and to remove the similarity of appearance provision for free-flying Peregrines in the conterminous United States. Federal Register 64 (164):46542-46558.
- U.S. Fish and Wildlife Service (USFWS). 1990. Endangered and threatened species recovery program: report to Congress. 406 pp.
- U.S. Fish and Wildlife Service. 1980. Selected vertebrate endangered species of the seacoast of the United States: American peregrine falcon. Tech. rep. FWS/OBS-80/01.57. U.S. Dept. Interior, Fish and Wildlife Service, Biological Services Program, Coastal Ecosystems Project, Slidell, LA. 14 p.
- U.S. Fish and Wildlife Service. 1991. Request for information on the Arctic and American peregrine falcons. Federal Register 56(113):26969-26971.
- USFWS. n.d.. American Peregrine Falcon Proposed Monitoring Plan. U.S. Fish and Wildlife Service. 5 pp.
- World Wildlife Fund. 1990. The official World Wildlife Fund guide to endangered species of North America. D. W. Lowe, J. R. Matthews, and C. J. Moseley (eds.). Beacham Publishing, Inc. Washington, D.C.

Bald Eagle (*Haliaeetus leucocephalus*)

Historic Range: BREEDING: central Alaska, northern Yukon, northwestern and southern Mackenzie, northern Saskatchewan, northern Manitoba, central Ontario, central Quebec, Labrador, and Newfoundland, south locally to the Commander and Aleutian Islands, southern Alaska, Baja California (both coasts), Sonora (Brown et al. 1988), New Mexico, Arizona, Texas Gulf Coast, and Florida (including the Keys); very local in Great Basin and prairie and plains regions in interior North America, where breeding range recently has expanded to include Nebraska and Kansas. NON-BREEDING: generally throughout the breeding range except in the far north (AOU 1983, Sibley and Monroe 1990), most commonly from southern Alaska and southern Canada southward. The Chilkat Bald Eagle Preserve, Alaska, supports the largest wintering population anywhere (Ehrlich et al. 1992). Winter concentrations occur in British Columbia-northwestern Washington, along the Missouri and Mississippi rivers, and in northern Arkansas. One of the largest fall (mid-October to mid-December) migrant concentrations (200-300 birds at any one time, close to a thousand individuals through the season) occurs at Hauser Lake near Helena, Montana.

Basic Description: Bald eagle. Mature adults have a white head and tail.

General Description: Adults have a white head, white tail, and a large bright yellow bill; elsewhere the plumage is dark. Immatures are dark with variable amounts of light splotching on the body, underwing coverts, flight feathers, and tail base; averages 79-94 cm long, 178-229 cm wingspan (NGS 1983).

Diagnostic Characteristics: Adults differ from other eagles in having both a white head and white tail (head of white-tailed eagle may look white at a distance). Bald eagle has a proportionately larger head and bill than does the golden eagle, in the immatures of which the white is confined to the base of the primaries and the base of the tail. Bald eagle lacks the long wedge-shaped tail of Steller's sea-eagle. Bald eagle's neck is shorter and tail is longer than in white-tailed eagle.

Reproduction Comments: Clutch size is 1-3 (usually 2). Incubation lasts about 5 weeks, by both sexes. Second hatched young often dies. Young first fly at 10-12.5 weeks, cared for by adults and may remain around nest for several weeks after fledging. Generally first breeds at about 5-6 years. Adults may not lay every year.

Ecology Comments: Commonly roosts communally, especially in winter. See Curnutt (1992) for information on the dynamics of a year-round communal roost in southern Florida. In Montana, the introduction of shrimp (*Mysis relicta*) had a cascading effect through the food chain, ultimately causing displacement of bald eagles (Spencer et al. 1991).

Non-Migrant: Yes

Locally Migrant: Yes

Long Distance Migrant: Yes

Mobility and Migration Comments: Most eagles that breed in Canada and the northern U.S. move south for winter. Migrates widely over most of North America (AOU 1983); moves generally E-SE across Canada and the Great Lakes region to the northeast coast of the U.S. In the northern Chesapeake Bay region, radio-tagged northern migrants arrived in late fall (mean date 21 December) and departed in early spring (mean date 27 March); radio-tagged southern migrants arrived throughout April-August and departed June-October (Buehler et al. 1991). See Palmer (1988) for fairly detailed review of seasonal movements in various regions. Defended territories are relatively small; 14 in Alaska varied from 11–45 hectares and averaged 23 ha (Hensel and Troyer 1964), and territory radius around active nests averaged 0.6 km in Minnesota

(Mahaffy and Frenzel 1987). Feeding home ranges surrounding active nests are undoubtedly much larger, depending on proximity to food sources and abundance of food. Minimum home range of breeding birds in Saskatchewan was 7 k^2 (Gerrard et al. 1992); on the Columbia River, Oregon, breeding home ranges averaged 21.6 k^2 (Garrett et al. 1993). Winter home ranges can be very large, especially for nonbreeding birds. An immature wintered in Arizona over an area of >40,000 k^2 and spent the summer in the Northwest Territories over a summer range of >55,000 k^2 (Grubb et al. 1994). Maximum distance between feeding area and night roost site was less than 16 km in winter in Missouri (Griffin et al. 1982). In north-central Arizona, February–April home range of immatures averaged 400 k^2; birds moved frequently and roosted singly or in small groups (Grubb et al. 1989).

Marine Habitat(s): Near shore

Estuarine Habitat(s): Bay/sound, Lagoon, River mouth/tidal river, Tidal flat/shore

Riverine Habitat(s): BIG RIVER, MEDIUM RIVER

Lacustrine Habitat(s): Deep water, Shallow water

Palustrine Habitat(s): FORESTED WETLAND, Riparian

Terrestrial Habitat(s): Cliff, Forest - Conifer, Forest - Hardwood, Forest - Mixed, Woodland - Conifer, Woodland - Hardwood, Woodland - Mixed

Special Habitat Factors: Standing snag/hollow tree

Habitat Comments: Breeding habitat most commonly includes areas close to (within 4.0 km) coastal areas, bays, rivers, lakes, or other bodies of water that reflect the general availability of primary food sources including fish, waterfowl, and seabirds (Andrew and Mosher 1982, Green 1985, Campbell et al. 1990). Preferentially roosts in conifers or other sheltered sites in winter in some areas; typically selects the larger, more accessible trees (Buehler et al. 1991, 1992). Perching in deciduous and coniferous trees is equally common in other areas (e.g., Bowerman et al. 1993). Communal roost sites used by two or more eagles are common, and some may be used by 100 or more eagles during periods of high use. Winter roost sites vary in their proximity to food resources (up to 33 km) and may be determined to some extent by a preference for a warmer microclimate at these sites. Available data indicate that energy conservation may or may not be an important factor in roost-site selection (Buehler et al. 1991). In Saskatchewan lakes, density was positively correlated with abundance of large fishes (Dzus and Gerrard 1993). In winter, may associate with waterfowl concentrations or congregate in areas with abundant dead fish (Griffin et al. 1982); often roosts communally at night in trees that are used in successive years. Wintering areas are commonly associated with open water though in some areas eagles use habitats with little or no open water if other food resources (e.g., rabbit or deer carrion) are readily available. Avoids areas with nearby human activity (boat traffic, pedestrians) and development (buildings) (Buehler et al. 1991). Bald eagles usually nest in tall trees or on cliffs near water. Nest trees include pines, spruce, firs, cottonwoods, oaks, poplars, and beech. Ground nesting has been reported on the Aleutian Islands in Alaska, in Canada’s Northwest Territories, and in Ohio, Michigan, and Texas. Nests located on cliffs and rock pinnacles have been reported historically in California, Kansas, Nevada, New Mexico, and Utah, but currently are known to occur only in Alaska and Arizona. Same nest may be used year after year, or may alternate between two nest sites in successive years. In British Columbia, nests with overhead canopy of foliage were most successful (Palmer 1988). See Livingston et al. (1990) for model of nesting habitat in Maine, Wood et al. (1989) for characteristics of nesting habitat in Florida (most nests in live pine trees). In Oregon, most nests were within 1.6 km of water, usually in largest tree in stand (Anthony and Isaacs 1989). In Colorado and Wyoming, forest stands containing nest trees varied from old-growth ponderosa pine to narrow strips of riparian vegetation surrounded by rangeland (Kralovec et al. 1992).

Adult Food Habits: Carnivore, Piscivore

Immature Food Habits: Carnivore, Piscivore

Food Comments: Feeds opportunistically on fishes, injured waterfowl and seabirds, various mammals, and carrion (Terres 1980). See Haywood and Ohmart (1986), Kralovec et al. (1992), Brown (1993), and Grubb (1995) for diet of inland breeding populations in Arizona, Colorado, and Wyoming. Hunts live prey, scavenges, and pirates food from other birds (e.g., osprey) and, in Alaska, sea otter (Watt et al. 1995, Condor 97:588-590). See Palmer (1988) for further information on hunting methods. In the Columbia River estuary, tidal flats and water less than 4.0 meters deep were important foraging habitats (Watson et al. 1991). See Caton et al. (1992) for information on foraging perches used in Montana. Sheep carcasses were significant food sources in winter in Oregon (Marr et al. 1995, Wilson Bulletin 107:251-257).

Adult Phenology: Crepuscular, Diurnal

Immature Phenology: Crepuscular, Diurnal

Phenology Comments: In the Columbia River estuary, foraging activity was most common at low tide and first daylight (Watson et al. 1991). In Arizona, foraging activity during the breeding season peaked at 0800-1000 and 1600-1900 MST (Grubb 1995).

Length: 94 cm

Weight: 5244 grams

Management Requirements: Recovery has been assisted by intensive management that included systematic monitoring, enhanced protection, captive breeding, relocation of wild birds, and publicity (Matthews and Moseley 1990). Knight and Knight (1984) recommended a 450 meter buffer between a human in a canoe and a feeding eagle. For northern Chesapeake Bay, Buehler et al. (1991) recommended a 1,360-meter-wide shoreline management zone that extends 1,400 meters inland to encompass nonbreeding roost sites and provide a buffer from human disturbance. Another study recommended a 250-m buffer between a human on land and an eagle in a shoreline tree. A 500-m buffer around the nest may be adequate (see Fraser et al. 1985). In Michigan, 75 percent of all alert and flight responses to human activity occurred when activity was within 500 m and 200 m, respectively; vehicles and pedestrians elicited the highest response frequencies. Anthony and Isaacs (1989) made recommendations for Oregon: size of areas for nest-site management should be 50-250 ha, with size and shape depending on surrounding vegetation, topography, and eagle behavior; human activities within 800 m of nests should be restricted from 1 January to 31 August; clearcut logging, road building, hiking trails, and boat launch facilities should not be allowed within 400 m of nests. In Arizona, pedestrians were the most disturbing human activity; eagles were more often flushed from perches than from nests and were most easily disturbed when foraging; eagle response to disturbance frequencies were 64% at distances less than 216 m, 45% at 216-583 m, and 24 at distances greater than 583 meters (Grubb and King 1991). Along northern Chesapeake Bay, flush distances because of approaching boats averaged 204 meters in winter, 176 meters in summer (Buehler et al. 1991, see for further information on the effects of human activity). In the Columbia River estuary, management of eagle foraging habitats should emphasize protection and enhancement of tidal flats (Watson et al. 1991). See Busch (1988) for a discussion of management activities in the southwestern U.S., Lefranc and Glinski (1988) for management recommendations. Supplemental feeding can be used in efforts to replace diminished supplies of natural foods, provide food free of environmental contaminants, provide essential nutrients, enhance survival of subadults, manipulate distribution of populations, increase nesting success, support released captive-bred birds, and/or afford opportunities for public viewing and education; potential disadvantages of supplemental feeding include prohibitive costs, the loss of natural and cautious behavior, dependence on these food supplies, which may alter migration patterns, and increased potential for disease transmission (Knight and Anderson 1990). See Grubb (1980) for information on construction and use of an artificial nest structure.

Monitoring Requirements: See Fraser et al. (1983) for information on scheduling reproductive surveys. See Britten et al. (1995) for information on satellite telemetry.

References:

- Abbott, Jackson M. 1978. Chesapeake Bay Bald Eagles. Delaware Conservationist May: P.3-9.
- Abbott, Jackson M. 1982. "Our National Heritage." Delaware Conservationist, 25(1):6-11.
- Abbott, Jackson M. 1982. 1982 Bald Eagle Nest Survey – Chesapeake Bay Region. Alexandria, VA (Printed by author). 6 pp.
- Abbott, Jackson M. 1983. Bald Eagle Continues Comback in Bay. Audubon Naturalist News. October.
- Abbott, Jackson. 1977. Chesapeake Bay Bald Eagle Survey. Hawk Mtn Sanctuary Assn. Thirty-fourth Annual Report, pp 11-14. Alexandria, VA.
- Abbott, Jackson. 1980. Eagle Survey Results Encouraging. Audubon Naturalist News, July-Aug.
- Allen, Craig R., Stephen Demarais, and R. Scott Lutz. 1994. Red Imported Fire Ant Impact on Wildlife: an Overview. Texas J. Sci. 46(1):51-59.
- American Ornithologists' Union (AOU). 1983. Check-list of North American Birds, 6th edition. Allen Press, Inc., Lawrence, KS. 877 p.
- American Ornithologists' Union (AOU). 1983. Check-list of North American Birds, 6th edition. Allen Press, Inc., Lawrence, KS. 877 pp.
- American Ornithologists' Union (AOU). 1983. Checklist of North American birds. 6th ed. American Ornithologists' Union, Allen Press, Inc., Lawrence, KS. 877 pp.
- American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
- American Ornithologists' Union. 1957. Check-list of North American birds. Fifth edition. American Ornithologists' Union. Port City Press, Inc. Baltimore, MD. 691 pp. (Reprinted in 1961 by Port City Press, Inc., Baltimore, MD.)
- Andrew, J.M. and J.A. Mosher. 1982. Bald eagle nest site selection and nesting habitat in Maryland. J. Wildlife Management 46:382-390.
- Andrews, R. R. and R. R. Righter. 1992. Colorado Birds. Denver Museum of Natural History, Denver. 442 pp.
- Anthony, R. G., and F. B. Isaacs. 1989. Characteristics of bald eagle nest sites in Oregon. J. Wildlife Management. 53:148-159.
- Aquin, P. 1999. Évaluation de la situation des groupes taxonomiques des oiseaux du Québec. Ministère de l'Environnement et de la Faune. 13 pages.
- Audubon Society. 1981-1985. Breeding Bird Atlas of New Hampshire. (unpublished).
- Buckelew, A. and G. Hall. 1994. WV Breeding Bird Atlas. University of Pittsburg Press. BUCKELEW, A. AND G. HALL. 1994.
- Buehler, D.A. et al. 1991. Differences in distribution of breeding, nonbreeding, and migrant bald eagles on the northern Chesapeake Bay. The Condor 93:399-408.

- Bagley, Fred. 1986-04-15. Unpublished report: Bald Eagle Nest locations in LA., MS.,AR.,AL.
- Baicich, P. J., and C. J. O. Harrison. 1997. A guide to the nests, eggs and nestlings of North American birds. Second edition. Academic Press, NY.
- Baker, R. J., and Y. A. Monstad. 2005. 2005 Minnesota Bald Eagle surveys. Nongame Wildlife Program, Minnesota Department of Natural Resources Report. 4 pp.
- Baker, R., J. Galli, and S. Nelson. 2000. 2000 Minnesota Bald Eagle survey. Nongame Wildlife Program, Minnesota Department of Natural Resources Report. 2 pp.
- Beebe, F.L. 1974. Field studies of the falconiformes of British Columbia. Vultures, eagles, hawks, and falcons. Occasional Papers of the British Columbia Provincial Museum No. 17. Dept. Recreation and Conservation, Victoria, BC, Canada. 163 pp.
- Behle, W. H. 1985. Utah birds: geographic distribution and systematics. Utah Mus. Natur. Hist., Occas. Pap. 5: 1-147.
- Bender, M. (ed.). 1994. Regional News - Region 2. End. Sp. Tech. Bull. 19(5): 18.
- Bengston, F., and L. D. Frenzel. 1984. Studies of lead toxicity in bald eagles at the Lac Qui Parle Wildlife Refuge. Thesis, Master of Science, University of Minnesota. 95 pp.
- Bent, A.C. 1937. Life histories of North American birds of prey. Part 1. Bull. U.S. Natl. Mus. 137. 409 pp.
- Bierly, M.L. 1980. Bird Finding in Tennessee. 3825 Bed- ford Ave., Nashville, TN 37125.
- BioSystems Analysis, Inc., Santa Cruz, CA. 1992. Ecology of bald eagles in Arizona. Prepared for Bureau of Reclamation, Lower Colorado Region, Boulder City, NV, Contract No. 6-CS-30-04470.
- Bird, D. M., editor. 1983. Biology and management of bald eagles and ospreys. MacDonald. 325 pp.
- BirdLife International. 2004. Threatened birds of the world 2004. CD ROM. BirdLife International, Cambridge, UK.
- Blood, D.A. and G.G. Anweiler. 1991. Status of the Bald Eagle in British Columbia. Unpublished report to British Columbia Ministry of Environment, Wildlife Branch, Victoria. 160 p.
- Bowerman, W. W., T. G. Grubb, J. P. Giesy, A. J. Bath, and G. A. Dawson. 1993. Population composition and perching habitat of wintering Bald Eagles in northcentral Michigan. Canadian Field Naturalist 107: 273- 278.
- Britten, M. W., C. L. McIntyre, and M. Kralovec. Satellite radiotelemetry and bird studies in national parks and preserves. Park Science 15(2):20-24.
- Brown, B. T. 1993. Winter foraging ecology of bald eagles in Arizona. Condor 95:132-138.
- Brown, B. T., P. L. Warren, and L. S. Anderson. 1988. Status of bald eagles in the Rio Yaqui drainage of Sonora, Mexico. Page 321 in Glinski et al., eds. Proc. Southwest raptor management symposium and workshop. Nat. Wildl. Fed. Sci. and Tech. Ser. No. 11.
- Brown, B. T., and L. E. Stevens. 1992. Winter abundance, age structure, and distribution of bald eagles along the Colorado River, Arizona. Southwestern Naturalist 37:404-435.
- Brown, B. T., et al. 1989. Changes in winter distribution of bald eagles along the Colorado River in Grand Canyon, Arizona. J. Raptor Research 23:110-113.
- Brown, B.T., et.al. 1989. Changes in winter distribution of bald eagles along the Colorado River in Grand Canyon, Arizona. J. Raptor Res. 23(3):110-113.

- Brownell, V. and M. Oldham. 1984. Status report on the Bald Eagle, *Haliaeetus leucocephalus*, in Canada. COSEWIC report.
- Brownell, V.R. and M.J. Oldham. 1980. Status Report on the Bald Eagle (*Haliaeetus leucocephalus*) in Canada. Ontario Ministry of Natural Resources, Toronto, and Committee on the Status of Endangered Wildlife in Canada, Ottawa. 82 pp.
- Brownell, V.R. and M.J. Oldham. 1980. Status report on the Bale Eagle (*Haliaeetus leucocephalus*) in Canada.. Draft Copy. 122 pp.
- Brownell, V.R. and M.J. Oldham. 1984. Status report on the Bald Eagle, *Haliaeetus leucocephalus*, in Canada. Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 88 pp.
- Buehler, D. A. 2000. Bald Eagle (*Haliaeetus leucocephalus*). Number 506 *in* A. Poole and F. Gill, editors. The birds of North America. The Birds of North America, Inc., Philadelphia, PA.
- Buehler, D. A., S. K. Chandler, T. J. Mersmann, J. D. Fraser, and J. K. D. Seegar. 1992. Nonbreeding Bald Eagle perch habitat on the northern Chesapeake Bay. Wilson Bulletin 104:540-545.
- Buehler, D. A., et al. 1991. Differences in distribution of breeding, nonbreeding, and migrant bald eagles on the northern Chesapeake Bay. Condor 93:399-408.
- Buehler, D. A., et al. 1991. Effects of human activity on bald eagle distribution on the northern Chesapeake Bay. J. Wildlife Management 55:282-290.
- Buehler, D. A., et al. 1991. Nonbreeding bald eagle communal and solitary roosting behavior and roost habitat on the northern Chesapeake Bay. J. Wildlife Management 55:273-281.
- Buehler, D. A., et al. 1991. Survival rates and population dynamics of bald eagles on Chesapeake Bay. J. Wildlife Management 55:608-613.
- Buehler, D. A., et al. 1991. Winter microclimate of bald eagle roosts on the northern Chesapeake Bay. Auk 108:612-618.
- Buehler, D.A. 2000. Bald Eagle (*Haliaeetus leucocephalus*). *In* The Birds of North America, No. 506. (A. Poole and F. Gills, eds.). The Birds of North America, Inc. Philadelphia, PA.
- Burleigh, T. D. 1972. Birds of Idaho. The Caxton Printers, Ltd., Caldwell, ID. 467 pp.
- Busch, D. E. 1988. Bald eagle. Pages 57-64 in Glinski et al., eds. Proc. Southwest Raptor Manage. Symp. and Workshop. National Wildlife Federation Sci. and Tech. Ser. No. 11.
- Byrd, M. A., and D. W. Johnston. 1991. Birds. Pages 477-537 in K. Terwilliger, coordinator. Virginia's endangered species: proceedings of a symposium. McDonald and Woodward Publ. Co., Blacksburg, VA.
- Chesapeake Bay Bald Eagle Recovery Team (Gary J. Taylor, Leader). 1980. The Chesapeake Bay Region Bald Eagle Recovery Plan.
- Chesapeake Bay Bald Eagle Recovery Team 1982. The Chesapeake Bay Region Bald Eagle Recovery Plan. Region 5, USFWS. 81 PP.
- Cline, K. 1985. Bald Eagles in the Chesapeake: a Management Guide for Landowners. . U.S. FWS et al. 16 pp.
- Cline, Keith and William Clark. 1981. Progress Report: Chesapeake Bay Bald Eagle Banding Project. Nat. Wildlife Federation, Raptor Information Center.

- California Department of Fish and Game (CDF&G). 1990. 1989 annual report on the status of California's state listed threatened and endangered plants and animals. 188 pp.
- Campbell, R. W., N. K. Dawe, I. McTaggart-Cowan, J. M. Cooper, G. W. Kaiser, and M. C. McNall. 1990. The birds of British Columbia. Volume 2. Nonpasserines: diurnal birds of prey through woodpeckers. University of British Columbia Press, Vancouver, B.C. 636 pp.
- Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser, and M.C.E. McNall. 1990. The Birds of British Columbia. Vol. 1. Nonpasserines: introduction and loons through waterfowl. Royal British Columbia Museum, Victoria, British Columbia, Canada. 514 pp.
- Cannings, S. 2001. EO Specifications for Bald Eagle (*Haliaeetus leucocephalus*). NatureServe, Unpublished. 2 pp.
- Caton, E. L., B. R. McClelland, D. A. Patterson, and R. E. Yates. 1992. Characteristics of foraging perches used by breeding Bald Eagles in Montana. Wilson Bulletin 104(1):136-142.
- Caton, E. L., et al. 1992. Characteristics of foraging perches used by breeding bald eagles in Montana. Wilson Bull. 104:136-142.
- Chester, D. N., et al. 1990. Habitat use by nonbreeding bald eagles in North Carolina. J. Wildlife Management 54:223-234.
- Chippewa National Forest. 1979. Bald Eagle - Osprey Status Report, 1979. Chippewa National Forest, Cass Lake, MN. 5 pp.
- Colorado Bird Observatory. 1997. 1996 Reference Guide to the Monitoring and Conservation Status of Colorado's Breeding Birds. Colorado Bird Observatory, Colorado Division of Wildlife, Great Outdoors Colorado Trust Fund, and Partners, March 21, 1997.
- Cory, C.B. 1909. The birds of Illinois and Wisconsin. Field Mus. Nat. Hist. Publ. 131, Zool. Ser. 9:1-766.
- Craig, Gerald R. 1997. Recommended buffer zones and seasonal restrictions for Colorado raptor nests. Unpublished report for Colorado Division of Wildlife. Updated January 6, 1997.
- Craig, R.J. et al. 1988. Time and energy budgets of bald eagles wintering along the Connecticut River. Jo. Field Ornith. 59:22-32.
- Curnutt, J. L. 1992. Dynamics of a year-round communal roost of bald eagles. Wilson Bull. 104:536-540.
- Dickinson, Mary B., ed. 1999. Field Guide to the Birds of North America, 3rd ed. National Geographic Society, Washington, D.C. 480 pp.
- DeGraaf, R. M. and D. R. Rudis. 1986. New England wildlife: habitat, natural history, and distribution. Univ. Mass. Press. Amherst, MA. 491 pp.
- Deschamps, V. 1997a. Southwestern Ontario Bald Eagle Monitoring Project - 1996 Final Report. Unpub. report, Ontario Birds At Risk Program, Long Point Bird Observatory, St. Williams, Ontario. 8 pp.
- Deschamps, V. 1997b. Southwestern Ontario Bald Eagle Monitoring Project - 1997 Report. Unpub. report, prepared for OMNR, Southcentral Region, Aylmer District, Ontario Birds At Risk Program, Long Point Bird Observatory, St. Williams, Ontario. 15 pp.
- Desrosiers A., F. Caron et R. Ouellet. 1995. Liste de la faune vertébrée du Québec. Les publications du Québec.

- Detrich, Philip J. 1988. Evaluation of the Relationship Between the Morphoedaphic Index and Bald Eagle Nesting Density in Minnesota. Funded by the Minnesota Department of Natural Resources. Results in unpublished report.
- Dionne C. 1906. Les oiseaux de la province de Québec. Dussault et Proulx.
- Division of Natural Resources, Navajo Fish and Wildlife Department. 1995. Endangered Species List for The Navajo Nation.
- Dugoni, Joseph A. 1980. Habitat utilization, food habits, and productivity or nesting southern bald eagles in La. MS thesis, Louisiana State University - Baton Rouge.
- Dunn, E. H., C. M. Downes, and B. T. Collins. 2000. The Canadian Breeding Bird Survey, 1967-1998. Canadian Wildlife Service Progress Notes No. 216. 40 pp.
- Dzus, E., and J. Gerrard. 1993. Factors influencing bald eagle densities in northcentral Saskatchewan. J. Wildlife Management 57:771-778.
- Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1992. Birds in Jeopardy: the Imperiled and Extinct Birds of the United States and Canada, Including Hawaii and Puerto Rico. Stanford University Press, Stanford, California. 259 pp.
- Evans, D. L. 1982. Status reports on twelve raptors. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report No. 238. 68 pp.
- Evers, D. C. 1992. A guide to Michigan's endangered wildlife. Univ. Michigan Press, Ann Arbor. viii + 103 pp.
- Frenzel, R.W. and R.G. Anthony. 1989. Relationship of diets and environmental contaminants in wintering bald eagles. J. Wildl. Mgmt. 53(3):792-802.
- Field, M. 1986. 1995 Bald Eagle Nesting Report for Southwestern Ontario. Ontairo Birds At Risk Newsletter Vol. 3 (1): 3-4.
- Field, M. 2000. 2000 Elgin County Bald Eagle Nesting. The Cardinal, No. 180: 38-39.
- Field, M. 2001. Bald Eagle Nests in Elgin County, Ontario, 2001. The Cardinal. No. 185: 32-33.
- Finnley, D. (ed.). 1979. Endangered species: new challenge for the Navajo. Endangered Species Technical Bulletin 4(6):1,7-11.
- Fischer, D.L. 1985. Piracy behavior of wintering bald eagles. The Condor 87:246-251.
- Fisher, A.K. 1893. The hawks and owls of the United States in their relation to agriculture. Washington U.S. Dept. of Agriculture Bull. no. 6. 210 pp.
- Forbis, L. A. 1988. Status and trends of bald eagles breeding in Arizona, 1975-1986. Pages 282-288 in Glinski et al., eds. Proc. Southwest raptor management symposium and workshop. Nat. Wildl. Fed. Sci. and Tech. Ser. No. 11.
- Fraser, J. D., L. D. Frenzel, and J. E. Mathisen. 1985. The impact of human activities on breeding bald eagles in north-central Minnesota. J. Wildlife Management 49:585-592.
- Fraser, J. D., et al. 1983. Scheduling bald eagle reproductive surveys. Wildlife Society Bull. 11:13-16.
- Frazer, J.D. 1985. The impact of human activities on Bald Eagle populations - a review. Pp. 68-84 in J.M. Gerrard and T.N. Ingram (eds.), The Bald Eagle in Canada. White Horse Plains Publishers, Headingley, Manitoba.
- Frenzel, L.D. 1988-1989. MN DNR Bald Eagle Nesting Activity and Productivity Data by County. Funded by the MN DNR, Section of Wildlife, Nongame Research Program. Results in unpublished report.

- Frenzel, L.D. 1988. 1988 MN DNR bald eagle nesting activity and productivity data by county. Draft final report to the Minnesota Department of Natural Resources. 7 pp.
- Frenzel, L.D. 1989. 1989 MN DNR bald eagle nesting activity and productivity data by county. Draft final report to the Minnesota Department of Natural Resources. 6 pp.
- Garrett, M. G., J. W. Watson, and R. G. Anthony. 1993. Bald Eagle home range and habitat use in the Columbia River estuary. Journal of Wildlife Management 57:19-27.
- Garrett, M. G., J. W. Watson, and R. G. Anthony. 1993. Bald Eagle home range and habitat use in the Columbia River estuary. Journal of Wildlife Management 57:19-27.
- Gerrard, J. M. 1983. A review of the current status of bald eagles in North America. Pp. 5-21 in D. M. Bird (Ed.). Biology and management of bald eagles and ospreys. Harpell Pr., Ste. Anne de Bellevue, Que.
- Gerrard, J. M., P. N. Gerrard, G. R. Bortolotti, and E. H. Dzus. 1992. A 24-year study of Bald Eagles on Besnard Lake, Saskatchewan. Journal of Raptor Research 26:159-166.
- Gerrard, J. M., P. N. Gerrard, G. R. Bortolotti, and E. H. Dzus. 1992. A 24-year study of Bald Eagles on Besnard Lake, Saskatchewan. Journal of Raptor Research 26:159-166.
- Gerrard, J. M., and G. R. Bortolotti. 1988. The bald eagle. Haunts and habits of a wilderness monarch. Smithsonian Institution Press, Washington, D.C. 194 pp.
- Gerrard, J.M. 1983. A review of the current status of Bald Eagles in North America. Pages 5-21 in D. M. Bird (Ed.). Biology and Management of Bald Eagles and Ospreys. Proceedings of First International Symposium on Bald Eagles and Ospreys, Montreal, 28-29 October 1981. Harpell Press. Ste. Anne de Bellevue, Quebec.
- Gibbs, J. P., and S. M. Melvin. 1992. American bittern, Botarius lentiginosus. Pages 51-69 in K. J. Schneider and D. M. Pence, editors. Migratory nongame birds of management concern in the Northeast. U.S. Fish and Wildlife Service, Newton Corner, MA. 400 pp.
- Godfrey, Earl W. 1986. Birds of Canada. National Museums of Canada, Ottawa, Ontario, Canada. 595 p. + plates.
- Green, N. 1985. The Bald Eagle. Pp 508-531 in R.L. DiSilvestro, ed., Audubon Wildlife Report 1985. National Audubon Society, NY.
- Grier, J.W., T. Armstrong, P. Hunter, S. Lockhart and B. Ranta. 2001. Report on the Status of Bald Eagles in Ontario. Unpublished draft (12 July). 47 pp.
- Griffin, C. R., T. S. Baskett, and R. D. Sparrowe. 1982. Ecology of bald eagles wintering near a waterfowl concentration. U.S. Fish and Wildlife Service Special Science Report - Wildlife No. 247:1-12.
- Grub, T.G., et.al. 1983. 1983 Arizona bald eagle research report. Rocky Mountain Forest and Range Experiment Station, U.S. Forest Service.
- Grubb, T. G. 1980. An artificial bald eagle nest structure. USDA Forest Service, Rocky Mountain Forest and Range Experimental Station, Research Note RM-383.
- Grubb, T. G. 1995. Food habits of bald eagles breeding in the Arizona desert. Wilson Bulletin 107:258-274.
- Grubb, T. G., S. J. Nagiller, W. L. Eakle, and G. A. Goodwin. 1989. Winter roosting patterns of bald eagles (*Haliaeetus leucocephalus*) in north-central Arizona. Southwestern Naturalist 34:453-459.
- Grubb, T. G., W. W. Bowerman, J. P. Giesy, and G. A. Dawson. 1992. Responses of breeding bald eagles, *Haliaeetus leucocephalis* [sic], to human activities in northcentral Michigan. Canadian Field-Naturalist 106:443-453.

- Grubb, T. G., W. W. Bowerman, and P. H. Howey. 1994. Tracking local and seasonal movements of wintering Bald Eagles *Haliaeetus leucocephalus* from Arizona and Michigan with satellite telemetry. Pages 247-358 *In* B.U. Meyburg and R. D. Chancellor, editors. Raptor conservation today. Pica Press, Moose Jaw, Saskatchewan.
- Grubb, T. G., W. W. Bowerman, and P. H. Howey. 1994. Tracking local and seasonal movements of wintering Bald Eagles *Haliaeetus leucocephalus* from Arizona and Michigan with satellite telemetry. Pages 247-358 IN B.-U. Meyburg and R. D. Chancellor, editors. Raptor conservation today. Pica Press, Moose Jaw, Saskatchewan.
- Grubb, T. G., and R. M. King. 1991. Assessing human disturbance of breeding bald eagles with classification tree models. J. Wildlife Management 55:500-511.
- Grubb, T.G. 1984. 1984 Arizona bald eagle research report. Annual progress report prepared by U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Tempe, AZ, for Master Interagency Agreement No. IAG-43.
- Grubb, T.G. and C.E. Kennedy. 1982. RUN WILD, Wildlife/Habitat Relationships: 1978 bald eagle winter habitat on the National Forest System in the Southwest. Southwestern Region, U.S. Forest Service Wildlife Unit Technical Series. 116 p.
- Hall, G. 1983. Birds of WV. Carnegie Museum of Natural History.
- Hancock, J. and J. Kushlan. 1984. The Herons Handbook.
- Harper, R.G. et al. 1988. Nonfish prey of wintering bald eagles in Illinois. Wilson Bull. 100:688-690.
- Harrison, C. 1978. A Field Guide to the Nests, Eggs and Nestlings of North American Birds. Collins, Cleveland, Ohio.
- Hawk Watch International. 2003. An online search for migration watch results, 1999-2002 data. . Accessed 11 September 2003.
- Hayward, C. L., C. Cottam, A. M. Woodbury, and H. H. Frost. 1976. Birds of Utah. Great Basin Naturalist Memoirs 1: 229 pp.
- Haywood, D. D., and R. D. Ohmart. 1986. Utilization of benthic-feeding fish by inland breeding bald eagles. Condor 88:35-42.
- Heagy, A. 1996. Southwestern Ontario Bald Eagle Monitoring Program. Ontario Birds At Risk Newsletter. Vol. 3 (1): 2.
- Hensel, R. J., and W. A. Troyer. 1964. Nesting studies of the bald eagle in Alaska. Condor 66:282-286.
- Herkert, J. R., editor. 1992. Endangered and threatened species of Illinois: status and distribution. Vol. 2: Animals. Illinois Endangered Species Protection Board. iv + 142 pp.
- Herkert, Jim. 1998. Proposed additions, deletions, and changes to the Illinois List of Threatened and Endangered Animals. 101st ESPB Meeting, August 21, 1998. 16pp.
- Hoffman, S.W., et.al. 1992. Patterns and recent trends in counts of migrant hawks in western North America: 1977-1991. Draft. Prepared by HawkWatch International, Albuquerque, NM, for U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Washington, DC.
- Howell, S. N. G., and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, Oxford, UK.
- Hunter, P., and D. Baird. 1994/95. The bald eagle in Ontario's Great Lakes basin. Bird Trends (Canadian Wildlife Service) (4):17-18.

- Hussel, D.J.T. and L. Brown. 1992. Population Changes in Diurnally-Migrating Raptors and Duluth, Minnesota (1974-1989) and Grimsby, Ontario (1975-1990). Ontario Ministry of Natural Resources.
- Imhof, T.A. 1976. Alabama Birds.
- Johnsgard, P. A. 1990. Hawks, eagles, and falcons of North America. Smithsonian Inst. Press, Washington, D.C. xvi + 403 pp.
- Knight, R.L. and S.K. Skagen. 1988. Agnostic asymmetries and foraging ecology of bald eagles. Ecol. 69(4):1188-1194.
- Kyle, Rober. 1982. Our National Bird Soars Again. The Washington Post, June 18, p. 57.
- King, W. B., compiler. 1979. Endangered birds of the world. The International Council for Bird Preservation. Smithsonian Institution Press, Washington, D.C. [Reprinted in handbook form in 1981.]
- Kirk, D. A., D. Hussell, and E. Dunn. 1995. Raptor population status and trends in Canada. Bird Trends (Canadian Wildlife Service) 4:2-9.
- Kirk, D.A., and C. Hyslop. 1998. Population status and recent trends in Canadian raptors: a review. Biological Conservation 83 (1): 91-118.
- Kjos, D.G. 1992. Bald eagle numbers continue to rise. Endangered Species Technical Bulletin Vol 27, nos. 1-2. 4p.
- Knight, R. L., and D. P. Anderson. 1990. Effects of supplemental feeding on an avian scavenging guild. Wildl. Soc. Bull. 18:388-394.
- Knight, R. L., and S. K. Knight. 1984. Responses of wintering bald eagles to boating activity. J. Wildlife Management 48:999-1004.
- Kozie, K. D., and R. K. Anderson. 1991. Productivity, diet, and environmental contaminants in bald eagles nesting near the Wisconsin shoreline of Lake Superior. Arch. Environ. Contam. Toxicol. 20:41-48.
- Kralovec, M. L., R. L. Knight, G. R. Craig, and R. G. McLean. 1992. Nesting productivity, food habits, and nest sites of bald eagles in Colorado and southeastern Wyoming. Southwestern Naturalist 37:356-361.
- LaRue, C.T. 1994. Birds of northern Black Mesa, Navajo County, Arizona. Great Basin Naturalist 54(1):1-63.
- Lagacé M., L. Blais et D. Banville. 1983. Liste de la faune vertébrée du Québec. Première édition. Ministère du Loisir, de la Chasse et de la Pêche.
- Larrison, E. J., J. L. Tucker, and M. T. Jollie. 1967. Guide to Idaho birds. Journal of the Idaho Academy of Science 5: 1-220.
- Leberman, R.C. 1987. A Field List of the Birds of Western Pennsylvania and Adjacent Regions. Unpublished.
- Lefranc, M. N., Jr., and R. L. Glinski. 1988. Southwest raptor management issues and recommendations. Pages 375-392 in Glinski et al., eds. Proc. Southwest raptor management symposium and workshop. National Wildlife Federation Science and Tech. Ser. No. 11.
- Lehman, R.N. 1979. A survey of selected habitat features of 95 bald eagle nest sites in California. California Department of Fish and Game, Wildlife Management Branch, Administrative Report 79-1.

- Lincer, J. L., W. S. Clark, and M. N. LeFranc, Jr. 1979. Working bibliography of the bald eagle. Raptor Information Center, National Wildlife Federation, Washington, D.C. NWF Scientific/Technical Series No. 2. 219 pp.
- Lincer, J.L., et.al. 1979. Working bibliography of the bald eagle. National Wildlife Federation Scientific/Technical Series No. 2, Washington, DC.
- Lincer, J.L.; W.S. Clark and M.N. LeFranc, JR. 1979. Working Bibliography of the Bald Eagle. Raptor Information Center, Nat. Wildlife Fed., Washington, D.C. USNWF Scientific/Technician – CAL Series No. 2 219 pp.
- Livingston, S. A., et al. 1990. Habitat models for nesting bald eagles in Maine. J. Wildlife Management 54:644-653.
- Lowery, George H. 1974. The Birds of Louisiana. LSU Press. 651pp.
- McKnight, J. 1989. Memorandum of November 3, to J. McKegg et al. RE: Somerville and Associated Properties, Alliance Property Corporation, Calvert County, MD.
- Moser, J.A. and J.M. Andrew. 1981. Nesting Habitat and Nest Site Selection by the Bald Eagle in Maryland. UMD, AEL, Frostburg State College, Frostburg, MD.
- Mahaffy, M. S., and L. D. Frenzel. 1987. Elicited territorial responses of northern bald eagles near active nests. Journal of Wildlife Management 51:551-554.
- Maniscalco, J., compiler. 1992. *Haliaeetus leucocephalus* (Linnaeus) bald eagle: a working bibliography. Available as a printed document or on diskette.
- Martell, M. 1988-1989. A study on wintering and released rehabilitated bald eagles in Minnesota. A report submitted to the Minnesota Department of Natural Resources Nongame Program. 34 pp.
- Martell, M. S., J. B. Nibe, P. T. Redig, and G. M. Buhl. 1991. A study of bald eagles wintering along the Mississippi river between St. Paul and Red Wing, Min., and the St. Croix river south of Hudson, Wis., 1987-1990. 1991. and Wisconsin rivers. Final report submitted to the Minnesota Department of Natural Resources Nongame Program. 53 pp.
- Martell, M., C. Gieck, J. Nibe, D. Erickson, B. Mandernack, and P. T. Redig. 1991. Bald eagle winter roosts on the Mississippi and Wisconsin rivers. A report submitted to the Minnesota and Wisconsin Departments of Natural Resources. 42 pp.
- Martell, M., J. Nibe, and J. Galli. 1990. A report on bald eagle use of the Wacouta Bay, (Mn.) area of the Mississippi River along with management recommendations. Final report to the Minnesota Department of Natural Resources Nongame Wildlife Program. 15 pp.
- Martell, M., P. T. Redig., J. Nibe, and G. Buhl. 1990. Survival of released rehabilitation bald eagles. Final report submitted to the Minnesota Department of Natural Resources. 73 pp.
- Martell, Mark; J. Nibe; P. Redig; and G. Buhl. 1987-1991. A Study on Wintering and Released Rehabilitated Bald Eagles in Minnesota. Funded by the MN DNR, Section of Wildlife, Nongame Research Program and Hormel, Incorporated. Results in unpublished report.
- Mathisen, J. E. 1987. Bald eagle and osprey populations. Wildlife monitoring report, Chippewa National Forest. 4+ pp.
- Matthews, J.R. and C.J. Moseley (eds.). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 + 33 pp. appendix + 6 pp. glossary + 16 pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.

- McAtee W.L. 1959. Folk - names of Canadian birds. National Museum of Canada. Folk - names of Canadian birds. National Museum of Canada. 74 pages.
- Millsap, B. A. 1986. Status of wintering bald eagles in the coterminous 48 states. Wildlife Society Bull. 14:433-440.
- Montana Bald Eagle Working Group. 1991. Habitat management guide for bald eagles in northwestern Montana. 29pp.
- Montana Bald Eagle Working Group. 1994. Montana Bald Eagle management plan. 2nd edition. Bureau of Reclamation. 104 pp.
- Montana Bird Distribution Online Database. 2001. Helena, Montana, USA. April-September 2003. http://nhp.nris.state.mt.us/mbd/.
- Montopoli, G. J., and D. A. Anderson. 1991. A logistic model for the cumulative effects of human intervention on bald eagle habitat. J. Wildlife Management 55:290-293.
- Newton, I. 1976. Population Limitation in Diurnal Raptors. Canadian field-Naturalist 90(3):274-300.
- Norman, D.M., A.M. Breault and J.E. Moul. 1989. Bald Eagle Incursions and Predations at Great Blue Heron Colonies. Colonial Waterbirds. 12(2):215-216.
- National Geographic Society (NGS). 1983. Field guide to the birds of North America. National Geographic Society, Washington, DC.
- National Geographic Society, 1987. Field Guide to the birds of North America, second edition. The National Geographic Society, Washington, D.C.
- Natural Heritage and Nongame Research Program. 1996. Minnesota's list of Endangered, Threatened, and Special Concern species. Effective 7/1/96. 16 pp.
- Nelson, D. 1993. Colorado Bird Atlas: Manual on Use of Breeding Codes. Denver Museum of Natural History, Denver. 27 pp.
- Nicholson, C.P. 1997. Atlas of the breeding birds of Tennessee. The University of Tennessee Press. 426 pp.
- Ohmart, R.D. and R.J. Sell. 1980. The bald eagle of the Southwest with special emphasis on the breeding population of Arizona. U.S. Prepared by Arizona State University for U.S. Water and Power Resources Service Contract No. BR-14-06-330-2674. 95 pp.
- Ouellet H., M. Gosselin et J.P. Artigau. 1990. Nomenclature française des oiseaux d'Amérique du Nord. Secrétariat d'État du Canada. 457 p.
- Palmer, R. S., editor. 1988. Handbook of North American birds. Vol. 4. [Diurnal raptors, part 1]. Yale University Press, New Haven, CT. vii + 433 pp.
- Parker III, T. A., D. F. Stotz, and J. W. Fitzpatrick. 1996. Ecological and distributional databases for neotropical birds. The University of Chicago Press, Chicago.
- Parks Canada. 2000. Vertebrate Species Database. Ecosystems Branch, 25 Eddy St., Hull, PQ, K1A 0M5.
- Pendleton, B. A. G., B. A. Millsap, K. W. Cline, and D. M. Bird. 1987. Raptor management techniques manual. National Wildlife Federation, Sci. and Tech. Ser. No. 10. 420 pp.
- Pennsylvania Breeding Bird Atlas Project. 1984-1987. Unpublished.
- Peterson, R. T. 1947. A Field Guide to the Birds. Houghton Mifflin Company, Boston. 230 pp.

- Peterson, R.T. 1980. A field guide to the birds of eastern and central North America. Houghton Mifflin Company, Boston.
- Peterson, R.T. 1990. A field guide to western birds. Houghton Mifflin Company, Boston.
- Postupalsky, Sergej. 1968. The Status of the Bald Eagle at Lake Nipigon and the Thunder Bay and Black Bay Area of Lake Superior, Ontario. report of an original field study conducted for Investigations in Ornithology (Zoology 709), The University of Michigan Biological Station. Not for Publication. 17 pp.
- Raffaele, H., J. Wiley, O. Garrido, A. Keith, and J. Raffaele. 1998. A guide to the birds of the West Indies. Princeton University Press, Princeton, NJ. 511 pp.
- Redig, P. T., G. E., S. Schwartz, and E. Lawler. 1983. An investigation into the effects of lead poisoning on bald eagles and other raptors: final report Submitted to the Minnesota Department of Natural Resources. Unpaged.
- Redig, Patrick T., Gary E., Samuel Schwartz, and Ellen Lawler. 1980 - 1983. An Investigation into the Effects of Lead Poisoning on Bald Eagles and Other Raptors: Final Report. Funded by the MN DNR, Section of Wildlife, Nongame Research Program. Results in unpublished report.
- Ridgway, R. 1889. The ornithology of Illinois. Vol. 1. Ill. State Lab. Nat. Hist. 520pp.
- Root, T. 1988. Atlas of wintering North American birds: An analysis of Christmas Bird Count data. University of Chicago Press. 336 pp.
- Ryke, N., D. Winters, L. McMartin and S. Vest. 1994. Threatened, Endangered and Sensitive Species of the Pike and San Isabel National Forests and Comanche and Cimarron National Grasslands. May 25, 1994.
- Shea, D. S. 1973. A management-oriented study of bald eagle concentrations in Glacier National Park. M.S. thesis. University of Montana, Missoula, 78 pp.
- Sibley, C.G., and B.L. Monroe, Jr. 1990. Distribution and Taxonomy of Birds of the World. Yale University Press, New Haven, CT. xxiv + 1111 pp.
- Sibley, Charles G. and Burt L. Monroe, Jr. 1990. Distribution and Taxonomy of Birds of the World. Yale University Press. New Haven, Connecticut and London. 1111pp.
- Snow, C. 1973. Southern bald eagle (*Haliaeetus leucocephalus leucocephalus*) and Northern bald eagle (*Haliaeetus leucocephalus alascanus*). U.S Bureau of Land Management Habitat Management Series for Endangered Species Report No. 5, Portland, OR.
- Sogge, M.K., et.al. 1995. Monitoring winter bald eagle concentrations in the Grand Canyon: 1993-1995. National Biological Service Colorado Plateau Research Station/Northern Arizona University. 33 p.
- Spencer, C. N., B. R. McClelland, and J. A. Stanford. 1991. Shrimp stocking, salmon collapse, and eagle displacement. BioScience 41:14-21.
- Stalmaster, M. V. 1987. The bald eagle. Universe. 227 pp.
- Stalmaster, M.V. 1987. The Bald Eagle.
- Steenhof, K. 1978. Management of Wintering Bald Eagles. U.S. Fish and Wildlife Service, FWS/OBS-79/79, 55 pp.
- Steenhof, K. 1978. Management of wintering bald eagles. U.S. Fish and Wildlife Service, FWS/OBS-79/79, 55 pp.
- Stupka, A. 1963. Notes on the Birds of Great Smoky Mountains National Park.

- Taylor, G.J. 1986. Memo to D.D. Boone et al. RE: 1986 Bald Eagle Nesting Productivity in Maryland.
- Taylor, Gary J. AND Glenn D. Therres. 1981. A Computer Generated Description of Potential Bald Eagle Nesting Habitat in Maryland. Wildlife Administration, DNR, Annapolis, MD.
- Terres, J. K. 1980. The Audubon Society Encyclopedia of North American Birds. Alfred A. Knopf, NY.
- Titus, K., and M. R. Fuller. 1990. Recent trends in counts of migrant hawks from northeastern North America. Journal of Wildlife Management 54:463-470.
- Todd, R. 1978. Winter bald eagle in Arizona. Arizona Game and Fish Department, Federal Aid in Wildlife Restoration Project W-53-R Work Plan 5 Job 1, Special Report.
- Todd, R. 1981. Multi-agency findings on the distribution of bald eagles for Arizona in the January months of 1979-1981. Arizona Game and Fish Department, Federal Aid Project W-53-R-31 Work Plan 5 Job 1, Special Report.
- U.S. Fish & Wildlife Service (USFWS). 1984. Draft Pacific states bald eagle recovery plan.
- 1990. Endangered and threatened species recovery program: report to Congress. 406 pp.
- U.S. Fish and Wildlife Service. 1982. Bald eagle recovery plan (Southwestern population). U.S. Fish and Wildlife Service, Albuquerque, NM. 65 p.
- U.S. Fish and Wildlife Service. 1999. Proposed rule to remove the Bald Eagle in the lower 48 states from the list of endangered and threatened wildlife. Federal Register 64:36453-36464.
- Vermeer, K., and K. H. Morgan. 1989. Nesting population, nest sites, and prey remains of bald eagles in Barkeley Sound, British Columbia. Northwestern Naturalist 70:21-26.
- Watson, J. W., M. G. Garrett, and R. G. Anthony. 1991. Foraging ecology of bald eagles in the Columbia River estuary. J. Wildlife Management 55:492-499.
- Weekes, F.M. 1975. Behavior of a young Bald Eagle at a southern Ontario nest. Canadian Field-Naturalist 89: 35-40.
- Wheye, D. 1992. Birds in Jeopardy: The Imperiled and Extinct Birds of the United States and Canada, Including Hawaii and Puerto Rico. Stanford University Press. Stanford, CA. 259 pp.
- White, L. 1995. Bald eagle distribution and habitat use on the Animas, La Plata, and Mancos rivers, Colorado and New Mexico, results of winter surveys: 1993–1995. Technical Service Center, U.S. Bureau of Reclamation, Denver.
- Whittam, B. 2000. Southern Ontario Bald Eagle Monitoring Project - 2000 Report. Report prepared by Bird Studies Canada, Ontario Birds At Risk Program for Ontario Power Generation, Ontario Ministry of Natural Resources, Canadian Wildlife Service, and the Edwards Charitable Foundation. 11 pp.
- Wiemeyer, S. N. et al. 1989. Environmental contaminants in blood of western bald eagles. J. Raptor Res. 23:140-146.
- Witmer, G., and T. A. O'Neil. 1990. Assessing cumulative impacts to wintering bald eagles in western Washington. Pages 144-150 in Mitchell et al., eds. Ecosystem management: rare species and significant habitats. New York State Museum Bull. 471.
- Wood, Merrill. 1979. Birds of Pennsylvania. Pennsylvania State University, University Park.133 pp.

- Wood, P. B., T. C. Edwards, Jr., and M. W. Collopy. 1989. Characteristics of bald eagle nesting habitat in Florida. J. Wildlife Management 53:441-449.
- Woodliffe, P.A. 1992. Recent nesting history of the Bald Eagle in Rondeau Provincial Park, Ontario. Ontario Birds 10(3):101-107.
- Yeager, B. and B. Masslich. 1995. Biological assessment for the St. George road Projects. Prepared for Utah Department of Transportation. Bio/West, Inc., 1063 West 1400 North, Logan, UT 84321.

California Brown Pelican (*Pelecanus occidentalis californicus*)

The California brown pelican has an implied federally Endangered status because it is a subspecies of the federally endangered brown pelican (*Pelecanus occidentalis*), which was listed on November 15, 1994.

Historic Range: Breeds along Pacific coast of central and southern California (the Channel Islands south), on islands off Baja California and on islands in the Gulf of California (south to Isabella and the Tres Marias Islands); ranges regularly north of the breeding grounds to southern British Columbia (Johnsgard 1993, AOU 1998). [*Pelecanus occidentalis*: BREEDING: along Pacific coast from southern California to Peru and (where *thagus* is regarded as conspecific) central Chile, and along Atlantic, Gulf, and Caribbean coasts from Maryland south around Florida to southern Texas, Bahamas (Sprunt 1984), West Indies, off Yucatan Peninsula, and off Venezuela and Caribbean coast of Colombia. Ranges in Pacific coastal waters north to southern British Columbia (after breeding, before winter). NON-BREEDING: Ranges in Pacific coastal waters north to southern British Columbia (after breeding, before winter). In western North America, winters mainly from California south. In the southeastern U.S., primary winter range includes Florida and the Gulf Coast. Subspecies *carolinensis*: breeds locally in Maryland and Virginia and south to Florida (primary nesting range), also locally in Louisiana (where reintroduced) and in central coastal Texas; breeds locally also off northeastern Yucatan and Belize, and ranges southward through coastal Honduras and Costa Rica to Panama, where local breeding occurs off the Pacific coast; vagrants wander north to New England and occur casually inland to the Great Lakes and Great Plains states (Johnsgard 1993). Breeds also in the Bahamas (Sprunt 1984) (extirpated, according to Johnsgard 1993). Ranges throughout breeding range and along eastern shores of Mexico south along Central America to the Caribbean coasts of Colombia and Venezuela, and through the Greater and Lesser Antilles to Trinidad; and on the Pacific coast of Central America (AOU 1957). Subspecies *californicus*: breeds along Pacific coast in southern California (Anacapa Island), and in Mexico on islands off Baja California and on islands in the Gulf of California (south to Isabella and the Tres Marias Islands); possibly locally along the coast of Sonora and Sinaloa; vagrants have occurred north to British Columbia and Idaho (Johnsgard 1993).]

Basic Description: A large bird (brown pelican).

General Description: A large heavy water bird with a massive bill and huge throat pouch; wings and body are mostly grayish-brown; nonbreeding adult has a whitish head and neck, often washed with yellow; hindneck of breeding adult is dark chestnut; head and neck of juvenile is grayish brown; size varies greatly depending on location, with the smallest individuals in the West Indies, medium birds on the coasts of the U.S. (Atlantic and Gulf), Central America, and Colombia and Ecuador, large birds on the coasts of California, Mexico, and Galapagos Islands, and very large in Peru and Chile (NGS 1983, Palmer 1962).

Diagnostic Characteristics: Differs from subspecies *carolinensis* in being larger (e.g., average bill length 347 mm and 312 mm in males and females, respectively, vs. 319 mm and 294 mm) and, in definitive alternate plumage, the brown hindneck being much darker (sometimes almost black) (Palmer 1962). Differs from subspecies *occidentalis* in being much larger (average bill length of *occidentalis* 288 mm and 261 mm, for males and females, respectively) (Palmer 1962).

Reproduction Comments: Along the west coast of North America, egg laying may occur from late winter to early spring (peak usually in March or April but may vary among colonies and from year to year). Subspecies *carolinensis*: southern populations nest irregularly, usually beginning in late fall and extending through June; northernmost populations nest in spring and summer; intermediate populations nest, somewhat irregularly, in winter and spring. Clutch size averages between two and three. Incubation, by both sexes, lasts about 28-30 days. Young leave ground nests at about 35 days, first fly at 71-88 days; leave nests in mangroves at about 63 days. May Some first breed at two years in some colonies (e.g., newly formed ones), possibly not until about four to seven years in stable populations (see Johnsgard 1993). Reproductive success varies with level of disturbance by humans, starvation of young, and/or flooding of nests, but typically the number of young fledged per nest averages one or less. See Johnsgard (1993) for information on productivity. Long-lived; reproduction tends to be "boom or bust." Colonies include up to 150 pairs in Trinidad.

Ecology Comments: Populations fluctuate considerably from year to year and from place to place.

Non-Migrant: Yes

Locally Migrant: Yes

Long Distance Migrant: Yes

Mobility and Migration Comments: Many stay close to nesting areas in winter. A portion of the eastern subspecies migrates to Florida, the Caribbean coasts of Colombia and Venezuela, and the Greater Antilles for winter. During cold winters, some Texas breeders winter along the Gulf Coast of Mexico. Individuals from breeding areas north of Florida winter mainly in Florida and Cuba; young and adults from Florida breeding colonies are more sedentary (young generally do not disperse more than 250 km from natal areas, adults may move up to 450-575 km from colony during the nonbreeding season) (Johnsgard 1993).

Marine Habitat(s): Near shore

Estuarine Habitat(s): Bay/sound, Lagoon, River mouth/tidal river, Scrub-shrub wetland

Terrestrial Habitat(s): Bare rock/talus/scree, Cliff, Sand/dune

Habitat Comments: Mainly coastal, rarely seen inland or far out at sea. Feeds mostly in shallow estuarine waters, less often up to 40 miles from shore. Makes extensive use of sand spits, offshore sand bars, and islets for nocturnal roosting and daily loafing, especially by nonbreeders and during the non-nesting season. Dry roosting sites are essential. Some roosting sites eventually may become nesting areas. BREEDING: Nests usually on coastal islands, on the ground or in small bushes and trees (Palmer 1962). Nests on middle or upper parts of steep rocky slopes of small islands in California and Baja California; usually nests on low-lying islands landward of barrier islands or reefs on Atlantic and Gulf coasts, where often nests in mangroves, sometimes in Australian "pines," red-cedars, live oaks, redbays, or sea grapes. In the subtropics and tropics, mangrove vegetation constitutes an important roosting and nesting substrate (Collazo and Klaas 1985, Schreiber 1979, Schreiber and Schreiber 1982). May shift between different breeding sites, apparently in response to changing food supply distribution (Anderson and Gress 1983) and/or to erosion/flooding of nesting sites.

Adult Food Habits: Piscivore

Immature Food Habits: Piscivore

Food Comments: Eats mainly fishes, especially menhaden, mullet, sardines, pinfish, and anchovies in U.S. waters; sometimes euphausiids; dives into water from air (USFWS 1980). Feeds by diving in deeper water, by swimming, sometimes in cooperative groups, in shallower water (Hilty and Brown 1986). Rarely reported scavenging or preying on eggs or young of water birds. Forages in shallow estuarine and inshore waters mostly within 10 km of the coast (Johnsgard 1993).

Adult Phenology: Crepuscular, Diurnal

Immature Phenology: Crepuscular, Diurnal

Phenology Comments: Most activity diurnal, little during twilight.

Colonial Breeder: Yes

Length: 122 cm

Weight: 3636 grams

References:

- American Ornithologists' Union (AOU). 1957. The A.O.U. Check-list of North American Birds, 5th ed. Port City Press, Inc., Baltimore, MD. 691 pp.
- American Ornithologists' Union (AOU). 1983. Check-list of North American Birds, 6th edition. Allen Press, Inc., Lawrence, KS. 877 pp.
- Anderson, D. W. 1988. Dose-response relationship between human disturbance and brown pelican breeding success. Wildl. Soc. Bull. 16:339-345.
- Anderson, D. W., and F. Gress. 1983. Status of a northern population of California brown pelicans. Condor 85:79-88.
- Biosystems Analysis, Inc. 1989. Endangered Species Alert Program Manual: Species Accounts and Procedures. Southern California Edison Environmental Affairs Division.
- California Department of Fish and Game (CDF&G). 1990. 1989 annual report on the status of California's state listed threatened and endangered plants and animals. 188 pp.
- Clapp, R. B., and P. A. Buckley. 1984. Status and conservation of seabirds in the southeastern United States. Pages 135-155 in Croxall et al., eds. Status and conservation of the world's seabirds. ICBP Tech. Pub. No. 2.
- Guravich, D, and J. E. Brown. 1983. The return of the brown pelican. Lousiana State Univ. Press, Baton Rouge. viii + 118 pp.
- Johnsgard, P. A. 1993. Cormorants, darters, and pelicans of the world. Smithsonian Institute Press, Washington, D.C. xiv + 445 pp.
- Matthews, J.R. and C.J. Moseley (eds.). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 + 33 pp. appendix + 6 pp. glossary + 16 pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.
- National Geographic Society (NGS). 1983. Field guide to the birds of North America. National Geographic Society, Washington, DC.
- Palmer, R. S. (editor). 1962. Handbook of North American birds. Vol. 1. Loons through flamingos. Yale University Press, New Haven. 567 pp.
- Sibley, C.G., and B.L. Monroe, Jr. 1990. Distribution and Taxonomy of Birds of the World. Yale University Press, New Haven, CT. xxiv + 1111 pp.
- Spendelow, J. A. and S. R. Patton. 1988. National Atlas of Coastal Waterbird Colonies in the Contiguous United States: 1976-1982. U.S. Fish and Wildlife Service, Biological Report 88(5). x + 326 pp.

- Terres, J. K. 1980. The Audubon Society encyclopedia of North American birds. Alfred A. Knopf, NY.
- U. S. Fish and Wildlife Service. 1980. Selected vertebrate endangered species of the seacoast of the United States--brown pelican eastern and California subspecies. FWS/OBS-80/01.40.
- U.S. Fish and Wildlife Service (USFWS). 1990. Endangered and threatened species recovery program: report to Congress. 406 pp.

Mexican Spotted Owl (*Strix occidentalis lucida*)

The Mexican spotted owl was designated as a federally Threatened species on March 16, 1993.

Historic Range: Range extends from southern Utah (Kertell 1977, Marti 1979) and central Colorado (Webb 1983) south through the mountainous regions of Arizona (Ganey and Balda 1989), New Mexico, western Texas (Guadalupe Mountains), northern Sonora, Chihuahua, and Nuevo Leon south to Michoacan and Puebla (AOU 1983; USFWS 1994, 1995). Mexican occurrences documented during 1990-1993 were in the Sierra Madre Occidental, Sierra Madre Oriental, and Eje Neovolcanico, south to Aguascalientes; the Mexican portion of the range has not been thoroughly surveyed (USFWS 1995). Many populations in Arizona and New Mexico occur in relatively isolated mountain ranges, sometimes separated by large expanses of nonforested habitats; little is known of the populations in many of these mountain ranges; some ranges may include too little habitat to support spotted owl populations indefinitely without periodic immigration from neighboring ranges (Ganey, in Thomas et al. 1990). Abundance (density) is greatest in the central portion of the range; a little more than half of the U.S. population occurs in the Upper Gila Mountains Recovery Unit in Arizona and New Mexico (USFWS 1995). See USFWS (1995) for a spot map showing distribution based on observations made during 1990-1993.

Basic Description: Medium-sized, dark-eyed owl lacking ear tufts.

General Description: A large, dark-eyed, round-headed, brown owl with whitish spotting on the head, back, and underparts (spotted breast, barred belly).

Diagnostic Characteristics: Differs from other subspecies in being generally paler and having the lighter markings of the underparts more whitish (Ridgway 1914).

Reproduction Comments: Egg dates: peak in April in Arizona and New Mexico, sometimes as early as early March. Clutch size is 2-4, usually 2. Incubation, by female (fed by male), lasts about 30 days. Hatching generally occurs in early to mid-May. Young leave nest at about 5 weeks (June), fly at about 6-7 weeks, stay near nest for several weeks, fed by adults until late summer, independent by early fall (dispersal of young occurs in September-October). First breeds at 2-3 years; may not breed every year. Reproductive success generally is low (USFWS 1993); average number of young fledged per pair is about 1.0 (USFWS 1995).

Ecology Comments: Mostly solitary outside the breeding season. Home range size apparently varies with location and habitat; generally the smallest home ranges are a few hundred hectares and the largest ones are about 1500 ha (minimum convex polygon) (see USFWS 1995). In northern Arizona, mean home range of three pairs was 847 ha; owls shifted seasonally such that year-round home range was larger than the range used during any one season (Ganey and Balda 1989). Mean home range size of four pairs in the Lincoln National Forest was 1180 ha; mean home ranges in Utah varied from 242 ha in Zion National Park to 625 ha for two owls elsewhere (see USFWS 1993). In Utah, some home ranges shifted seasonally, others did not (see USFWS 1994). In general, fidelity to territories is apparently high (USFWS 1995). In Utah, seven juveniles dispersed 24-145 km (USFWS 1995). In New Mexico, five juvenile females dispersed 8-56 km (mean 22 km), five juvenile males dispersed 2-13 km (mean 6 km); some females, including an adult, made intermountain movements (Gutierrez et al. 1996). Density generally is less than 0.4/sq km (mostly about 0.1-0.2/sq km) (USFWS 1995). Annual survival rate appears to be about 80-90% in adults, 6-29% in juveniles (White et al. 1995, USFWS 1995).

Non-Migrant: Yes

Locally Migrant: Yes

Long Distance Migrant: No

Mobility and Migration Comments: In the southwestern U.S., apparently largely nonmigratory, with some vertical migration at higher elevations (Ganey et al. 1988) (i.e., owls move to lower elevations for winter, with some exceptions). Some owls remain year-round in the same general areas but exhibit seasonal shifts in habitat use pattern (USFWS 1995). Some migrate 20-50 km between summer and winter ranges (see USFWS 1995).

Palustrine Habitat(s): Riparian

Terrestrial Habitat(s): Cliff, Forest - Conifer, Forest - Hardwood, Forest - Mixed

Special Habitat Factors: Standing snag/hollow tree

Habitat Comments: Highest densities occur in mixed-conifer forests that have experienced minimal human disturbance (USFWS 1995, Ganey and Dick 1995). In the southwestern U.S., most common where unlogged closed canopy forests occur in steep canyons; uneven-aged stands with high basal area and many snags and downed logs are most favorable. In Arizona, occurs primarily in mixed-conifer, pine-oak, and evergreen oak forests; also occurs in ponderosa pine forest and rocky canyonlands (Ganey and Balda 1989). In Arizona, generally foraged more than or as frequently as expected (based on availability) in virgin mixed-conifer and ponderosa pine forests, and less than expected in managed forests; roosted primarily in virgin mixed-conifer forests; both foraging and especially roosting sites had more big logs, higher canopy closure, and greater densities and basal areas of both trees and snags than did random sites (Ganey and Balda 1994). In southern Utah, commonly used mesa tops, benches and warm slopes above canyons in fall and winter; relatively cool canyons were the primary summer habitat (see USFWS 1994). In New Mexico, breeding and roosting occurred in mixed-conifer forests that contained an oak component more frequently than expected by chance; generally did not use pinyon pine-alligator juniper woodlands for nesting or roosting; selected roost and nest sites in forests characterized by mature trees with high variation in tree heights and canopy closure greater than 75% (Seamans and Gutierrez 1995). Basically intolerant of even-age forest management practices (USFWS, Federal Register, 1 April 1994). Requires cool summer roosts (Barrows 1981, Ganey et al. 1993), such as near canyon bottoms, in dense forests, on shady cliffs or in caves (Ganey et al. 1988). Sometimes occurs in deep canyons in areas that lack extensive forests. Sometimes may winter in comparatively open habitats at lower elevations. Breeding formerly occurred in desert riparian habitat, but occurrences are rare in this habitat today. In general, foraging habitat requirements are not well known (USFWS 1995). See USFWS (1993, 1994, 1995) for further details on habitat. Nests on broken tree top, cliff ledge, in natural tree cavity, or in tree on stick platform, often the abandoned nest of hawk or mammal; sometimes in cave. In Utah and Colorado, most nests are in caves or on cliff ledges in steep-walled canyons; elsewhere, nests apparently most often are in trees, especially Douglas-fir (USFWS 1995, Seamans and Gutierrez 1995). Exhibits high level of nest site fidelity. Typically selects cool, shady sites with high canopy closure and at least a few old-growth trees, usually on moderate to steep slopes (USFWS 1993). In New Mexico, 61% of nest structures were on clumps of limbs caused by dwarf mistletoe infections; nest trees averaged 164 years old and 60.6 cm in diameter (Seamans and Gutierrez 1995). See also USFWS (1995).

Adult Food Habits: Carnivore

Immature Food Habits: Carnivore

Food Comments: Diet varies with location; woodrats, mice, and voles are common prey (USFWS 1995, Ward and Block 1995). Zion National Park, Utah: *Neotoma*, *Thomomys*, and beetles (Kertell 1977). Arizona: mainly cottontails, deer mice, woodrats, and voles (Ganey et al. 1988); also various birds, bats, lizards, and snakes (Duncan, 1992, Herpetol. Rev. 23:81). Arizona: mainly *Neotoma*, *Peromyscus*, *Microtus*, *Sylvilagus*, and *Thomomys* (Ganey 1992). Generally hunts from a perch. May cache prey.

Adult Phenology: Crepuscular, Nocturnal

Immature Phenology: Crepuscular, Nocturnal

Phenology Comments: Roosts during the day; hunts at dusk and at night. May leave roost during day to capture prey beneath roost, retrieve cached prey, or to drink or bathe in stream. In northern Arizona, calling peaked in late spring and during 2-hour period following sunset (Ganey 1990).

Length: 45 cm

Restoration Potential: Recovery plan (USFWS 1995) indicates that delisting could occur within 10 years (depends on results of monitoring over that period).

Preserve Selection & Design Considerations: Preserves should be distributed among the six U.S. and five Mexican recovery units designated by USFWS (1995). This subspecies probably exists as more or less discrete clusters of populations, reflecting the patchiness of the habitat; each cluster of populations (e.g., the Mogollon Rim cluster and the Southern Rockies cluster) apparently can be regarded as a classical metapopulation; owls disperse frequently within clusters but only rarely between clusters (Keitt et al. 1995).

Management Requirements: Management initially should focus on the alleviation of major threats: catastrophic wildfire and widespread use of even-aged silviculture; thereafter, other priorities, such as creating replacement owl habitat, should be pursued (USFWS 1995, which see for detailed management information). Manipulative experiments are needed to evaluate effects of fire (or other forest management activities) on owls (Bond et al. 2002). See also Dawson et al. (1987) and Lefranc and Glinski (1988) for management and research recommendations. See USFWS (1994) for a review of management policies and practices by agencies and tribes.

Monitoring Requirements: Monitoring of the population and habitat over the next 10 years is regarded as an essential part of the recovery plan (USFWS 1995). See USFWS (1995) for detailed information on monitoring procedures. See also Bull (1987) for information on capture techniques, Bosakowski (1987) and Forsman (1983) for census methods. See Ganey (1990) for cautions on censusing owls through calling surveys. Paton et al. (1991) concluded that the use of backpack-mounted radio tags should be avoided (due to impaired reproduction and survival of radio-tagged owls).

References:

- Allen, Craig R., Stephen Demarais, and R. Scott Lutz. 1994. Red Imported Fire Ant Impact on Wildlife: an Overview. Texas J. Sci. 46(1):51-59.
- American Ornithologists' Union (AOU). 1957. The A.O.U. Check-list of North American Birds, 5th ed. Port City Press, Inc., Baltimore, MD. 691 pp.
- American Ornithologists' Union (AOU). 1983. Check-list of North American Birds, 6th edition. Allen Press, Inc., Lawrence, KS. 877 pp.
- Andrews, R. R. and R. R. Righter. 1992. Colorado Birds. Denver Museum of Natural History, Denver. 442 pp.
- Barrowclough, G. F., and R. J. Gutierrez. 1990. Genetic variation and differentiation in the spotted owl (*Strix occidentalis*). Auk 107:737-744.
- Barrows, C.W. 1981. Roost selection by spotted owls: an adaptation to heat stress. Condor 83:302-309.

- Bond, M. L., R. J. Gutiérrez, A. B. Franklin, W. S. LaHaye, C. A. May, and M. E. Seamans. 2002. Short-term effects of wildfires on spotted owl survival, site fidelity, mate fidelity, and reproductive success. Wildlife Society Bulletin 30:1022-1028.
- Bosakowski, T. 1987. Census of barred owls and spotted owls. Pages 307-308 in Nero, R. W., et al., eds. Biology and conservation of northern forest owls. USDA For. Serv., Gen. Tech. Rep. RM-142.
- Bull, E. L., et al. 1987. Nest platforms for great gray owls. Pp. 87-90 in Nero, R. W., et al., eds. Biology and conservation of northern forest owls. USDA Forest Service, Gen.Tech. Rep. RM-142.
- Bull, E.L. 1987. Capture techniques for owls. Pages 291-293 in R.W. Nero, R.J. Clark, R.J. Knapton, and R.H. Hamre, editors. Biology and conservation of northern forest owls. USDA Forest Service, Gen. Tech. Rep. RM-142.
- Campbell, L. 1995. Endangered and Threatened Animals of Texas: Their Life History and Management. Texas Parks and Wildlife Department, Endangered Resources Branch, Austin, Texas. ix + 129 pp.
- Dawson, W. R., J. D. Ligon, and J. R. Murphy. 1987. Report of the Scientific Advisory Panel on the Spotted Owl. Condor 89:205-229.
- Division of Natural Resources, Navajo Fish and Wildlife Department. 1995. Endangered Species List for The Navajo Nation.
- Fletcher, K.W. and H.E. Hollis. 1994. Habitats used, abundance, and distribution of the Mexican spotted owl, Strix occidentalis lucida, on National Forest System lands in the Southwestern Region. Southwestern Regional Office, U.S. Forest Service.
- Forsman, E. D. 1983. Methods and materials for locating and studying spotted owls. U.S.D.A. Forest Service, Gen. Tech. Report PNW-162. Portland, Oregon. 8 pp.
- Forsman, E., and E. C. Meslow. 1986. The spotted owl. Pages 742-761 in R. L. Di Silvestro, editor. Audubon Wildlife Report 1986. National Audubon Society, NY. 1094 pp.
- Ganey, J. L. 1990. Calling behavior of spotted owls in northern Arizona. Condor 92:485-490.
- Ganey, J. L. 1992. Food habits of Mexican spotted owls in Arizona. Wilson Bull. 104:321-326.
- Ganey, J. L. et al. 1988. Mexican spotted owl. Pages 145-150 in Glinski et al., eds. Proc. Southwest raptor management symposium and workshop. Nat. Wildl. Fed. Sci. and Tech. Ser. No. 11.
- Ganey, J. L., R. P. Balda, and R. M. King. 1993. Metabolic rate and evaporative water loss of Mexican spotted and great horned owls. Wilson Bull. 105:645-656.
- Ganey, J. L., and J. L. Dick, Jr. 1995. Habitat relationships of the Mexican spotted owl: current knowledge. Pages 1-42 in U.S. Fish and Wildlife Service. Mexican spotted owl recovery plan. Volume II. Albuquerque, NM.
- Ganey, J. L., and R. P. Balda. 1989. Distribution and habitat use of Mexican spotted owls in Arizona. Condor 91:355-361.
- Ganey, J. L., and R. P. Balda. 1989. Home-range characteristics of spotted owls in northern Arizona. J. Wildlife Management 53:1159-1165.
- Ganey, J. L., and R. P. Balda. 1994. Habitat selection by Mexican spotted owls in northern Arizona. Auk 111:162-169.
- Ganey, J.L. 1990. Calling behavior of spotted owls in northern Arizona. The Condor 92:485-490.

- Ganey, J.L. 1992. Food habits of Mexican spotted owls in Arizona. Wilson Bull. 104(2):321-326.
- Ganey, J.L. and R.P. Balda. 1989. Distribution and habitat use of Mexican spotted owls in Arizona. The Condor 91:355-361.
- Ganey, J.L. and R.P. Balda. 1989. Home-range characteristics of spotted owls in northern Arizona. J. Wildl. Manage 53(4):1159-1165.
- Ganey, J.L., et.al. 1993. Metabolic rate and evaporative water loss of Mexican spotted and great horned owls. Wilson Bull. 105(4):645-656.
- Gutierrez, R. J., M. E. Seamans, and M. Z. Peery. 1996. Intermountain movement by Mexican potted owls (*Strix occidentalis lucida*). Great Basin Naturalist 56:87-89.
- Hayward, C.L., et.al. 1976. Birds of Utah. Great Basin Naturalist Memoirs, No. 1, Brigham Young University, Provo, UT.
- Johnson, C. L. 1997. Distribution, Habitat, and Ecology of the Mexican Spotted Owl in Colorado. Masters Thesis, University of Northern Colorado, Greeley.
- Keitt, T., A. B. Franklin, and J. P. Ward, Jr. 1995. Landscape analysis and metapopulation structure. Pages 1-16 in U.S. Fish and Wildlife Service. Mexican spotted owl recovery plan. Volume II. Albuquerque, NM.
- Kertell, K. 1977. The spotted owl at Zion National Park, Utah. Western Birds 8:147-150.
- LaRue, C.T. 1994. Birds of northern Black Mesa, Navajo County, Arizona. Great Basin Naturalist 54(1):1-63.
- Lefranc, M. N., Jr., and R. L. Glinski. 1988. Southwest raptor management issues and recommendations. Pages 375-392 in Glinski et al., eds. Proc. Southwest raptor management symposium and workshop. National Wildlife Federation Science and Tech. Ser. No. 11.
- Marti, C. D. 1979. Status of owls in Utah. Pages 29-35 in P. Schaeffer and S. Ehlers, eds. Owls of the West: their ecology and conservation. National Audubon Society, Western Education Center, Tiburon, CA.
- McDonald, C.B., et.al. 1991. Mexican spotted owl, *Strix occidentalis lucida*, status review. U.S. Fish and Wildlife Service Endangered Species Report 20, Albuquerque, NM.
- Nelson, D. 1993. Colorado Bird Atlas: Manual on Use of Breeding Codes. Denver Museum of Natural History, Denver. 27 pp.
- Paton, P. W. C., C. J. Zabel, D. L. Neal, G. N. Steger, N. G. Tilghman, and B. R. Noon. 1991. Effects of radio tags on Spotted Owls. J. Wildlife Management 55:617-622.
- Ridgway, R. 1914. The birds of North and Middle America. Part VI. U.S. National Museum Bull. 50.
- Rinkevich, S. E. 1995. Mexican spotted owl draft recovery plan. Endangered Species Bulletin 20(4):12-13.
- Rinkevich, S. E., J. L. Ganey, J. P. Ward, Jr., G. C. White, D. L. Urban, A. B. Franklin, W. M. Block, and F. Clemente. 1995. General biology and ecological relationships of the Mexican spotted owl. Pp. 19-35 in W. M. Block et al., Recovery plan for the Mexican spotted owl (*Strix occidentalis lucida*). U. S. Fish and Wildlife Service, Albuquerque, NM. 172 pp.
- Ryke, N., D. Winters, L. McMartin and S. Vest. 1994. Threatened, Endangered and Sensitive Species of the Pike and San Isabel National Forests and Comanche and Cimarron National Grasslands. May 25, 1994.

- Seamans, M. E., R. J. Gutiérrez, C. A. May, and M. Z. Peery. 1999. Demography of two Mexican spotted owl populations. Conservation Biology 13:744-754.
- Seamans, M. E., and R. J. Gutierrez. 1995. Breeding habitat of the Mexican spotted owl in the Tularosa Mountains, New Mexico. Condor 97:944-952.
- Spahr, R., L. Armstrong, D. Atwood, and M. Rath. 1991. Threatened, endangered, and sensitive species of the Intermountain Region. U.S. Forest Service, Ogden, Utah.
- Thomas, J. W., E. D. Forsman, J. B. Lint, E. C. Meslow, B. R. Noon, and J. Verner. 1990. A conservation strategy for the northern spotted owl: a report to the Interagency Scientific Committee to address the conservation of the northern spotted owl. U.S. Forest Service, U.S. Fish and Wildlife Service, and National Park Service, Washington, D.C. 427 pp.
- U.S. Fish and Wildlife Service (USFWS). 1993. Notice of 90-day finding on petition to remove the Mexican spotted owl from the list of endangered and threatened wildlife and plants. Federal Register 58(183):49467-49468. 23 September 1993.
- U.S. Fish and Wildlife Service (USFWS). 31 August 2004. Final designation of critical habitat for the Mexican spotted owl. Federal Register 69(168):53182-53231.
- U.S. Fish and Wildlife Service. 1993. Final rule to list the Mexican spotted owl as a threatened species. Federal Register 58(49):14248-14271. 16 March 1993.
- U.S. Fish and Wildlife Service. 1994. Proposed determination of critical habitat for the Mexican spotted owl. Federal Register 59(234):63162-63201. 7 December 1994.
- U.S. Fish and Wildlife Service. 1995. Draft recovery plan for the Mexican spotted owl. xxvi + 646 pp.
- U.S. Fish and Wildlife Service. 1995. Recovery plan for the Mexican spotted owl (*Strix occidentalis lucida*). Volume 1. Albuquerque, NM. 172 pp.
- Ward, J. P., Jr., A. B. Franklin, S. E. Rinkevich, and F. Clemete. 1995. Distribution and abundance of Mexican spotted owls. Pages 1-14 in U.S. Fish and Wildlife Service. Mexican spotted owl recovery plan. Volume II. Albuquerque, NM.
- Ward, J. P., Jr., and W. M. Block. 1995. Mexican spotted owl prey ecology. Pages 1-48 in U.S. Fish and Wildlife Service. Mexican spotted owl recovery plan. Volume II. Albuquerque, New Mexico.
- Webb, B. 1983. Distribution and nesting requirements of montane forest owls in Colorado. Part IV. Spotted owl (*Strix occidentalis*). Colorado Field Ornithologists' Journal 17:2-8.
- White, G. C., A. B. Franklin, and J. P. Ward, Jr. 1995. Population biology. Pages 1-25 in U.S. Fish and Wildlife Service. Mexican spotted owl recovery plan. Volume II. Albuquerque, NM.
- Zarn, M. 1974. Spotted owl (*Strix occidentalis*). Habitat Management Series for Unique or Endangered Species Report No. 10, U.S. Bureau of Land Management Technical Note 242, Denver, CO. 22 p.

Ocelot (*Felis pardalis*)

The ocelot was designated as a federally Endangered species on July 21, 1982.

Historic Range: Historical range: Texas, Louisiana, Arkansas, and Arizona south through Mexico, Central America, and South America to eastern Peru, eastern Bolivia, Paraguay, Uruguay, and northern Argentina. Occurs in the mountains of Colombia, Ecuador, and northern Peru, but not on the high plateaus of southern Peru and Bolivia (Kitchener 1991); recently recorded in Uruguay (see Kitchener 1991); to elevations of 1000 m. In the U.S., currently found regularly only in southern Texas (e.g., Laguna Atascosa National Wildlife Refuge, site of a recent radiotelemetry study). Occurrence in Arizona is based only on a few old records from the vicinity of Fort Verde and Patagonia (Hoffmeister 1986); documentation for these records is less than ideal.

Basic Description: A cat (ocelot).

General Description: A small spotted cat with a long tail; ground color ranges from whitish or tawny yellow to reddish gray and gray; dark markings form chainlike streaks, generally forming black-bordered elongated spots, which run obliquely down the sides; adult total length 92-137 cm, tail length 27-40 cm; mass 11-16 kg; greatest length of skull of adults, 120-158 mm (Hall 1981, Nowak 1991).

Diagnostic Characteristics: Differs from the jaguar in much smaller size (jaguar is 157-242 cm in total length) and pelage spots not forming distinct rosettes. Differs from *Felis wiedii* and *F. tigrina* in being larger (hind foot longer than 145 mm vs. shorter, greatest length of skull more than 120 mm vs. shorter, length of P4 more than 12.7 mm vs. shorter) (Hall 1981). Differs from young mountain lion in having spots arranged in rows or in a chainlike pattern.

Reproduction Comments: Texas: breeds in late summer. Births occur in fall and winter in Texas and Mexico (Leopold 1959). Tropics: breeds year-round. Gestation lasts about 70 days. Litter size is 2-4 (usually 2).

Ecology Comments: Population density in Costa Rica was estimated at 14-25/100 sq km (Kitchener 1991). In Brazil, Trolle and Kery (2003) used capture-recapture analysis of camera-trapping data to estimate density at 2.82 independent individuals per 5 sq km.

Non-Migrant: Yes

Locally Migrant: No

Long Distance Migrant: No

Mobility and Migration Comments: Home range in Texas reportedly is a few square kilometers (Kitchener 1991). In Peru, adult females occupied exclusive home ranges of about 2 sq km; male ranges were several times larger, exclusive of those of other males, and overlapped multiple female ranges; individuals often were solitary but appeared to make contact with others frequently (Emmons 1988).

Palustrine Habitat(s): FORESTED WETLAND, Riparian

Terrestrial Habitat(s): Forest - Hardwood, Savanna, Shrubland/chaparral, Woodland - Hardwood

Special Habitat Factors: Standing snag/hollow tree

Habitat Comments: Habitats with good cover; when active by day, tends to keep hidden in dense brush (Emmons and Feer 1990). Inhabits dense chaparral thickets in Texas. Elsewhere, occurs in humid tropical forests, mangrove forests, swampy savannas, brushland, and riverine scrub in deserts. Where not hunted, adapts well to disturbed habitats around villages; often uses man-made trails (Emmons and Feer 1990). Mainly terrestrial but climbs, jumps, and swims well (Nowak 1991). Dens are in caves, hollow trees, thickets, or the spaces between the closed buttress roots of large trees; rarely climbs but sometimes may sleep on tree branch.

Adult Food Habits: Carnivore

Immature Food Habits: Carnivore

Food Comments: Feeds on various small to moderate-sized vertebrates: rodents, rabbits, and other small mammals; young deer and peccaries; birds (sometimes including domestic poultry); snakes; lizards; fishes; etc. Hunts and captures prey on the ground (Emmons and Feer 1990).

Adult Phenology: Crepuscular, Nocturnal

Immature Phenology: Crepuscular, Nocturnal

Phenology Comments: Nocturnal and diurnal; mainly nocturnal (Emmons and Feer 1990).

Length: 125 cm

Weight: 14000 grams

References:

- Allen, Craig R., Stephen Demarais, and R. Scott Lutz. 1994. Red Imported Fire Ant Impact on Wildlife: an Overview. Texas J. Sci. 46(1):51-59.
- Albuja, L. 1991. Lista de vertebrados del Ecuador. Escuela Politécnica XVI:163-203.
- Anderson, S. 1997. Mammals of Bolivia, taxonomy and distribution. Bulletin of the American Museum of Natural History, No 231.
- Campbell, L. 1995. Endangered and Threatened Animals of Texas: Their Life History and Management. Texas Parks and Wildlife Department, Endangered Resources Branch, Austin, TX. ix + 129 pp.
- Carrillo, E., G. Wong, and A. Cuarón. 2000. Monitoring mammal populations in Costa Rican protected areas under different hunting restrictions. Conservation Biology 14:1580-1591.
- Davis, W. B. 1978. The mammals of Texas. Texas Parks and Wildlife Dept., Bull. No. 41. 294 pp.
- Emmons, L. H. 1988. A field study of ocelots (*Felis pardalis*) in Peru. Rev. Ecol. (Terre Vie) 43:133-157.
- Emmons, L. H. and F. Feer. 1990. Neotropical rainforest mammals: a field guide. Univ. of Chicago Press. xiv + 281 pp.
- Engstrom, M. and B. Lim. 2000. Checklist of the mammals of Guyana. Smithsonian Institute. Http://www.mnh.si.edu/biodiversity/bdg/guymammals.html. \Escamilla, A., M. Sanvicente, M. Sosa, and C. Galindo-Leal. 2000. Habitat mosaic, wildlife availability, and hunting in the tropical forest of Calakmul, Mexico. Conservation Biology 14:1592-1601.
- Foster, M.L. and S.R. Humphrey. 1995. Use of highway underpasses by Florida panthers and other wildlife. Wildl. Soc. Bull. 23(1):95-100.

- Hall, E. R. 1981. The Mammals of North America, 2nd. Ed., 2 Vols. John Wiley and Sons, New York, NY. 1181 pp.
- Hall, E. Raymond. 1981. The Mammals of North America, Vols. I & II. John Wiley & Sons, New York, NY. 1181 pp.
- Hoffmeister, D. F. 1986. Mammals of Arizona. Univ. Arizona Press and Arizona Game and Fish Dept. 602 pp.
- Jones, C., R. S. Hoffman, D. W. Rice, M. D. Engstrom, R. D. Bradley, D. J. Schmidly, C. A. Jones, and R. J. Baker. 1997. Revised checklist of North American mammals north of Mexico, 1997. Occasional Papers, Museum of Texas Tech University 173:1-20.
- Jones, J. K., Jr., R. S. Hoffman, D. W. Rice, C. Jones, R. J. Baker, and M. D. Engstrom. 1992. Revised checklist of North American mammals north of Mexico, 1991. Occasional Papers, The Museum, Texas Tech University, 146:1-23.
- Kitchener, A. 1991. The natural history of the wild cats. Comstock Publishing Associates, Cornell Univ. Press, Ithaca. xxi + 280 pp.
- Lowery, G. H., Jr. 1974. The mammals of Louisiana and its adjacent waters. Louisiana State University Press, Baton Rouge. 565 pp.
- Mares, M. A., R. M. Bárquez, J. K. Braun, and R. A. Ojeda. 1996. Observations on the mammals of Tucumán Province, Argentina. I. Systematics, distribution, and ecology of the Didelphimorphia, Xenarthra, Chiroptera, Primates, Carnivora, Perissodactyla, Artiodactyla, and Lagomorpha. Annals of the Carnegie Museum 65:89-152.
- Matthews, J.R. and C.J. Moseley (eds.). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 + 33 pp. appendix + 6 pp. glossary + 16 pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.
- Murray, J. L., and G. L. Gardner. 1997. Leopardus pardalis. Mammalian Species (548):1-10.
- Nowak, R. M. 1991. Walker's mammals of the world. Fifth edition. Vols. I and II. Johns Hopkins Univ. Press, Baltimore, MD. 1629 pp.
- Nowell, K., and P. Jackson. 1996. Wild cats: Status survey and conservation action plan. Gland, Switzerland, IUCN.
- Pacheco, V., H. de Macedo, E. Vivar, C. Ascorra, R. Arana-Cardó, and S. Solari. 1995. Lista anotada de los mamíferos peruanos. Conservation International, Washington, DC.
- Pacheco, V., S. Solari, E. Vivar, and P. J. Hocking. 1994. La riqueza biológica del Parque Nacional Yanachaga - Chemillén. Magistri et Doctores 7:3-6.
- Russell, Dennis N. 1971?. History and status of the felids of Texas. Presentation at "Symposium on the Status and Management of the Wild Cats of North America"; North American Wildlife and Natural Resources Conference; Portland, Oregon; A Contribution of Federal Aid in Wildlife Restoration Project Texas W-103-R.
- Sealander, J.A. and G.A. Heidt. 1990. Arkansas Mammals: Their Natural History, Classification and Distribution. University of Arkansas Press, Fayetteville. 308 pp.
- Tirira, D. 1999. Mamíferos del Ecuador. Museo de Zoología, Pontificia Universidad Católica del Ecuador, Quito.
- Trolle, M., and M. Kery. 2003. Estimation of ocelot density in the Pantanal using capture-recapture analysis of camera-trapping data. Journal of Mammalogy 84:607-614.

- U.S. Fish and Wildlife Service (USFWS). 1990. Endangered and threatened species recovery program: report to Congress. 406 pp.
- Wilson, D. E., and D. M. Reeder (editors). 1993. Mammal Species of the World: a Taxonomic and Geographic Reference. Second Edition. Smithsonian Institution Press, Washington, DC. xviii + 1206 pp. Available online at: http://www.nmnh.si.edu/msw/.
- Wilson, D. E., and S. Ruff. 1999. The Smithsonian book of North American mammals. Smithsonian Institution Press, Washington, D.C. 750 pp.

Lesser Long-nosed Bat (*Leptonycteris curasoe*)

The lesser long-nosed bat was designated as a federally Endangered species on September 30, 1988.

Distribution: Central California (Constantine 1998), southern Arizona (e.g., Sidner and Davis 1988), and New Mexico to Honduras and El Salvador (Simmons, in Wilson and Reeder 2005). U.S. populations apparently winter in Mexico.

Habitat: The habitat in Mexico is primarily tropical deciduous forest and thorn forest (Arita 1991). In the United States, this bat roosts in old mines and caves at the base of mountains near alluvial fans vegetated with agave, yucca, saguaro, and organ pipe cactus (Barbour and Davis 1969). Young are born in maternity colonies in caves and mines.

Diet: Frugivore, Nectarivore

Threats: USFWS (1987, 1989) stated that the species was threatened by disturbance of roosts, loss of food sources through land clearing and human exploitation, and direct killing by humans. Overall, however, this species does not appear to be very threatened.

References:

- Arita, H. T. 1991. Spatial segregation in long-nosed bats, *Leptonycteris nivalis* and *Leptonycteris curasoae*, in Mexico. Journal of Mammalogy 72:706-714.
- Arita, H. T., and S. R. Humphrey. 1988. Revisión taxonómica de los murciélagos magueyeros del género Leptonycteris (*Chiroptera: Phyllostomidae*). Acta Zoologica Mexicana (n.s.) 29:1-60.
- Cockrum, E. L., and Y. Petryszyn. 1991. The long-nosed bat, *Leptonycteris*: an endangered species in the southwest? Occas. Pap. Mus. Texas Tech Univ. (142):1-32.
- Davis, W. B., and D. C. Carter. 1962. Review of the genus *Leptonycteris* (*Mammalia: Chiroptera*). Proceedings Biological Society Washington 75:193-197.
- Fleming, T. H. 1989. Climb every cactus. Bats 7(3):3-6.
- Fleming, T. H. 1991. Following the nectar trail. Bats 9(4):4-7.
- Jones, J. K., Jr., R. S. Hoffman, D. W. Rice, C. Jones, R. J. Baker, and M. D. Engstrom. 1992. Revised checklist of North American mammals north of Mexico, 1991. Occasional Papers, The Museum, Texas Tech University, 146:1-23.
- Nabhan, G. P., and T. Fleming. 1993. The conservation of New World mutualisms. Conservation Biology 7:457-459.
- U.S. Fish and Wildlife Service (USFWS). 1994. Endangered and Threatened Wildlife and Plants; Animal Candidate Review for Listing as Endangered or Threatened Species. Proposed Rule. Federal Register, 59(219): 58982-59028.
- Wilson, D. E., and D. M. Reeder (editors). 2005. Mammal species of the world: a taxonomic and geographic reference. Third edition. The Johns Hopkins University Press, Baltimore. Two volumes. 2,142 pp.

Jaguar (*Panthera onca*)

The jaguar was designated as a federally Endangered species on July 22, 1997.

Historic Range: The jaguar once ranged throughout tropical lowlands of Mexico, Central America (now very rare except in Belize), and South America (to northern Argentina); in the United States, there are records from southern California, Arizona (Hoffmeister 1986, Johnson and Van Pelt 1997), New Mexico (Findley et al. 1975, Frey 2004), Texas (Schmidly 2004), and perhaps farther east in Louisiana; most records are from Arizona, where a minimum of 64 jaguars have been killed since 1900; some believe that a breeding population formerly existed in portions of the southwestern United States (Federal Register, 13 July 1994, 22 July 1997, which see for a state-by-state review of records). The species is now absent from much of the former range; it has been extirpated as a resident in most or all of the northern extent of the range in the southwestern United States and northern Mexico (see Federal Register, 13 July 1994, p. 35676, for discussion of recent records), El Salvador, Uruguay, developed areas of Brazilian coast, all but the northernmost parts of Argentina, and elsewhere. The largest remaining population is in Amazonian Brazil (Seymour 1989). In recent decades, jaguars occasionally have strayed into the United States in southern Arizona-New Mexico.

Basic Description: A large cat (jaguar).

Reproduction Comments: In tropical areas may breed throughout the year; births most common November-December in Paraguay, December-May in Brazil, March-July in Argentina, July-September in Mexico, June-August in Belize. Gestation lasts about 90-115 days. Litter size is 1-4 (average 2). Young begin to eat meat at about 10-11 weeks, though may suckle 5-6 months; remain in den about 1.5-2 months; stay with mother 1.5-2 year; females sexually mature in 2-3 years, males in 3-4 years (Seymour 1989).

Ecology Comments: Solitary and somewhat territorial, except during breeding season. Density estimated at 4/137 sq km in Brazil, 25-30 per 250 sq km in Belize (Seymour 1989). In Belize, daily home range may be only a few sq km, but may shift to new area every week or two. Home range in Brazil was estimated at 25-76 sq km (see Kitchener 1991). Major cause of mortality is hunting by humans.

Non-Migrant: Yes

Locally Migrant: No

Long Distance Migrant: No

Palustrine Habitat(s): Riparian

Terrestrial Habitat(s): Forest - Hardwood, Forest - Mixed, Grassland/herbaceous, Shrubland/chaparral, Woodland - Hardwood, Woodland - Mixed

Habitat Comments: Habitat includes a wide variety of situations, such as tropical and subtropical forests, lowland scrub and woodland, thorn scrub, pampas/llanos, desert, swampy savanna, mangrove swamps, lagoons, marshland, and floating islands of vegetation. At the southern extreme of the range, this cat inhabits open savanna, flooded grasslands, and desert mountains; at the northern extreme it may be found in chaparral and timbered areas. Young are born in a sheltered place such as a cave or thicket, under an uprooted tree, among rocks, or under a river bank (Seymour 1989).

Adult Food Habits: Carnivore

Immature Food Habits: Carnivore

Food Comments: Feeds on large and small mammals, reptiles and ground-nesting birds. Known to feed on peccaries, capybaras, tapirs, agoutis, deer, small crocodilians and turtles; opportunistic, see Seymour (1989) for further details. Hunts mostly on ground but may pounce on prey from tree or ledge.

Phenology Comments: Active throughout the year. Hunts primarily at night, but may be active day or night (Seymour 1989).

Length: 242 cm

Weight: 136000 grams

References:

- Allen, Craig R., Stephen Demarais, and R. Scott Lutz. 1994. Red Imported Fire Ant Impact on Wildlife: an Overview. Texas J. Sci. 46(1):51-59.
- Brown, D. E. 1983. On the status of the jaguar in the Southwest. Southwestern Naturalist 28:459-460.
- Cadena, A., R. P. Anderson, and P. Rivas-Pava. 1998. Colombian mammals from the chocoan slopes of Nariño. Occasional Papers Museum of Texas Tech University 180:1-15.
- Carrillo, E., G. Wong, and A. Cuarón. 2000. Monitoring mammal populations in Costa Rican protected areas under different hunting restrictions. Conservation Biology 14:1580-1591.
- Engstrom, M. and B. Lim. 2000. Checklist of the mammals of Guyana. Smithsonian Institute. Http://www.mnh.si.edu/biodiversity/bdg/guymammals.html.
- Escamilla, A., M. Sanvicente, M. Sosa, and C. Galindo-Leal. 2000. Habitat mosaic, wildlife availability, and hunting in the tropical forest of Calakmul, Mexico. Conservation Biology 14:1592-1601.
- Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. Univ. of New Mexico Press, Albuquerque, NM. 360 pp.
- Fish and Wildlife Service. 1980. Selected vertebrate endangered species of the seacoast of the United States- the jaguar. FWS/OBS-80/01.41., Slidell.
- Frey, J. K. 2004. Taxonomy and distribution of the mammals of New Mexico: an annotated checklist. Museum of Texas Tech University Occasional Papers 240. 32 pp.
- Hall, E. Raymond. 1981. The Mammals of North America, Vols. I & II. John Wiley & Sons, New York, New York. 1181 pp.
- Hoffmeister, D. F. 1986. Mammals of Arizona. Univ. Arizona Press and Arizona Game and Fish Dept. 602 pp.
- Honacki, James H., et al, eds. 1982. Mammal Species of the World: A Taxonomic and Geographical Reference. Allen Press, Inc. and The Association of Systematics Collections, Lawrence, KS. 694 p.
- Johnson, T. B., and W. E. Van Pelt. 1997. Conservation assessment and strategy for the jaguar in Arizona and New Mexico. Technical Report 105, Nongame and Endangered Wildlife Program Program, Arizona Game and Fish Department, Phoenix, AZ. 24 pp.
- Jones, J. K., Jr., R. S. Hoffman, D. W. Rice, C. Jones, R. J. Baker, and M. D. Engstrom. 1992. Revised checklist of North American mammals north of Mexico, 1991. Occasional Papers, The Museum, Texas Tech University, 146:1-23.

- Kitchener, A. 1991. The natural history of the wild cats. Comstock Publishing Associates, Cornell Univ. Press, Ithaca, NY. xxi + 280 pp.
- Lowery, George H. 1974. The mammals of Louisiana and its adjacent waters. Kingsport Press, Inc. Kingsport, TN. 565 pp.
- Mammalian Species, nos. 1-604. Published by the American Society of Mammalogists.
- Medellin, R. A., C. Chetkiewicz, A. Rabinowitz, K. H. Redford, J. G. Robinson, E.W. Sanderson, and A. Taber. 2000. El Jaguar en el nuevo milenio. Una evaluacion de su estado, deteccion de prioridades y recomendaciones para la conservacion de los jaguares en America. Universidad Nacional Autonoma de Mexico/Wildlife Conservation Society. Mexico D. F., Mexico.
- New Mexico Department of Game and Fish. 1996. October 1-last update. Fish and Wildlife Information Exchange-VA Tech. Online. Available: http//www.fw.vt.edu/fishex/nm.html. Accessed 1997, April 8.
- Nowak, R. 1994. Jaguars in the United States. Endangered Species Technical Bulletin 19(5):6.
- Nowak, R. M. 1991. Walker's mammals of the world. Fifth edition. Vols. I and II. Johns Hopkins Univ. Press, Baltimore. 1629 pp.
- Nowak, R. M. 1999. Walker's mammals of the world. Johns Hopkins University Press, Baltimore, MD. Two volumes, 1,936 pp.
- Nowell, K. and P. Jackson (compilers and editors). 1996. Wild cats. Status survey and conservation action plan. IUCN/SSC Cat Specialist Group. IUCN, Gland, Switzerland.
- Pacheco, V., H. de Macedo, E. Vivar, C. Ascorra, R. Arana-Cardó, and S. Solari. 1995. Lista anotada de los mamíferos peruanos. Conservation International, Washington, DC.
- Perry, R. 1970. The world of the jaguar. 168 pp.
- Phelps, J. Jaguar (*Panthera* onca). Unpublished article prepared for University of Arizona Extension Service in house Beaver Transplant Meeting. Game Branch, Wildlife Managment Division, Arizona Game and Fish Department.
- Quigley, H. B., and P. G. Crawshaw, Jr. 1992. A conservation plan for the jaguar *Panthera onca* in the Pantanal region of Brazil. Biological Conservation 61:149-157.
- Russell, Dennis N. 1971?. History and status of the felids of Texas. Presentation at “Symposium on the Status and Management of the Wild Cats of North America”; North American Wildlife and Natural Resources Conference; Portland, Oregon; A Contribution of Federal Aid in Wildlife Restoration Project Texas W-103-R.
- Redford, K. H. and J. F. Eisenberg. 1992. Mammals of the Neotropics, The Southern Cone, Volume 2, Chile, Argentina, Uruguay, Paraguay. Chicago, The University of Chicago Press.
- Sanderson, E. W., K. H. Redford, C.-L. B. Chetkiewicz, R. A. Medellin, A. R. Rabinowitz, J. G. Robinson, and A. B. Taber. 2002. Planning to save a species: the jaguar as a model. Conservation Biology 16:58-72.
- Schmidly, D. J. 2004. The mammals of Texas. Revised edition. University of Texas Press, Austin. xviii + 501 pp.
- Seymour, K. L. 1989. *Panthera onca*. Am. Soc. Mamm., Mammalian Species No. 340:1-9.
- Silver, S. C., L.E.T. Ostro, L. K. Marsh, L. Maffei, A. J. Noss, M. J. Kelly, R. B. Wallace, H. Gómez, and G. Ayala. 2004. The use of camera traps for estimating jaguar *Panthera onca* abundance and density using capture/recapture analysis. Oryx 38:148-154.

- Swank, W. G., and J. G. Teer. 1989. Status of the jaguar - 1987. Oryx 23(1):14-21.
- Tirira, D. 1999. Mamíferos del Ecuador. Museo de Zoología, Pontificia Universidad Católica del Ecuador, Quito.
- Van Pelt, W. E., and T. B. Johnson. [In prep.]. Conservation agreement for the jaguar in Arizona and Mew Mexico. Nongame and Endangered Wildlife Program Technical Report 105. Arizona Game and Fish Department, Phoenix, Arizona.
- Wallace, R. B., H. Gomez, G. Ayala, and F. Espinoza. 2003. Camera trapping for jaguar (*Panthera onca*) in the Tuichi Valley, Bolivia. Mastozoología Neotropical 10:133-139.
- Weber, W., and A. Rabinowitz. 1996. A global perspective on large carnivore conservation. Conservation Biology 10:1046-1053.
- Whitaker, J. O., Jr. 1980. The Audubon Society field guide to North American mammals. Alfred A. Knopf, New York. 745 pp.
- Wilson, D. E., and D. M. Reeder (editors). 1993. Mammal Species of the World: a Taxonomic and Geographic Reference. Second Edition. Smithsonian Institution Press, Washington, DC. xviii + 1206 pp. Available online at: http://www.nmnh.si.edu/msw/.
- Wilson, D. E., and D. M. Reeder (editors). 2005. Mammal species of the world: a taxonomic and geographic reference. Third edition. The Johns Hopkins University Press, Baltimore. Two volumes. 2,142 pp.

Cochise Pincushion Cactus (*Coryphantha robbinsorum*)

The Cochise pincushion cactus was designated as a federally Threatened species on January 9, 1986.

Historic Range: Cochise Co., Arizona and Sonora, Mexico. Despite intensive searching, this species is known only from 1 population in southeastern Arizona and 1 in adjacent Sonora, Mexico. Most of the plants are concentrated in small pockets of this tiny range, making the species especially vulnerable to cactus poachers; also potentially threatened by pesticides and mining.**Habitat Comments:** Grey limestone hills within a semidesert grassland, with small shrubs, other succulents, and grama grasses. About 1280 m elevation.

Threats: Habitat destruction from grazing, exploration and potential drilling for oil; collection; and off-road vehicles.

Reproduction: Lower reproduction rate than most cacti - estimated average annual production is 3 fruits with 20 seeds per plant.

References:

- Benson, L. 1982. The Cacti of the United States and Canada. Stanford Univ. Press, Stanford, California. 1044 pp.
- Kartesz, J.T. 1994. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. 2nd edition. 2 vols. Timber Press, Portland, OR.
- Kartesz, J.T., and R. Kartesz. 1980. A synonymized checklist of the vascular flora of the United States, Canada and Greenland. Vol. 2. The biota of North America. Univ. of North Carolina Press, Chapel Hill. 500 pp.
- Lopresti, V. 1984. *Coryphantha robbinsorum* en Mexico. Cactus and Succulent J. Mexico 29: 81.
- Rutman, S. 1992. Handbook of Arizona's endangered, threatened, and candidate plants. U.S. Fish and Wildlife Service. Phoenix, AZ. 30 pp.
- U.S. Fish and Wildlife Service. 1985. Proposal to determine *Coryphantha robbinsorum* (Cochise pincushion cactus) to be a threatened species. Federal Register 50(44): 9083-9086.
- U.S. Fish and Wildlife Service. 1986. Endangered and threatened status for *Coryphantha robbinsorum*. Federal Register 51(6): 952-956.

Lemmon Fleabane (*Erigeron lemmonii*)

The Lemmon fleabane was designated as a Federal Candidate species on December 6, 2007.

Historic Range: Known from a single canyon in the Huachuca Mountains, Cochise County, Arizona. Despite extensive searching for several years, only this one population is confirmed.

Habitat Comments: Crevices and ledges in limestone canyon walls and on vertical faces of large boulders along canyon bottoms. Surrounding vegetation is pine-oak woodland. 1920-2225 m elevation.

Threats: The greatest threat to *Erigeron lemmonii* is wildfire, which could be intense in the narrow canyon; an intense fire could directly kill individuals, desiccate plants, and alter habitat (Falk 2004). Measures have been taken to reduce the threat of wildfire (Falk 2004). Most plants are on cliff faces well above the heavy fuel loads (Stone 2003). Other potential threats include extended drought, major rock falls, and unauthorized rock climbing (Warren et al. 1991 cited by Stone 2003). Because the species is only known from one population, it is also especially vulnerable to catastrophic events. A management plan for the species has been developed. Rappelling, smoking, and leaving the trail are prohibited in Scheelite Canyon (Stone 2003).

Environmental Specificity: Narrow. Specialist or community with key requirements common.

Environmental Specificity Comments: Known only from crevices and ledges of west, south and north facing cliffs, and on vertical faces of large boulders along a single canyon. It is found on substrates of sandy silicate or granitic soils, and limestone outcrops, between 1920-2225 m (6,300-6,600 ft) elevation.

References:

- Arizona Ecological Services Field Office. 2001. September last update. Lemmon fleabane (*Erigeron lemmonii*) general species information. U.S. Fish and Wildlife Service, Southwest Region 2. Online. Available: http://www.fws.gov/arizonaes/lemmon.htm (accessed 19 January 2006).
- Arizona Game and Fish Department. 2004. *Erigeron lemmonii*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, AZ. 5 pp.
- Falk, M. 2004. June-last update. Species Assessment and Listing Priority Assignment Form: *Erigeron lemmonii.* U.S. Fish and Wildlife Service, Endangered Species Program. Online. Available: http://ecos.fws.gov/docs/candforms_pdf/r2/Q0QA_P01.pdf. Accessed 2005, November 30.
- Kartesz, J.T. 1994. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. 2nd edition. 2 vols. Timber Press, Portland, OR.
- Kearney, T.H., R.H. Peebles, and collaborators. 1951. Arizona flora. 2nd edition with Supplement (1960) by J.T. Howell, E. McClintock, and collaborators. Univ. California Press, Berkeley, CA. 1085 pp.
- Rutman, S. 1992. Handbook of Arizona's endangered, threatened, and candidate plants. U.S. Fish and Wildlife Service, Phoenix, AZ.
- Stone, S. 2003. Management plan template for species at risk on DOD installations: *Erigeron lemmonii*. U.S. Army, Fort Huachuca, AZ.
- U.S. Fish and Wildlife Service. 2002. Candidate and listing priority assignment form: *Erigeron lemmonii*. USFWS, Arizona Ecological Serivices Field Office, Tucson Sub-office.

- U.S. Fish and Wildlife Service. 2005. Endangered and Threatened Wildlife and Plants; Review of Native Species that are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions; Proposed Rule. Federal Register May 11, 2005, Vol. 70, No. 90: 24870-24934.

Huachuca Water Umbel (Cienega False Rush) (*Lilaeopsis schaffneriana* var. *recurva)*

The Huachuca water umbel was designated as a federally Endangered species on January 6, 1997.

Historic Range: The distribution of *Lilaeopsis schaffneriana* var. *recurva* ranges throughout southeastern Arizona and adjacent Sonora, Mexico from Sonoita Creek on the west to Rio San Bernadino on the east. Historically the species reached north to Tucson and south to Cananea, Sonora. The Tucson population along the Santa Cruz River (type locality) no longer exists, presumably due to the loss of perennial flow in this area. The taxon is restricted within this range to small sites with specific wetland requirements. As of 1991, a total of 10 locations in the U.S. and 6 in Sonora, Mexico are known.

Technical Description: An herbaceous semiaquatic perennial with slender erect leaves that grow from the nodes of creeping rhizomes. The rhizomes are usually very shallow, only 1-2 cm underground. They occasionally run along the bottom of still ponds and are generally white. Rhizomes branch freely and may form dense mats in the sand or mud streambed, making it impossible to identify individual plants. The cylindrical hollow leaves, which are typically borne two or three per node, have septa at irregular intervals. The pale green leaves are generally 1-3 mm in diameter, but their length varies depending upon the microhabitat in which they grow. When growing out of the water in wet soil near a stream, the leaves are often only 3-5 cm tall; growing in water that supports their weight, leaves up to 20 cm or more have been observed (Affolter 1985). Three to 10 tiny flowered umbels arise from root nodes. The inflorescence peduncles are typically 1-5 cm tall and always shorter than the leaves. Peduncle length also varies depending upon microhabitat; when growing out of the water they may be only 1-2 cm long, but when under water they may reach 6-7 cm. The flowers are 1-2 mm wide with tiny maroon-tinted petals. The fruits are globose, 1.5-2 mm in diameter, and usually slightly longer than wide.

Diagnostic Characteristics: *Lilaeopsis schaffneriana* var. *recurva* grows in perennial, shallow and slow-moving water. Such sites are rare in southeastern Arizona and northern Sonora, Mexico. *Lilaeopsis* is difficult to locate in the field, in part because it usually occurs with and resembles another small wetland species, *Eleocharis charibea*. *Lilaeopsis* has semisucculent leaves that are somewhat flexuous, whereas *Eleocharis* leaves are pithy, strictly straight and not at all succulent. The leaves of *Lilaeopsis* also appear to be a pale yellow-green compared to the darker green of most co-occurring herbaceous species.

Ecology Comments: Affolter (1985) observed flowering specimens from collections made in June and August and fruiting specimens from May and July through early September. Nature Conservancy botanists have observed Lilaeopsis flowering abundantly only once (April 1988), as the local conditions were drying out at Cottonwood Spring along Sonoita Creek. Flowering at low frequency has also been observed from March through October. Affolter (1985) suspects that other members of the genus Lilaeopsis self-pollinate. Seed germination from plants grown in an aquarium has been observed. The seeds stuck to the aquarium sides after falling from the parent plants and germinated within 1-2 weeks after ripening (Warren, pers. comm.). Although seeds from *Lilaeopsis schaffneriana* var*. recurva* appear to germinate easily, vegetative reproduction via rhizomatous spreading and dispersal of dislodged clumps is clearly important. Liz Ecker, curator of the Living Collection at the Desert Botanical Garden, has a living specimen which has flowered and born fruit, but she has done no germination studies with the taxon to date (L. Ecker, pers. comm.). An experimental transplant program for *Lilaeopsis* was conducted at the San Bernadino National Wildlife Refuge in 1991 in order to establish a second secure population on the refuge that would be less vulnerable to destructive flooding than the existing population on Black Draw. Aside from securing a population, the project allows us to learn more about the ecology and habitat of the species for future management (Warren 1991). Three transplant sites were chosen at perennial ponds. The first transplant took place August 26, 1990; the two subsequent transplants were made on March 2, 1991, with follow-up monitoring of the transplants done on April 26, 1991. The three transplant sites yielded different results. *Lilaeopsis* could not be relocated at the first transplant site. Competition with other herbaceous plants appeared to have wiped out the transplanted colony. At the second site the *Lilaeopsis* transplant persisted, but due to a moderate amount of surrounding competitive vegetation, the patch did not grow beyond its original 5-inch diameter. However, the third site which was relatively free of competing vegetation, showed tremendous growth and vigor - increasing from 5 inches to approximately 2 feet in diameter over the 1.5-month period. The major conclusion is that *Lilaeopsis* can not survive where there is heavy competition from other herbaceous aquatic plants. Shallow standing water, in contrast to flowing streams, is grown in quickly with aquatic vegetation. Therefore *Lilaeopsis* grown at ponds may need special management to reduce density and accumulated litter from competing vegetation. *Lilaeopsis* is a vulnerable taxon which is easily destroyed by heavy flooding and scouring of habitat, although it also appears to need some amount of disturbance to the habitat in order to decrease surrounding competitive vegetation. *Lilaeopsis* appears to grow year round in the absence of killing frost whereas other aquatic plants tend to die off during the winter, allowing *Lilaeopsis* to more effectively colonize open space following low-level disturbance.

Census data: The Nature Conservancy established and monitored transects at three *Lilaeopsis* locations in 1989. Transects were established at Scotia Creek and Bear Creek in the Huachuca Mountains and another at Cottonwood Spring along Sonoita Creek near Patagonia. The location (distance along the transect), length, and width of every *Lilaeopsis* patch along permanent transects was recorded. The density of leaves in each patch was also estimated using a rank scale. Lowest density patches received a 0.5 ranking, and highest density patches ranked 3.0. The rank-density value for a sample of patches was correlated with actual stem counts in 12cm x 12cm quadrants to calibrate the scale. Using these counts, a mean density (number of stems per 0.01 square meters) was calculated for each density rank (Gori et al. 1990). Density and coverage of *Lilaeopsis* varies greatly from site to site. Percent coverage of *Lilaeopsis* varied among the sites from 11.5% to 58.3%; of the total area occupied by *Lilaeopsis*, 10.4% to 75.3% had a density value of 2.0 or greater. For specific data see Gori et al. (1990). Together these data provide a profile of the distribution and density of *Lilaeopsis schaffneriana* var. *recurva* along transects in 1989. Similar measurements in subsequent years will indicate what changes have occurred in these streams. The fate of individual patches can also be tracked since the position, length, width and estimated leaf density of every patch is mapped along each transect.

Related species: The genus *Lilaeopsis* contains 13 species of perennial, rhizomatous herbs which live in temperate and alpine regions of North and South America and Australasia. These plants grow in damp, marshy and aquatic habits, often in brackish water. *Lilaeopsis schaffneriana* is one of 4 strictly freshwater species in the genus. It occurs in southeastern Arizona, central and northern Mexico and northwestern South America (Affolter 1985). There is a great deal of morphological variation within *Lilaeopsis schaffneriana*. Some is due to local environmental conditions, as Affolter (1985) showed when he reared plants from the same stock in different depths of water and got great differences in leaf length. Genetic differences, on the other hand, could easily arise among small populations which grow primarily by rhizomatous spreading. Affolter (1985) recognized the Arizona populations as a distinct subspecies based on differences in fruit shape as well as the major geographical gap across the continental divide between the ranges of the Arizonan and Mexican groups. *Lilaeopsis schaffneriana* var. *recurva* inhabits disjunct locations in southeastern Arizona and northern Sonora. Known locations for *Lilaeopsis schaffneriana* var. *schaffneriana* are similarly separated on the central plateau of central and southern Mexico. This kind of distribution is expected for an aquatic species surrounded by arid lands. Affolter expressed suspicion that the discontinuity between the subspecific ranges might reflect a lack of exploration for the plant. However, it is significant that the two subspecies of Lilaeopsis are found on opposite sides of the continental divide. So the predominant dispersal mechanism for the species, water, could not serve to mix populations (Warren 1991). *Lilaeopsis masonii* is a candidate category 2 species of northern California. It grows along the margins of rivers, sloughs, and islands of the San Joaquin-Sacramento River delta (California Fish and Game 1988); there are approximately 30 known occurrences. *Lilaeopsis masonii* differs from L*. schaffneriana* var. *recurva* in that it is found in intertidal zones of brackish water marsh. It grows far enough inland so it does not grow directly in salt water as some species of *Lilaeopsis*, but the water is brackish and the plants do experience tidal fluctuation (R. Bittman, pers. comm.). *Lilaeopsis masonii* grows in dense mats at water margins. Associated species are: marsh pennyworts (*Hydrocotyle umbellata* and *H. verticillata*), three-ribbed arrow grass (*Triglochin striata*), mudwort (*Limosella subulata*), tules (*Scirpus* spp.), rushes (*Juncus* spp.), and Suisun marsh aster (*Aster chilensis* var. *lentus*). *Lilaeopsis masonii* grows from an elevation of sea level to 25 feet. It flowers from April to October. Little is known about the ecology/biology of this species (R. Bittman, pers. comm.). The primary threats to *Lilaeopsis masonii* are proposed water projects which involve dredging, rip-rapping, levee construction, and other alterations to natural banks and river channels. Heavy cattle grazing also occurs at some of the sites. Petroleum processing plants exist in the area and the species is vulnerable to oil spills. One spill impacted two populations in 1988. The long-term effects of oil on the species is unknown (California Fish and Game 1988). No recovery programs are currently necessary for *Lilaeopsis masonii*, but the species is of interest here because proposed management for the species includes an experimental transplant program. Rip-rap work has been proposed along Barker's Slough in Solano County. This could potentially destroy dense colonies of *Lilaeopsis masonii*. A project to transplant all *Lilaeopsis masonii* at the rip-rap sites to suitable habitat has been proposed. Information gained from California's transplant program may prove useful to our efforts at managing *Lilaeopsis schaffneriana* var. *recurva*.

Habitat Comments: Cienegas (mid-elevation wetland communities), riverine systems, and springs at about 1150-2130 m elevation. Usually in wet soils along the periphery of a channel, in backwaters, or in small openings in the understory near springs. Does not tolerate much competition with other species, but will quickly colonize open habitat created by scouring floods and persist there until interspecific plant competition becomes too great. In order for populations to expand, some plants must remain in areas that escape the effects of periodic scouring floods. *Lilaeopsis schaffneriana* var. *recurva* is restricted to cienega habitats, which are marshy or meadow-like wetlands surrounded by semiarid vegetation (Warren 1991). Hendrickson and Minckley (1984) describe three different types of cienegas based on elevation: low, mid, and high elevation cienegas. Low elevation cienegas or subtropical marshes occur mostly along major perennial rivers below 3000 feet. The low elevation Lileaopsis sites have experienced the most disturbance both human and natural. Low elevation cienega habitats were probably river backwaters and floodplain seeps. These locations are very unstable, experiencing cycles of flooding and drying due to varying climatic patterns. Human influence including groundwater pumping and diversion of water for irrigation have eliminated perennial flow in most southeastern Arizona rivers. Perennial flow is essential for wetland formation. This loss of habitat is evident in the disappearance of 4 historic locations of the taxon. Grazing has added to the problem by contributing to watershed deterioration, which exacerbates erosive flooding and further destabilizes cienega habitats. There are 2 known sites occurring at low elevation on the same stream; one is in the San Bernadino National Wildlife Refuge, in the U.S., and the other in Sonora, Mexico near the border along the Rio San Bernadino. Mid-elevation cienegas occur between 3000-6000 feet. This elevation range fits Hendrickson and Minckley's (1984) definition of true cienega habitat. Permanent water is available and a unique wetland community has developed at these sites (Warren 1991). Flooding potential is lower at these cienega sites because they have smaller drainage areas. Also, the gradients are gentler at these mid-elevation sites as opposed to the higher elevation cienegas. There are 6 current U.S. locations for *Lilaeopsis* at mid-elevation sites, and 4 in Sonora; they are: Bear Canyon, Lone Mountain Canyon, Cottonwood Spring, San Rafael Valley (3 springs) and Turkey Creek in Arizona, and Ojo de Agua de Cananea, Rio San Rafael, Arroyo Los Fresnos and along the Rio Magdalena in Sonora. Flooding, however, is still a potential problem at this elevation range as demonstrated by the population at Cottonwood Spring, which was seriously reduced by flooding from Hog Canyon in 1988. Grazing also has a negative impact on this watershed. High elevation cienegas occur at elevations over 6000 feet. They are described by Hendrickson and Minckley (1984) as "marshy to bog-like alpine and cold temperate meadowland." They may form in surface depressions that fill with water or at stream headwaters. There are few potential sites for *Lilaeopsis* at these elevations because usually these higher sites are in canyons with stream gradients too steep to support cienega wetlands. Three high elevation sites of *Lilaeopsis* are known in the Huachuca Mountains. One is in upper Scotia Canyon and another in upper Garden Canyon. An additional *Lilaeopsis* population is reported in Sunnyside Canyon from 6050-6200 feet (S. McLaughlin, pers. comm.). The surrounding vegetation of the cienega communities varies with elevation. Willow (*Salix* spp.) and cottonwood (*Populus* spp.) trees, cattails (*Tyogys* spp.), large reeds, bulrush (*Scirpus* spp.), and halophytes in nearby saline areas are typical of desert-scrub communities of the low elevation cienega sites. Rushes, grasses, fewer cattails, semiaquatic sedges, watercress (*Nasturtium officinale*), water pennywort (*Hydrocoytle americana*), halophytes in adjacent saline areas, and trees (not as common with willows being the most common) are the dominant species of the grassland/oak woodland habitat of mid-elevation cienegas. Finally, the high elevation community is conifer forest including cold-resistant sedges and rushes, semiaquatic and terrestrial grasses, and low, woody alder (*Alnus* spp.) and willow (*Salix* spp.) shrubs. Physical factors, particularly hydrological conditions such as watershed area and stream gradient, appear to limit the distribution of *Lilaeopsis schaffneriana* var. *recurva*. The taxon appears to have specific requirements which limit its distribution to perennial water, gentle stream gradients, small- to medium-sized drainage areas and mild winters. Weather and precipitation data (NOAA 1986) from stations within the range of Lilaeopsis: At Canelo 1 NW station in Santa Cruz County, the data are summarized as follows: elevation 5010'; N latitude 31 33'; W longitude 110 32'; mean annual precipitation 17.06"; January mean temperature (F) 42.2; July mean temperature (F) 74.2; and annual mean temperature (F) 57.2.

At Douglas FAA station in Cochise County, the data are summarized as follows: elevation 4098'; N latitude 31 28"; W longitude 109 36'; mean annual precipitation 12.16"; January mean temperature (F) 44.9; July mean temperature (F) 79.1; and annual mean temperature (F) 61.6. Because the *Lilaeopsis* sites are so dispersed, climatic data provided here are relatively non-specific. Populations inhabit the physiographic province known as the Sonoran Desert Section of Basin and Range. The hydrologic regime appears to be a critical aspect of *Lilaeopsis* habitat. In an effort to characterize hydrologic conditions at each site, we estimated site substrate stability and watershed gradient above the site based on visual observations of the sites. We have made a somewhat arbitrary classification of stream channel conditions at each site as "stable" or "unstable" based on the condition of herbaceous vegetation along the stream bank and channel: stable sites are those where the stream banks, and part or all of the channel, are well stabilized by herbaceous vegetation; unstable sites are those where the channel and much of the banks are unconsolidated, shifting alluvium. Under present watershed conditions, 10 square miles appears to be a watershed size threshold above which flooding is too severe for *Lilaeopsis* to persist, although larger watershed area may be mitigated by low gradient, as at San Bernadino. This taxon does not tolerate much competition with other species, but will quickly colonize habitat disturbed by scouring floods and persist there until interspecific plant competition becomes too great. In order for populations to expand, some plants must remain in areas that escape the effects of periodic floods (Rutman and Rorabaugh 1995).

Stewardship Overview: High priority needs include protecting perennial stream flow through acquisition of water rights; management of the watershed to assume a good vegetative cover by perennial grasses to prevent scouring floods and monitoring known populations to detect downward trends if they occur. Working with private landowners is a high priority since several sites are on private land.

Restoration Potential: At present there is not enough evidence of a decline in the populations to require a recovery program. However, it is important to maintain existing populations at their present levels to guard against any possible future decline. The species shows evidence of successful reproduction at all known sites indicating a high recovery potential. The experimental transplant program at San Bernadino shows a high survivorship rate given suitable growing conditions (ie. few surrounding competitive species).

Preserve Selection & Design Considerations: Adequate protection of *Lilaeopsis* populations requires consideration of the direct site impacts as well as indirect effects of water supply and watershed condition. Therefore, primary site boundaries may be relatively small and include only the wetland habitat where *Lilaeopsis* is found. Secondary site boundaries should include key portions of the watershed to be managed for maintenance of water supply and erosion control. An important protection consideration is the acquisition of water rights to ensure stable future water levels. Various privately owned sites should be protected through continuing land owner education and assistance. These sites should be put in protective ownership if the opportunity presents itself.

Management Requirements: The primary management need of *Lilaeopsis schaffneriana* var. *recurva* is to protect the cienega habitat that supports known populations. Management procedures include protecting water supplies by acquiring instream flow water rights and managing watersheds to reduce flood frequency and intensity. Continued monitoring of the known populations and surveys for other potential locations should also be part of the management procedure. Recreation management may be necessary at some local populations. Prescribed burns may be essential for certain populations to reduce the density of accumulated litter from competing vegetation.

Monitoring Requirements: Continued monitoring every other year of existing populations is needed in order to determine whether the populations are stable, increasing or declining and subject to nearby threats. Three of the 12 known sites have been monitored by The Nature Conservancy since 1989. The percent coverage and density of the species were determined along transects (Gori et al 1990).

Management Programs: This element is not being actively managed.

Monitoring Programs: One program underway since 1989. Contact: Peter Warren, Public Lands Protection Planner, The Nature Conservancy, Arizona Field Office, Tucson, Az.

Management Research Programs: One research program involving transplant populations was conducted by The Nature Conservancy in 1991 and is being monitored at the San Bernadino National Wildlife Refuge.

References:

- Affolter, J. M. 1985. A monograph of the genus Lilaeopsis (Umbelliferae). Systematic Botany Monographs. Vol. 6. American Society of Plant Taxonimists. 140 pp.
- Affolter, J.M. 1985. A monograph of the genus Lilaeopsis (Umbelliferae). Systematic Botany Monographs 6: 1-140.
- California Department of Fish and Game Endangered Plant Project and the Natural Diversity Data Base. 1988. California Native Plant Status Report: *Lilaeopsis masonii*. California Dept. of Fish and Game, Sacramento, CA.
- Correll, D.S., and H.B. Correll. 1972. Aquatic and wetland plants of southwestern United States. 2 volumes. Stanford Univ. Press, Stanford, CA. 1777 pp.
- Gori, D.F., P.L. Warren and L.S. Anderson. 1990. Population studies of sensitive plants of the Huachuca, Patagonia and Atacosa Mountains, Arizona. Submitted to Coronado National Forest in completion of P. O. 40-8197-9-0119. The Arizona Nature Conservancy, Tucson, AZ.
- Hendrickson, D. A. and W.L. Minckley. 1984. Cienegas: Vanishing climax communitites of the American Southwest. Desert Plants 6(3): 1-175.
- Hill, A. W. 1927. The genus LILAEOPSIS: a study in geographical distribution. Journal of the Linnaeus Society of Botany 47:525-551.

- Kartesz, J.T. 1994. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. 2nd edition. 2 vols. Timber Press, Portland, OR.
- Kartesz, J.T. 1999. A synonymized checklist and atlas with biological attributes for the vascular flora of the United States, Canada, and Greenland. First edition. In: Kartesz, J.T., and C.A. Meacham. Synthesis of the North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, NC.
- Kartesz, John T. 1991. Synonym names from 1991 checklist, as extracted by Larry Morse, TNC, June 1991.
- Kearney, T.H., R.H. Peebles, and collaborators. 1951. Arizona flora. 2nd edition with Supplement (1960) by J.T. Howell, E. McClintock, and collaborators. Univ. California Press, Berkeley, CA. 1085 pp.
- NOAA. 1986. Climatological data annual summary: Arizona 90 (13). U.S. Department of Commerce, National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC.
- Rutman, S. 1992. Handbook of Arizona's endangered, threatened, and candidate plants. U.S. Fish and Wildlife Service, Phoenix, AZ.
- Rutman, S., and J. Rorabaugh. 1995. Endangered and threatened wildlife and plants: Proposal to determine endangered status for three wetland species found in southern Arizona and northern Sonora. Federal Register 60(63): 16836-16846.
- Shreve, F., and I.L. Wiggins. 1964. Vegetation and flora of the Sonoran Desert. 2 volumes. Stanford Univ. Press, Stanford. 1740 pp.
- U.S. Fish and Wildlife Service. 1993. Endangered and threatened wildlife and plants; review of plant taxa for listing as endangered or threatened species. Federal Register, 50 CFR Part 17, 58(188):51144-51190.
- Warren, P. L., D.F. Gori, L.S. Anderson and B.S. Gebow. 1991. Status report: *Lilaeposis schaffneriana* var. *recurva.* Submitted to : U.S. Fish and Wildlife Service. The Arizona Nature Conservancy, Tucson, AZ.
- Warren, P.L. 1991. Reconvery of *Lilaeopsis schaffneriana* var. *recurva* at San Bernadino National Wildlife Refuge. Submitted to : U.S. Fish and Wildlife Service. The Arizona Nature Conservancy, Tucson, AZ.
- Warren, P.L., L.S. Anderson and P.B. Shafroth. 1989. Population studies of sensitive plants of the Huachuca and Patagonia Mountains, Arizona. Submitted to Coronado National Forest in completion of P.O. No. 40-8197-9-431. The Arizona Nature Conservancy, Tucson, AZ.

Madrean (Canelo Hills) Ladies Tresses (*Spiranthes delitescens*)

The Madrean ladies tresses was designated as a federally Endangered species on January 6, 1997.

Historic Range: Four populations of *Spiranthes delitescens* have been found in Arizona: Cochise County, above the dam in Babocomari Cienega; Santa Cruz County, along Turkey Creek, at O'Donnell Cienega, and on a slope below Sheehy Spring (Sheviak 1990). This species most likely exists in Mexico; however, to date, no plants have been located south of Arizona (Sheviak 1990). The occurrence of other populations of this species of Ladies' Tresses in the United States is probably unlikely due to the limited available sites possessing the specific habitat parameters which appear to be required by these plants (Sheviak 1990).

Diagnostic Characteristics: *Spiranthes delitescens* can be distinguished from other Mexican and southwestern United States *Spiranthes* species by the shape of its medium-sized flowers: the floral tube curving into a horizontal apex and an ascending base, and the sepals curving outward and downward. In addition, the pubescence is distinct; the trichomes are glandular-capitate and taper at the apex. Cytological differences between *S*. delitescens and other *Spiranthes* species also exist (Sheviak 1990).

Reproduction Comments: Flowers, Pollination and Hybridization: Orchid flowers have a unique morphology which has coevolved with their pollinators (van der Pijl and Dodson 1966). A large petal, called the labellum or lip, acts as a landing platform for many pollinators. In *Spiranthes* spp., balls of sticky pollen grains, pollinia, are positioned near the column (the partially united stamen and pistil) in such a way that when the pollinator enters the floral tube, on its way to the nectaries, it inadvertently triggers the rostellum causing the pollinia to be deposited on the pollinator (van der Pijl and Dodson 1966). Bees are the primary pollinator for *Spiranthes*, with Bombus being the most common genus; other pollinating organisms include flies, moths, and butterflies (van der Pijl and Dodson 1966; Dressler 1981). Within three days of successful pollination, *Spiranthes* flowers dehydrate and become discolored (Catling 1982). One pollinia contains over 10,000 pollen grains. This allows for efficient fertilization of the thousands of ovules in the ovaries of most orchids (van der Pijl and Dodson 1966). Some orchids are self-fertile, but most often fertilization is the result of outcrossing. Self-pollination is advantageous when plants have extended their range into areas not previously inhabited by the species (Dressler 1981). *Spiranthes* are often self-fertilized, and individuals that require cross-pollination are receptive for only 10 to 40 days (Catling 1982). Flowers older than 40 days contain dead ovules (Catling 1982). Within three weeks of pollination the seeds are fully developed and the ovary splits. Usually 100% of *Spiranthes* ovaries expand, but often only 50% of them contain seeds (Catling 1982). Orchids easily hybridize; both inter-specific and inter-generic hybrids occur in the wild (Sanford 1974). In dry climates, flowering often occurs during the rainy season. Flowering of the *Spiranthes* occurs in July, when temperatures range from 60°F at night to 100°F during the day and when the majority of the year's 15 to 20 inches of precipitation falls (Merrigan 1990; The Nature Conservancy Arizona Field Office, pers. comm.). In some cases too much rain, possibly causing a decrease in pollinator activity, results in a decrease in the number of flowers and consequently the number of fruits (Dressler 1981). Most nontropical species release their seeds in the fall at the beginning of the dormant period (Dressler 1981). In addition to moisture dependency, flowering of some species of *Spiranthes* is photoperiodically induced (Catling 1982). The age of sexual maturity is dependent on the species and can range from several years to over twenty years (Stoutamire 1974; B. Jennings, pers. comm. 25 Jan. 1990). Inflorescences first develop in *Spiranthes spiralis* thirteen to fifteen years after seed germination (Wells 1981). Once reproductively mature, the age of the plant is not a factor in flowering, whereas temperature and precipitation appear to be significantly related to the percentage of flowering plants (Wells 1981). *Spiranthes diluvialis* will not bloom in dry years when precipitation levels are atypically low (B. Jennings, pers. comm. 25 Jan. 1990). *S. spiralis* plants which have reverted back to the saprophytic stage are capable of flowering during the initial year of resuming above-ground growth (Wells 1967). The average percentage of flowering *S*. *spiralis* plants over a thirteen year period was 33, ranging from 73% in 1966, 19% in 1970, 43% in 1973, down to 1% after the 1976 drought, and recovering to 31% the following year (Wells 1981).

Ecology Comments: *Spiranthes* of Canelo Hills Cienega and Turkey Creek: The grass-like leaves of the orchid, growing low in the sedge and horsetail fields, are difficult to see for most of the year. The inconspicuous plants are visible July and August when the roughly 20 cm tall inflorescences develop (P. Sundt, pers. comm. 23 Jan. 1990; The Nature Conservancy Arizona Field Office, pers. comm.). The fruits mature approximately three weeks after the flowers form, usually during the end of August, releasing hundreds of tiny seeds from each capsule to be dispersed, probably via the wind (McClaran and Sundt 1992; P. Sundt, pers. comm. 23 Jan. 1990). Many inflorescences are damaged during the summer; Sundt (pers. comm. 23 Jan. 1990) feels that grasshoppers may be responsible for the broken stalks and the chewed capsules. The life-cycle of the plants is unclear. Most likely these orchids are perennial; however, no dormant underground structures have been identified (McClaran and Sundt 1992). Determining the over-wintering structure is difficult without disturbing the plants. The plant may remain below-ground most of the year or, common to many *Spiranthes*, small, inconspicuous leaf rosettes may grow throughout the cool months, hidden by the tall vegetation (McClaran and Sundt 1992; B. Jennings, pers. comm. 25 Jan. 1990). In February, an inspection of approximately 40 flagged areas (presumably indicating the previous year's orchids) revealed no above-ground orchid structures (Newman 1990). Plants rarely flower in consecutive years and the relationship between the flowering plants cannot be elucidated since the growth pattern of the subterranean structures is unknown (McClaran and Sundt 1992). Censusing of the *Spiranthes* at Canelo Hills began in 1978; however, accurate assessment of the demographic patterns is difficult because varying techniques were used during the first eight years of monitoring. With this caveat in mind, the total number of plants in O'Donnell Canyon fluctuated from 40 in 1978, 196 in 1979, dropping to 30 in 1982 through 1984, and then increasing to roughly 80 plants in 1988 (McClaran and Sundt 1992). These data suggests that the number of flowering plants has declined since 1979. Few conclusions can be drawn from the data, considering that the early measurements were based on the number of flowering plants and the later censusing was based on the total number of plants (flowering and not flowering), and that individual plants would appear one year, not appear the following year (no visible above-ground structures), and then reappear in subsequent years. In fact, it is difficult to estimate population size based on counts of aboveground plants due to the lack of information concerning the life-cycle and environmental requirements of *Spiranthes delitescens*. Other species of *Spiranthes* grow initially underground saprophytically for many years, revert back to saprophytic growth when environmental conditions are not favorable and flower irregularly. Population declines followed by recoveries are characteristic of many *Spiranthes*. The plants growing at Turkey Creek appear to be in a plant community characterized by shorter plant height and greater alpha diversity than at Canelo Cienega. Grazers have been excluded from the latter location since 1969, when this part of Canelo Hills was bought by The Nature Conservancy; Turkey Creek is currently grazed (McClaran and Sundt 1992; P. Sundt, pers. comm. 23 Jan. 1990). Thus, although soils and topography of the two sites differ, grazing is also a likely factor differentiating the two sites. The population in Turkey Creek, ranging from hundreds to thousands of plants, appears healthier and more vigorous than the Canelo Hills' population (McClaran and Sundt 1992; M. Heitlinger, pers. comm. 8 Jan. 1990; P. Warren, pers. comm. 25 Jan. 1990). Sundt (pers. comm. 23 Jan. 1990) proposes that the Turkey Creek plants have always been more vigorous than the O'Donnell Creek plants, due to the different characteristics of the particular sites, and that little significant change has occurred in the two populations over time.

Spiranthes and Other Terrestrial Orchids

Seeds and Fruits: Terrestrial orchid fruit are usually thin-walled, dry, and papery (Dressler 1981). Depending upon the species, *Spiranthes* fruit may mature within a few days after fertilization or may take as long as one year to completely develop (Luer 1975). Seeds of terrestrial orchids tend to mature and are dispersed at the end of the plants' growing season, which often coincides with the time of maximum germination (Stoutamire 1974). When fully mature, the valves on the capsule open and the wind-borne seeds are dispersed (Luer 1975). Water and humans have also been implicated in orchid seed dispersal; there is no evidence supporting the involvement of non-human animals (Sanford 1974). Orchid seeds have been found 400 miles from the parent plant; without human intervention, however, dispersal rarely occurs this far (Sanford 1974). Orchid seeds are rudimentary when dispersed; the sole protection of the undifferentiated embryo is the seed coat, and no endosperm or other form of nourishment surrounds the embryonic plant (Luer 1975; B. Jennings, pers. comm. 25 Jan. 1990). Due to the naked, unprotected seed structure a dormancy period is highly unlikely and the period of viability relatively short (Stoutamire 1974; B. Jennings, pers. comm. 25 Jan. 1990). The rapid dispersal, lack of dormancy, requirement for specific fungi, and necessity of precise environmental conditions explains the extremely low seed survival rate of an estimated one in a million (Stoutamire 1974; Luer 1975; B. Jennings, pers. comm. 25 Jan. 1990). Cultivated Orchids: Terrestrial orchids are difficult to grow due to the specific symbiotic associations often required. Dimmitt (pers. comm. 22 Jan. 1990) does not know of any amateur orchidist having successfully germinated and cultivated any member of the genus *Spiranthes*. Although limited, laboratory and greenhouse experiments have uncovered some information on the germination and growth of terrestrial orchids. The seeds of many *Spiranthes* species retain their viability for three years when stored in a refrigerator (Stoutamire 1974). *Spiranthes cernua* seeds germinate readily in sterile water; *S. orchioides* seeds swell with imbibition but fail to germinate (Stoutamire 1974). When placed under a light source after germination, several *Spiranthes* species produce chlorophyll; this indicates an ability to grow autotrophically in the absence of a mycorrhizal associate. However, other species require sterile agar media, containing mineral salts and an external source of organic carbon, indicating an obligate heterotrophic (required mycorrhizal associates) stage (Stoutamire 1974; Dressler 1981; Arditti 1982). Arditti (1982) lists the specific media requirements for laboratory growth of many *Spiranthes* species. No information is available about the early growth requirements of *S. porrifolia* and *S. vernalis*, the putative parents of the southern Arizona plants. When plants are grown in sterile laboratory conditions, light is required for normal development of many early photosynthesizing species, but it may inhibit the germination of the late-photosynthesizing species (Stoutamire 1974). A protocorm develops from the undifferentiated embryo and is the initial external structure when seed germination commences (Sanford 1974; Stoutamire 1974). Two stages of high mortality are found in agar-grown seedlings: the first stage occurs shortly after the protocorm emerges from the seed coat, when it reaches 1 mm to 2 mm in length, and the second stage occurs shortly after the roots develop. In the wild this later stage correlates with the transitional period when the seedling changes from an obligate mycorrhizal dependent to a partly autotrophic organism (Stoutamire 1974). In the lab, seedling growth initially occurs in the downward direction and after several centimeters of growth the apical meristem turns and grows upward (Stoutamire 1974); in *Spiranthes* the protocorm initially forms into the tubercle (Sanford 1974). During the first year of growth, short thickened corms or modified lateral buds, called sinkers, are formed in most terrestrial orchids (Stoutamire 1974). *Spiranthes spiralis* development is expedited by laboratory conditions and within 18 months after the seeds are sown, four green leaves and a 5 mm long tuber are produced (Wells 1981). Enlarged primary structures develop concurrently with the first seedling leaves. Adventitious buds on the stem of some *Spiranthes* species are capable of vegetative reproduction (Stoutamire 1974). In the greenhouse, *S. cernua* and *S. sinensis* develop from a protocorm to a flowering plant in 35 months and 29 months, respectively (Stoutamire 1974).

Germination and Mycorrhizal Associations: Mycorrhizal penetration into the seed and embryo is required for successful germination of most terrestrial orchid seeds; the seedlings are obligate mycorrhizal dependents until aerial shoots and photosynthesizing apparatuses have developed (Dressler 1981). The abundance of hair-like projections on the non-photosynthesizing protocorms may allow for rapid mycorrhizal association (Stoutamire 1974). Results from laboratory studies suggest a more rapid germination and development period in the early photosynthesizing species than in the late photosynthesizing species, possibly due to a facultative, rather than obligate, relationship of the former species with the fungus (Stoutamire 1974). Most often chlorophyll does not develop for several months even in the early photosynthesizing species (Dressler 1981). Wells' (1981) results indicate that juvenile orchids remain underground and thus without chlorophyll for greater than one year and maybe as long as fifteen years. As the plant ages, the dependency on fungi is reduced; however, most mature terrestrial orchid roots are associated with endophytic fungi (Warcup 1975, Dressler 1981). Most of the rapidly photosynthesizing protocorm species require sunlight to germinate and often grow in sunny wet areas, characteristic of open marshes and bogs (Stoutamire 1974; Dressler 1981). Whereas germination of most of the non-photosynthesizing protocorm species is inhibited by light, these species grow in well-drained forest soils or open, seasonally dry grasslands (Stoutamire 1974; Dressler 1981). Thus species that grow in cienegas, such as the southern Arizona plants, are presumably early photosynthesizers. Mycorrhizal fungi are required to supply the embryo with needed enzymes and nutrients early in the growth of the seedling; minerals, vitamins and an available organic carbon source are essential to the development of the plant (Stoutamire 1974; Luer 1975; Dressler 1981). The species-specificity of the fungi-orchid symbiosis is ambiguous and is thought to decrease as the plant ages (Warcup 1975). Several different species of fungi are associated with most roots, and taxonomic relationships between fungi and orchid species appear to exist (Warcup 1975; Dressler 1981). Environmental conditions will affect the fungi-orchid relationship; high levels of nitrogen and low soil pH may reduce the likelihood of fungal penetration into the seed, thus decreasing the germination rate (Warcup 1975). The absence of visible growth of an orchid plant does not imply dormancy or death of the plant (Stoutamire 1974). Often orchids grow below-ground for several years without emerging from the soil, receiving nourishment from fungal assimilates (Stoutamire 1974). Some terrestrial orchids have grown saprophytically and remained underground for fifteen years (Sanford 1974). *Spiranthes spiralis* grows saprophytically, solely as a mycorrhizal-rhizome type structure, for eight years before a tuber is produced and a total of eleven years before aerial stems are produced (Wells 1981).

Vegetative Growth and Population Fluctuations: Orchids may grow vegetatively for many years before flowering. *Cypripedium candidum* requires more than twelve years to reach reproductive maturity (Bender 1986) and some *Spiranthes* only bloom every twenty years (B. Jennings, pers. comm. 25 Jan. 1990). Underground structures include tubers, corms, sinkers, roots, and storage roots (Stoutamire 1974). Vegetative propagation occurs through the growth of buds on lateral underground stems, and newly formed plants eventually separate from the parent plant (Wells 1967). Orchids do not produce typical primary roots and most growth occurs in the secondary root system (Stoutamire 1974). The roots of most terrestrial orchids which grow in moist areas occur above the water-line, allowing for the provision of sufficient amounts of oxygen (Dressler 1981). Depending on the species, above-ground vegetative growth may continue year-round or only during the warm growing season. The normally slow growth rate often decreases in the cool season and small over-wintering leaf rosettes may form (B. Jennings, pers. comm. 25 Jan. 1990). *Spiranthes spiralis*, growing in the grasslands of England, are green year-round; leaf rosettes are present when the plants are not in bloom (Wells 1981). In January, a mature plant will contain two mature tubers produced the previous year and a small protuberance, which will develop into the following year's tuber. Plants of this species produce no roots, thus the tuber and fungi are responsible for obtaining the necessary nutrients and water. In July the leaf rosettes die and by August new leaves are formed and a flowering stalk develops (Wells 1981). Stable communities, with a relatively fixed number of mature plants, often have high seedling mortality (Stoutamire 1974). However, terrestrial orchid populations often display great fluctuation within several year periods (Luer 1975). Colonies of many *Spiranthes* species are often labile and above-ground parts may appear and disappear in alternating years (Luer 1975). Population size can alternate from several to hundreds to thousands and back down to several plants in a few years (B. Jennings, pers. comm. 25 Jan. 1990). Plants of *Spiranthes diluvialis* in one location fluctuated from 5500 visible flowering plants in 1986 to 200 plants in 1989, whereas another population, experiencing similar weather conditions and apparently no different management practices, did not have a large flux in population size (B. Jennings, pers. comm. 25 Jan. 1990). One population of *Spiranthes spiralis* went from 420 plants in 1963 to 1050 plants in 1969 (Wells 1981); however, the population size of *Spiranthes spiralis* usually remains relatively constant (Wells 1967). Sheviak (1974) attributes the pronounced changes in population size and distribution to both climatic fluctuations and edaphic factors which influence the saprophytic/autotrophic state of the orchid. Due to the narrow pH tolerance, specific temperature and moisture requirements of the fungi-orchid association, changes in the environment will lead to altered states of the orchid (Sheviak 1974, B. Jennings, pers. comm. 25 Jan. 1990). In horticultural conditions, *S. cernua* and *S. magnicamporum* can revert from an autotrophic state to a saprophytic state (Sheviak 1974). Some orchids, such as *Triphora trianthophora*, grow underground saprophytically for most of their life and only occasionally produce aerial stems (Sheviak 1974). *Habenaria leucophaea* and some other very rare orchids, may produce hundreds of plants in a location where it was previously rare and then one or two seasons later disappear back to the saprophytic state where it remains for many years (Sheviak 1974). The various negative slopes in the linear survivorship curves (number of plants versus survival years) of different *Spiranthes spiralis* cohorts (same age plants) indicate that the chance of survival is dependent on the year in which the cohorts were produced and is not significantly affected by varying environmental conditions (Wells 1981). The mean expected life for all the cohorts was 53 years and the calculated time until only one plant remained for each cohort ranged from 23 years to 67 years (Wells 1981).

Habitat Comments: Cienegas (mid-elevation wetland communities) at about 1525 m elevation. Soils are highly organic and seasonally or continuously water-saturated, but are not subject to scouring floods. Associated plants are mostly tall grasses, sedges, and rushes. Most members of the genus *Spiranthes* require a moist habitat (B. Jennings, pers. comm. 25 Jan. 1990). *S. graminea* grows abundantly in cienegas (permanently wet meadows in desert foothills) and in the mountains of central Mexico (Luer 1975). *Spiranthes diluvialis*, in Colorado and Utah, grow in flood plains, old stream channels and along streambeds, in densely vegetated open sites and under willow trees (B. Jennings, pers. comm. 25 Jan. 1990). The four populations of *Spiranthes delitescens* occur above a dam in Babocomari Cienega, in marshy meadows, seeps and hummocks along Turkey Creek, in marshy meadows and seeps at O'Donnell Cienega, and on a seeping slope below Sheehy Spring (Sheviak 1990). The dominant vegetation in the cienegas near the *Spiranthes* include grasses, sedges (*Carex* spp.), rushes (*Juncus* spp.), spike-rush (*Eleocharis* spp.), cat-tails (*Typha* spp.), and horsetails (*Equisetum* spp.) (Grater 1973, Merrigan 1990, The Nature Conservancy Arizona Field Office, pers. comm.). Johnson grass (*Sorghum halepense*), a potential threat to the orchid, appears to be spreading into the marshy meadow (McClaran and Sundt 1992). The cienegas are at approximately 1500 m elevation and contain fine grained, highly organic, saturated soils (Merrigan 1990, The Nature Conservancy Arizona Field Office, pers. comm.). The orchid grows in both saturated soil and the surrounding drier sites.

Stewardship Overview: *Spiranthes delitescens* is a newly identified species known from four populations in southern Arizona; it is distinct from *Spiranthes graminea*. The population at one site, ranging from hundreds to thousands of plants, appears healthier and more vigorous than another one. Possibly the greatest threat to the survivability and fecundity of the orchid is the dense vegetation surrounding the small orchid plants. Possible effective management practices such as grazing, fires, and control of competing native and non-native plants have not been researched enough to determine the best practice or the best combination of practices. Due to the possible fluctuation in population size resulting from the reversion from a partially autotrophic plant back to a saprophytic plant, a characteristic common to many *Spiranthes* species, the status of these plants cannot be determined. Extensive research on the life-cycle and environmental requirements of this species is required before management plans should be discussed; burning experiments are being planned for one population.

Restoration Potential: Recovery of the *Spiranthes* is dependent on determining the optimum habitat conditions required for successful flowering, fruiting, germination, and maturation. Most probably this will relate to reduction in the density of the vegetation cover of the marsh. A prescribed burn at one protected site in 1991 failed to increase orchid numbers that year. But because saprophytic individuals in other *Spiranthes* species take at least one year to revert to aboveground plants and because germinated seeds must spend one to twelve years as obligate saprophytes, the response of the population to the prescribed burn is not known at this time. Therefore, until the ecological requirements are known and optimal conditions can be produced through management actions, we can only speculate as to the recovery potential of the populations.

Management Requirements: Discussions on Natural Occurrence and Management Implications of Fire and Grazing at Two Sites and the Response of Orchids to Habitat Alterations: Heitlinger (pers. comm. 8 Jan. 1990) and McClaran (pers. comm. 24 Jan. 1990) feel that historically fires occurred naturally in the cienegas when lightning-caused fires in the uplands spread down into the marshes and burned at cool temperatures. Suppression activities and roads are factors resulting in the reduction of the spread of natural fires. Most likely the fires would have occurred in the late spring (April through June) before moist, green vegetation developed (Merrigan 1990). In this case, fires would have periodically removed the dense vegetation surrounding the orchids prior to maximum orchid growth. However, Gehlbach (1986) and Sundt (pers. comm. 23 Jan. 1990) feel that little evidence exists to support the assumption that fires frequently swept through the marshes; they believe the wet marsh would not support fires. Perhaps fire was restricted to drought years or occurrences of winter lightning storms. The possibility of burning having a detrimental effect on the orchid does exist if the fire occurs during a crucial growth phase or if the fleshy surface tubers are damaged by fire (P. Sundt, pers. comm. 23 Jan. 1990; The Nature Conservancy Arizona Field Office, pers. comm.). Controlled burning maintains the appropriate habitat for some orchid species (Dressler 1981). Some species in South Africa and Australia flower only after fires, some flower more prolifically without fire, and the flowering of some other species is unaffected by fire (Dressler 1981). Several prairie orchids, such as *Spiranthes cernua*, sand-prairie ecotype, and *Spiranthes lacera*, appear to increase the number of flowering plants after burns (conditions of the burns were not indicated); possibly, fire physiologically triggers the bloom stage (Sheviak 1974; Sanford 1974; B. Jennings, pers. comm. 25 Jan. 1990). Orchids with protected underground buds tend to benefit (increase in number of flowering plants) or be unaffected by fires, whereas species with surface pseudobulbs require protective rocky spots in order to survive fires (Sanford 1974). Most likely, the timing of a fire is extremely critical. A burn at one site conducted in April 1979 resulted in the increase in orchid number from 40 to 196 in August following the fire (McClaran and Sundt 1992; The Nature Conservancy Arizona Field Office, pers. comm.). However, the number of plants growing in unburned locations also increased during this period, so possibly other environmental conditions were responsible for the significant increase in number of orchid plants (McClaran and Sundt 1992; The Nature Conservancy Arizona Field Office, pers. comm.). A fire conducted in May 1986 resulted in a decrease in population size from 97 (flags, presumably indicating orchids from the previous year) to 8 plants (McClaran and Sundt 1992; The Nature Conservancy Arizona Field Office, pers. comm.). The difference in the effect of the second fire compared to the 1979 fire may be due to the more advanced, vulnerable growth stage of the orchid in May. These results indicate the importance of determining the most beneficial time of burning. The effects of high fuel loads and temperature of burns in the cienega should be determined in order to prevent damage to the tuber by hot fires. Gehlbach (1986) emphasizes the importance of grazing on marsh vegetation. Over the past 10,000 years periodic exposure of southern Arizona cienegas to mammoths, Spanish cattle and Anglo livestock have resulted in trampling and grazing. Gehlbach (pers. comm. 25 Feb. 1990) feels that short durations of heavy grazing, analogous to the conditions of migratory animals, may be a natural and efficient means of managing the cienega. Livestock possibly aids in the survival of the orchid by tilling the soil, providing appropriate microsites for seedling establishment, and decreasing the litter accumulation. McClaran and Sundt (1992) suggest that grazing at one site and the exclusion of grazing at another site may explain the more abundant orchid plants at the former location. *Spiranthes* at the first site grow in a more open and less crowded vegetative (not necessarily more natural) setting than those at the second site (P. Sundt, pers. comm. 23 Jan. 1990). Possibly, cattle grazing may aid in the orchid growth by reducing the competition of neighboring grasses for space and nutrients (Fernald 1987). However, the populations at both of these sites are both described as decreasing in the number of flowering plants over the past ten years (M. McClaran, pers. comm. 24 Jan. 1990), thus damaging the argument of the effectiveness of grazing. Due to the absence of grazers for thousands of years, between the period of mammoths and cattle, Heitlinger (pers. comm. 8 Jan. 1990) feels that a non-grazing disturbance was most likely associated with the recent evolution of this orchid. Management experiments on *Spiranthes spiralis* indicate that grazing by rabbits cleared the vegetation and provided sites for seed germination eleven years prior to the study. This is evident by the increase in number of autotrophic seedlings of a species that requires eleven years of saprophytic development prior to emergence (Wells 1981). This experiment suggests the long-term time span required to assess the response of a *Spiranthes* species to a particular management technique. The rare orchid *Spiranthes magnicamporum* increases significantly in lightly grazed areas, but apparently the benefit from grazing is not due to increases in light level; the optimum grazing level is so low that there is no significant reduction in vegetation (Sheviak 1974). Casual observations indicate a high concentration of several *Spiranthes* species in grazed areas. The rare *S. parksii*, which grows in open, grassy woodland sites in Texas, is most abundant in areas exposed to heavy cattle grazing; the *S. romanzoffiana* growing in Alaska is especially abundant along moose trails: Gehlbach (pers. comm. 25 Feb. 1990) suggests the possiblity of the hoof-turned soil benefitting the establishment and/or survival of the plants. Higher concentrations of *S. cernua* and *S. gracilis* are found growing beside horse trails than in areas distant from horse trails; the plants occur close to the trail where the effects of the hooves are present, but far enough from the trail to be out of reach of the grazers (F. Gehlbach, pers. comm. 25 Feb. 1990). Detrimental effects of grazing are illustrated by the apparent (but not confirmed) extirpation of a population of *Spiranthes diluvialis* plants in Utah in a heavily grazed field (Sheviak 1984). The species may have a number of additional management needs although the research needed to identify these needs has not be completed. These needs include: (1) maintenance of the hydrologic regime; (2) control of exotics like Johnson grass; and (3) reduction of accumulated litter to increase light and water availability to orchids. Maintenance of the hydrologic regime may require the retirement or reduction of grazing in the watershed to (i) stabilize spring flows and (ii) reduce the probability of a scouring flood and channel erosion, thus ensuring that water table depths remain near the surface. Flooding of marshy species has most likely resulted in the apparent decline or extirpation of *Spiranthes* populations in southern Arizona and Utah (Sheviak 1984, McClaran and Sundt 1992). However, Gehlbach (pers. comm. 25 Feb. 1990) speculates on a beneficial scheme of periodic flash floods playing a historical role in restoring favorable conditions for the orchid by removing the dense vegetation cover. Control of exotic species like Johnson grass can be accomplished by (i) frequent mowing in areas that are completely dominated by Johnson grass and too dry to support *Spiranthes* and (ii) hand-application of herbicides to weeds in areas that are dominated by native species. Many orchid species cannot compete with fast growing, large herbaceous plants. The population size of *Spiranthes spiralis* growing in areas where land is frequently disturbed (mowed, plowed, etc.) decreases when tall grasses or dense short grasses increase in abundance (Sanford 1974). *Spiranthes ovalis* is a rare plant under undisturbed conditions; however, it readily invades areas that have been altered, particularly abandoned wooded pastures and old fields (Sheviak 1974). *Cypripedium candidum* and *Spiranthes lacera* thrive in sites where annual mowing occurs (Curtis 1946; Sheviak 1974). A recovery in the number of Cypripedium candidum plants was seen within five years of initiation of mowing practices which reduced the amount of shrubs (Curtis 1946). In mowed sites, flowering of *Spiranthes lacera* is directly dependent (the dependency was not explained) on the clipping regime (Sheviak 1974). Reduction of accummulated litter can be accomplished by prescribed burning, grazing, mowing, or clipping. Disagreement over the most natural management regime for the *Spiranthes* exists, with several individuals suggesting burning (M. Heitlinger, pers. comm. 8 Jan. 1990; P. Warren, pers. comm. 25 Jan. 1990) and others recommending grazing (Gehlbach 1986; P. Sundt, pers. comm. 23 Jan. 1990). Manipulations which alter the soil characteristics should be avoided in the fall when the seeds are most likely beginning to germinate and commence the mycorrhizal relationship; in many orchid species the initial orchid-fungi association is extremely precarious (Wells 1981). More information on the orchid's life-cycle and environmental requirements and experimentation on the effect of different management practices (grazing, fire, mowing, clipping) are needed to identify the most effective management procedures.

Monitoring Requirements: Monitoring *Spiranthes delitescens* at all known sites is needed to assess the current status of the species. T here is some background information on population numbers of aboveground plants at two well-studied sites. Both populations appear to be declining; the declines have been most dramatic at one site. There are no estimates of population size for the other two populations which are known only from collection records. Monitoring can also be used to understand the developmental processes and ecological requirements of this species, thereby increasing our ability to accurately forecast and interpret population fluctuations. A permanent marking system should be employed, allowing for continual monitoring of individual plants. The position of each plant should be labelled with respect to the perimeter of the specific plot in which the plant is contained. Labelled stakes, indicating the precise location, should be placed consistently on one side (i.e. due north) of each plant. McClaran and Sundt (1992) use a 1 m X 1 m square placed over permanent corner stakes to mark the plot boundary, and each plant is labelled with both the distance to each stake and the direction (E or W) relative to the line connecting the two stakes. Yearly vegetative and floral measurements should be taken consistently in August, during the period of flower and fruit development. Measurements on each individual plant should include presence or absence of vegetative and floral growth, height of shoot and inflorescence and number of flowers and fruits. The percentage of mature fruits which contain seeds is valuable information, since some *Spiranthes* species develop fruit without producing seeds (Catling 1982). Along with the yearly detailed monitoring, visual observations of the vegetative conditions (presence or absence of leaf rosettes) throughout the year should be noted. The environmental requirements for germination, growth, survivorship and reproduction are unknown for *Spiranthes delitescens*. If research indicates that one or more of the following environmental parameters are important, then this parameter(s) should also be monitored on a monthly or biweekly basis throughout the growing season. Potentially important environmental parameters may include: soil temperature, moisture, pH, light intensity at soil level and 10 cm above the soil level (orchid leaf level), and precipitation. Possibly, complete soil analyses should be performed periodically in order to determine differences in mineral availability and microorganism diversity at the various sites.

Management Programs: Burning experiments are being planned for one protected site. The study site will be divided into thirds and the three treatments will include a control, burns conducted every two years and every seven years. Contact: Mark Heitlinger, Director of Stewardship, The Nature Conservancy, Arizona Field Office, Tucson, Arizona.

Monitoring Programs: Several monitoring programs are currently underway at one protected site.

Contacts: Peter Warren/Dave Gori, The Nature Conservancy, Arizona Field Office, Tucson, Arizona 85705; (602) 622-3861. The monitoring plan for *Spiranthes* includes counts of vegetative and reproductive individuals in eleven experimental plots that were randomly assigned one of three prescribed burn treatments. Dave Gori has received funds from The Nature Conservancy to develop a monitoring plan for *S. delitescens* in 1992.

Mitchel McClaran and Peter Sundt, Department of Range Management, University of Arizona, Tucson, Arizona 85721; (602) 621-1673. Vegetative and floral parameters of the *Spiranthes* have been monitored by various people from 1978 to 1989 (McClaran and Sundt 1992).

Judy Davis, Department of Hydrology, University of Arizona, Tucson, Arizona 85721; (602) 621-1723. Monitoring of several hydrological features at the cienega have been conducted from 1988 to 1990 (J. Davis, pers. comm. 29 Jan. 1990).

Spiranthes spiralis was monitored from 1963 until 1980 at the following location: Knocking Hoe National Nature Reserve, Bedfordshire, England (Wells 1981).

Management Research Programs: The Nature Conservancy is now conducting a long-term study to assess the effect of prescribed burns and burn frequency on the structure and composition of cienega vegetation and *Spiranthes*. For more information about this study, contact: Dave Gori, The Nature Conservancy, 300 E. University Blvd., #230, Tucson, Arizona 85705; (602) 622-3861.

Cytological and morphological studies have been performed by: Charles Sheviak, Botanist, New York State Museum, Albany, New York.

References:

- Arditti, J. 1982. Orchid biology, reviews, and perspectives. Cornell University Press, Ithaca, NY. 390p.
- Arizona Game and Fish Department. 2000. *Spiranthes delitescens*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, AZ. 4 pp.
- Bender, J. 1986. Element stewardship abstract for *Cypripedium candidum*. The Nature Conservancy. Midwest Regional Office, Minneapolis, MN.
- Catling, P. 1982. Breeding systems of northeastern North American Sprianthes. Canadian Journal of Botany 60: 3017-3034.
- Catling, P. and V. Catling. 1988. *Spiranthes nebulorum* a new species from southern Mexico and Guatemala. Rhodora 90:139-146.
- Curtis, J. 1946. Use of mowing in management of white ladyslipper. Journal of Wildlife MAnagement 10(4): 303-308.
- Dressler, R. 1981. The Orchids: Natural History and Classification. Harvard Univ. Press, Cambridge, MA. 332 pp.
- Fernald, A. 1987. Plant community ecology of two desert marshes in southeastern Arizona. M.A. thesis, University of Colorado, Boulder, CO.
- Gehlbach, F. 1986. Professor, Department of Biology, Baylor University. Correspondence, TNC files, Tucson, AZ.
- Grater, R. 1973. Canelo Hills Cienega, an evaluation. The Nature Conservancy files, Tucson, AZ.
- Kartesz, J.T. 1994. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. 2nd edition. 2 vols. Timber Press, Portland, OR.
- Luer, C.A. 1975. The native orchids of the United States and Canada excluding Florida. New York Botanical Garden. 361 pp.
- McClaran, M. and P. Sundt. 1992. Population dynamics of the rare orchid, *Spiranthes delitescens*. In press, Southwestern Naturalist.
- Merrigan, S. 1990. Element stewardship abstract - Cienega (in preparation). The Nature Conservancy, Tucson, AZ.
- Rutman, S. 1992. Handbook of Arizona's endangered, threatened, and candidate plants. U.S. Fish and Wildlife Service, Phoenix, AZ.
- Rutman, S., and J. Rorabaugh. 1995. Endangered and threatened wildlife and plants: Proposal to determine endangered status for three wetland species found in southern Arizona and northern Sonora. Federal Register 60(63): 16836-16846.
- Sanford, W. 1974. The ecology of orchids. In C. Withner, editor, The orchids, scientific studies. John Wiley & Sons, New York, NY. 1-101p.

- Sheviak, C.J. 1984. *Spiranthes diluvialis* (Orchidaceae), a new species from the western United States. Brittonia 36:8-14.
- Sheviak, C.J. 1990. A new *Spiranthes* (Orchidaceae) from the cienegas of southernmost Arizona. Rhodora 92(872):213-231.
- Sheviak, C.T. 1974. An Introduction to the Ecology of the Illinois Orchidaceae, Illinois State Museum Scientific Papers XIV, Springfield, IL, U.S.A. B74SHE01PAUS
- Stoutamire, W. 1974. Terrestrial orchid seedlings. In C. Withner, editor, The Orchids, scientific studies. John Wiley and Sons, New York, NY. 101-128 p.
- Warcup, J. 1975. Factors affecting symbiotic germination of archid seed. In F. Sanders, B. Mosse, and P. Tinker. editors, Endomycorrhizeas. Academic Press, London, England. 87-105p.
- Wells, T. 1967. Changes in a population of *Spiranthes spiralis* Chevall. at Knocking Hoe National Nature Reseve, Bedfordshire, 1962-65. Journal of Ecology 55:83-89.
- Wells, T. 1981. Population ecology of terrestrial orchids. In H. Synge, editor, The biological aspects of rare plant conservation. John Wiley and Sons, New York, NY. 181-195 p.
- Williams, L. 1951. The Orchidaceae of Mexico. Cieba 2:1-132.
- van der Pijl, L., and C. Dodson. 1966. Orchid flowers: Their pollination and evolution. University of Miami Press, Coral Gables, FL. 214 pp.

BIOLOGICAL SURVEY
ATTACHMENT B

DOUGLAS STATION WILDLIFE SPECIES LISTS

Group / Family / Scientific Name	Common Name	Global and State Rank	State Status	Federal Status
BIRDS				
Blackbirds, Orioles				
Emberizidae				
Agelaius phoeniceus	Red-winged blackbird	G5/S5	---	---
Dolichonyx oryzivorus	Bobolink	G5/S1	---	---
Euphagus cyanocephalus	Brewer's blackbird	G5/S5	---	---
Icterus bullockii	Bullock's oriole	G5/SNRB	---	---
Icterus cucullatus	Hooded oriole	G5/S5	---	---
Icterus parisorum	Scott's oriole	G5/S5	---	---
Molothrus aeneus	Bronzed cowbird	G5/S5	---	---
Molothrus ater	Brown-headed cowbird	G5/S5	---	---
Quiscalus mexicanus	Great-tailed grackle	G5/S5	---	---
Sturnella magna	Eastern meadowlark	G5/S5	---	---
Sturnella neglecta	Western meadowlark	G5/S5	---	---
Xanthocephalus xanthocephalus	Yellow-headed blackbird	G5/S5	---	---
Bushtits				
Aegithalidae				
Psaltriparus minimus	Bushtit	G5/S5	---	---
Caracaras, Falcons				
Falconidae				
Caracara cheriway	Crested caracara	G5/S1S2	---	---
Falco columbarius	Merlin	G5/S4N	---	---
Falco mexicanus	Prairie falcon	G5/S4	---	---
Falco peregrinus	Peregrine falcon	G4T4/S4	SC	WSC
Falco sparverius	American kestrel	G5/S5	---	---
Cormorants				
Phalacrocoracidae				
Phalacrocorax auritus	Double-crested cormorant	G5/S5	---	---
Phalacrocorax brasilianus	Neotropic cormorant	G5/S1N	---	---
Cranes				
Gruidae				
Grus canadensis	Sandhill crane	G5/S3N	---	---
Crows and Jays				
Corvidae				
Aphelocoma californica	Western scrub jay	G5/S5	---	---
Corvus corax	Common raven	G5/S5	---	---
Corvus cryptoleucus	Chihuahuan raven	G5/S4	---	---
Cyanocitta stelleri	Steller's jay	G5/S5	---	---
Cuckoos				
Cuculidae				
Coccyzus americanus	Yellow-billed cuckoo	G3T3Q/S3	C	WSC

Group / Family / Scientific Name	Common Name	Global and State Rank	State Status	Federal Status
BIRDS (continued)				
Geococcyx californianus	Greater roadrunner	G5/S5	---	---
Doves				
Columbidae				
Columbina inca	Inca dove	G5/S5	---	---
Columbina passerina	Common ground-dove	G5/S4	---	---
Columbina talpacote	Ruddy ground-dove	G5/S1B,S2N	---	---
Zenaida asiatica	White-winged dove	G5/S5	---	---
Zenaida macroura	Mourning dove	G5/S5	---	---
Ducks, Geese, Swans				
Anatidae				
Aix sponsa	Wood duck	G5/S2B,S3N	---	---
Anas acuta	Northern pintail	G5/S2B,S5N	---	---
Anas americana	American wigeon	G5/S1B,S5N	---	---
Anas clypeata	Northern shoveler	G5/S1B,S5N	---	---
Anas crecca	Green-winged teal	G5/S3B,S5N	---	---
Anas cyanoptera	Cinnamon teal	G5/S5	---	---
Anas discors	Blue-winged teal	G5/S2B,S5N	---	---
Anas penelope	Eurasian wigeon	G5/S2N	---	---
Anas platyrhynchos	Mallard	G5/S5	---	---
Anas strepera	Gadwall	G5/S5	---	---
Anser albifrons	Greater white-fronted goose	G5/S2N	---	---
Aythya affinis	Lesser scaup	G5/S5N	---	---
Aythya americana	Redhead	G5/S4	---	---
Aythya collaris	Ring-necked duck	G5/S5	---	---
Aythya valisneria	Canvasback	G5/S1B,S4N	---	---
Branta canadensis	Canada goose	G5/S1B,S4N	---	---
Bucephala albeola	Bufflehead	G5/S5N	---	---
Chen caerulescens	Snow goose	G5/S3N	---	---
Cygnus columbianus	Tundra swan	G5/S1N	---	---
Dendrocygna autumnalis	Black-bellied whistling-duck	G5/S3	---	WSC
Dendrocygna bicolor	Fulvous whistling-duck	G5/?	---	---
Lophodytes cucullatus	Hooded merganser	G5/S2N	---	---
Mergus merganser	Common merganser	G5/S3S4	---	---
Oxyura jamaicensis	Ruddy duck	G5/S5	---	---
Finches				
Fringillidae				
Carduelis lawrencei	Lawrence’s goldfinch	G3G4/S1,S3N	---	---
Carduelis pinus	Pine siskin	G5/S5	---	---
Carduelis psaltria	Lesser goldfinch	G5/S5	---	---
Carduelis tristis	American goldfinch	G5/S1B,S5N	---	---
Carpodacus cassinii	Cassin’s finch	G5/S4	---	---

Group / Family / Scientific Name	Common Name	Global and State Rank	State Status	Federal Status
BIRDS (continued)				
Carpodacus mexicanus	House finch	G5/S5	---	---
Carpodacus purpureus	Purple finch	G5/S1,S2N	---	---
Gnatcatchers				
Muscicapidae				
Polioptila caerulea	Blue-gray gnatcatcher	G5/S5	---	---
Polioptila melanura	Black-tailed gnatcatcher	G5/S5	---	---
Goatsuckers				
Caprimulgidae				
Chordeiles acutipennis	Lesser nighthawk	G5/S5	---	---
Phalaenoptilus nuttallii	Common poorwill	G5/S5	---	---
Grebes				
Podicipedidae				
Aechmophorus occidentalis	Western grebe	G5/S3	---	---
Podiceps nigricollis	Eared grebe	G5/S3B,S5N	---	---
Podilymbus podiceps	Pied-billed grebe	G5/S5	---	---
Grosbeaks and Buntings				
Emberizidae				
Cardinalis cardinalis	Northern cardinal	G5/S5	---	---
Cardinalis sinuatus	Pyrrhuloxia	G5/S5	---	---
Guiraca caerulea	Blue grosbeak	G5/S5	---	---
Passerina amoena	Lazuli bunting	G5/S4	---	---
Passerina ciris	Painted bunting	G5/S2,S3M	---	---
Passerina cyanea	Indigo bunting	G5/S3	---	---
Passerina versicolor	Varied bunting	G5/S3	---	---
Pheucticus ludovicianus	Rose-breasted grosbeak	G5/S3N	---	---
Pheucticus melanocephalus	Black-headed grosbeak	G5/S5	---	---
Spiza americana	Dickcissel	G5/S2M	---	---
Gulls, Terns				
Laridae				
Chlidonias niger	Black tern	G4/S3,S4M	---	---
Larus delawarensis	Ring-billed gull	G5/S5N	---	---
Larus philadelphia	Bonaparte’s gull	G5/S3,S4M	---	---
Sterna forsteri	Forster’s tern	G5/S2N	---	---
Hawks, Kites, Eagles				
Accipitridae				
Accipiter cooperi	Cooper’s hawk	G5/S4	---	---
Accipiter striatus	Sharp-shinned hawk	G5/S4	---	---
Aquila chrysaetos	Golden eagle	G5/S4	---	---
Buteo albonotatus	Zone-tailed hawk	G4/S4	---	---
Buteo jamaicensis	Red-tailed hawk	G5/S5	---	---

Group / Family / Scientific Name	Common Name	Global and State Rank	State Status	Federal Status
Buteo lagopus	Rough-legged hawk	G5/SNRN	---	---
BIRDS (continued)				
Buteo nitidus	Gray hawk	G5T4Q/S3	SC	WSC
Buteo regalis	Ferruginous hawk	G5/S3	---	---
Buteo swainsoni	Swainson's hawk	G5/S3	---	---
Buteogallis anthracinus	Common black-hawk	G4G5/S3	---	WSC
Circus cyaneus	Northern harrier	G5/S1S2B,S5N	---	---
Elanus leucurus	White-tailed kite	G5/S2B,S2S3N	---	---
Haliaeetus leucocephalus	Bald eagle	G5/S4N	LT,PDL	WSC
Ictinia mississippiensis	Mississippi kite	G5/S3	---	WSC
Pandion haliaetus	Osprey	G5/S2B,S4N	---	---
Parabuteo unicinctus	Harris's hawk	G5/S5	---	---
Herons, Bitterns, Allies				
Ardeidae				
Ardea herodias	Great blue heron	G5/S5	---	---
Botaurus lentiginosus	American bittern	G4/S1S2	---	---
Bubulcus ibis	Cattle egret	G5/S1B, S4N	---	---
Butorides striatus	Green-backed heron	G5/S4	---	---
Casmerodius albus	Great egret	G5/S1B,S4N	---	---
Egretta caerulea	Little blue heron	G5/S1S2N	---	---
Egretta thula	Snowy egret	G5/S1B,S4N	---	---
Ixobrychus exilis	Least bittern	G5/S3	---	---
Nycticorax nycticorax	Black-crowned night-heron	G5/S3	---	---
Nycticorax violaceus	Yellow-crowned night-heron	G5/?	---	---
Hummingbirds				
Trochilidae				
Archilochus alexandri	Black-chinned hummingbird	G5/S5	---	---
Calypte anna	Anna's hummingbird	G5/S5	---	---
Calypte costae	Costa's hummingbird	G5/S5	---	---
Cynanthus latirostris	Broad-billed hummingbird	G4/S3	---	---
Eugenes fulgens	Magnificent hummingbird	G5/S4	---	---
Selasphorus platycercus	Broad-tailed hummingbird	G5/S5	---	---
Selasphorus rufus	Rufous hummingbird	G5/S5M	---	---
Stellula calliope	Calliope hummingbird	G5/S4M	---	---
Ibises				
Threskiornithidae				
Eudocimus albus	White ibis	G5/?	---	---
Plegadis chihi	White-faced ibis	G5/S?B,S2S3N	SC	---
Kingfishers				

Group / Family / Scientific Name	Common Name	Global and State Rank	State Status	Federal Status
Alcedinidae				
BIRDS (continued)				
Ceryle alcyon	Belted kingfisher	G5/S2B,S5N	---	---
Chloroceryle americana	Green kingfisher	G5/S2	---	---
Kinglets and Thrushes				
Muscicapidae				
Catharus guttatus	Hermit thrush	G5/S5	---	---
Regulus calendula	Ruby-crowned kinglet	G5/S5	---	---
Sialia mexicana	Western bluebird	G5/S5	---	---
Turdus migratorius	American robin	G5/S5	---	---
Larks				
Alaudidae				
Eremophila alpestris	Horned lark	G5/S5	---	---
Loons				
Gaviidae				
Gavia immer	Common loon	G5/S2N	---	---
Mockingbirds and Thrashers				
Mimidae				
Dumetella carolinensis	Gray catbird	G5/S1	---	---
Mimus polyglottos	Northern mockingbird	G5/S5	---	---
Oreoscoptes montanus	Sage thrasher	G5/S5	---	---
Toxostoma bendirei	Bendire’s thrasher	G4G5/S4	---	---
Toxostoma curvirostre	Curve-billed thrasher	G5/S5	---	---
Toxostoma dorsale	Crissal thrasher	G5/S5	---	---
Toxostoma rufum	Brown thrasher	G5/S1N	---	---
Nuthatches				
Sittidae				
Sitta carolinensis	White-breasted nuthatch	G5/S5	---	---
Owls				
Strigidae				
Asio otus	Long-eared owl	G5/S2B,S3S4N	---	---
Athene cunicularia	Burrowing owl	G4T4/S3	SC	---
Bubo virginianus	Great horned owl	G5/S5	---	---
Micrathene whitneyi	Elf owl	G5/S5	---	---
Otus kennicottii	Western screech owl	G4/S4	---	---
Tytonidae				
Tyto alba	Common barn owl	G5TNR/?	---	---
Pelicans				
Pelicanidae				
Pelecanus occidentalis	Brown pelican	G4/S1N	---	---
Pipits				
Motacillidae				
Anthus rubescens	American pipit	G5/S2B,S5N	---	---

Group / Family / Scientific Name	Common Name	Global and State Rank	State Status	Federal Status
BIRDS (continued)				
Plovers				
Charadriidae				
Charadrius vociferus	Killdeer	G5/S5	---	---
Quail, New World				
Phasianidae				
Callipepla gambelii	Gambel’s quail	G5/S5	---	---
Callipepla squamata	Scaled quail	G5/S5	---	---
Cyrtonyx montezumae	Montezuma quail	G4G5/S4	---	---
Rails, Gallinules, Coots				
Rallidae				
Fulica americana	American coot	G5/S5	---	---
Gallinula chloropus	Common moorhen	G5/S5	---	---
Porzana carolina	Sora	G5/S4	---	---
Rallus limicola	Virginia rail	G5/S4	---	---
Sandpipers, Phalaropes				
Scolopacidae				
Actitis macularius	Spotted sandpiper	G5/S3S4	---	---
Calidris bairdii	Baird’s sandpiper	G5/S4M	---	---
Calidris mauri	Western sandpiper	G5/S1N	---	---
Calidris minutilla	Least sandpiper	G5/S5N	---	---
Calidris pusilla	Semipalmated sandpiper	G5/S2M	---	---
Catoptrophorus semipalmatus	Willet	G5/S4M	---	---
Gallinago delicata	Wilson’s snipe	G5/S1B,S4N	---	---
Limnodromus scolopaceus	Long-billed dowitcher	G5/S3S4N	---	---
Numenius americana	Long-billed curlew	G5/S1B,S3S4N	---	---
Phalaropus tricolor	Wilson’s phalarope	G5/S1B,S5N	---	---
Tringa flavipes	Lesser yellowlegs	G5/S4M	---	---
Tringa melanoleuca	Greater yellowlegs	G5/S3N	---	---
Tringa solitaria	Solitary sandpiper	G5/S3M	---	---
Shrikes				
Laniidae				
Lanius ludovicianus	Loggerhead shrike	G4/S4	---	---
Silky Flycatchers				
Ptilogonatidae				
Phainopepla nitens	Phainopepla	G5/S5	---	---
Sparrows, New World				
Emberizidae				
Aimophila botterii	Botteri’s sparrow	G4/S4	---	---
Aimophila cassinii	Cassin’s sparrow	G5/S4	---	---
Aimophila ruficeps	Rufous-crowned sparrow	G5/S4	---	---
Ammodramus savannarum	Grasshopper sparrow	G5/S3	---	---

Group / Family / Scientific Name	Common Name	Global and State Rank	State Status	Federal Status
BIRDS (continued)				
Amphispiza belli	Sage sparrow	G5/S4	---	---
Amphispiza bilineata	Black-throated sparrow	G5/S5	---	---
Calamospiza melanocorys	Lark bunting	G5/S1B,S5N	---	---
Calcarius ornatus	Chestnut-collared longspur	G5/S3N	---	---
Chondestes grammacus	Lark sparrow	G5/S5	---	---
Junco hyemalis	Dark-eyed junco	G5/S5		
Melospiza georgiana	Swamp sparrow	G5/S2S3N	---	---
Melospiza lincolnii	Lincoln's sparrow	G5/S3B,S5N	---	---
Melospiza melodia	Song sparrow	G5/S5	---	---
Passerculus sandwichensis	Savannah sparrow	G5/S5	---	---
Pipilo chlorurus	Green-tailed towhee	G5/S3B,S4N	---	---
Pipilo fuscus	Canyon towhee	G5/S5	---	---
Pipilo maculatus	Spotted towhee	G5/S5	---	---
Pooecetes gramineus	Vesper sparrow	G5/S5	---	---
Spizella atrogularis	Black-chinned sparrow	G5/S5	---	---
Spizella breweri	Brewer's sparrow	G5/S5	---	---
Spizella passerina	Chipping sparrow	G5/S5	---	---
Zonotrichia albicollis	White-throated sparrow	G5/S2S3N	---	---
Zonotrichia atricapilla	Golden-crowned sparrow	G5/S1S2N	---	---
Zonotrichia leucophrys	White-crowned sparrow	G5/S1B,S5N	---	---
Sparrows, Old World				
Passeridae				
Passer domesticus	House sparrow	G5/SNA	---	---
Starlings				
Sturnidae				
Sturnus vulgaris	European starling	G5/SNA	---	---
Stilts, Avocets				
Recurvirostridae				
Himantopus mexicanus	Black-necked stilt	G5/S2	---	---
Recurvirostra americana	American avocet	G5/S2	---	---
Storks				
Ciconiidae				
Mycteria americana	Wood stork	G4/S1N	---	---
Swallows				
Hirundinidae				
Hirundo pyrrhonota	Cliff swallow	G5/S5	---	---
Hirundo rustica	Barn swallow	G5/S5	---	---
Progne subis	Purple martin	G5/S4	---	---

Group / Family / Scientific Name	Common Name	Global and State Rank	State Status	Federal Status
Riparia riparia	Bank swallow	G5/S4M	---	---
BIRDS (continued)				
Stelgidopteryx serripennis	Northern rough-winged swallow	G5/S5	---	---
Tachycineta bicolor	Tree swallow	G5/S3	---	---
Tachycineta thalassina	Violet-green swallow	G5/S5	---	---
Swifts				
Apodidae				
Aeronautes saxatilis	White-throated swift	G5/S5	---	---
Chaetura vauxi	Vaux's swift	G5/S4M	---	---
Tanagers				
Emberizidae				
Piranga ludoviciana	Western tanager	G5/S5	---	---
Piranga rubra	Summer tanager	G5/S4	---	---
Titmice				
Paridae				
Parus wollweberi	Bridled titmouse	G5/S4	---	---
Turkeys				
Galliformes				
Meleagris gallopavo	Wild turkey	G5/S5	---	---
Tyrant Flycatchers				
Tyrannidae				
Campostoma imberbe	Northern beardless-tyrannulet	G5/S4	---	---
Contopus cooperi	Olive-sided flycatcher	G4/S4	---	---
Contopus sordidulus	Western wood-peewee	G5/S5	---	---
Emidonax hammondii	Hammond's flycatcher	G5/S1B,S2S3N	---	---
Empidonax oberholseri	Dusky flycatcher	G5/S4	---	---
Empidonax occidentalis	Cordilleran flycatcher	G5/S2S3B	---	---
Empidonax traillii	Willow flycatcher	G5/S1	---	---
Empidonax wrightii	Gray flycatcher	G5/S5	---	---
Myiarchus cinerascens	Ash-throated flycatcher	G5/S5	---	---
Myiarchus tuberculifer	Dusky-capped flycatcher	G5/S4	---	---
Myiarchus tyrannulus	Brown-crested flycatcher	G5/S4	---	---
Myiodynastes luteiventris	Sulphur-bellied flycatcher	G5/S3	---	---
Pachyramphus aglaiae	Rose-throated becard	G4G5/S1	---	---
Pyrocephalus rubinus	Vermilion flycatcher	G5/S5	---	---
Sayornis nigricans	Black phoebe	G5/S5	---	---
Sayornis phoebe	Eastern phoebe	G5/S1N	---	---
Sayornis saya	Say's phoebe	G5/S5	---	---

Group / Family / Scientific Name	Common Name	Global and State Rank	State Status	Federal Status
Tyrannus crassirostris	Thick-billed kingbird	G5/S2	---	WSC
Tyrannus melancholicus	Tropical kingbird	G5/S3	---	WSC
BIRDS (continued)				
Tyrannus verticalis	Western kingbird	G5/S5	---	---
Tyrannus vociferans	Cassin's kingbird	G5/S5	---	---
Verdins				
Remizidae				
Auriparus flaviceps	Verdin	G5/S5	---	---
Vireos				
Vireonidae				
Vireo bellii	Bell's vireo	G5/S4	---	---
Vireo gilvus	Warbling vireo	G5/S5	---	---
Vireo huttoni	Hutton's vireo	G5/S5	---	---
Vireo plumbeus	Plumbeous vireo	G5/S5	---	---
Vireo solitarius	Blue-headed vireo	G5/?	---	---
Vultures, New World				
Cathartidae				
Cathartes aura	Turkey vulture	G5/S5	---	---
Coragyps atratus	Black vulture	G5/S1S2	---	---
Waxwings				
Bombycillidae				
Bombycilla cedrorum	Cedar waxwing	G5/S3S4N	---	---
Woodpeckers				
Picidae				
Colaptes auratus	Northern flicker	G5/S5	---	---
Colaptes chrysoides	Gilded flicker	G5/S5	---	---
Melanerpes lewis	Lewis's woodpecker	G4/S4	---	---
Melanerpes uropygialis	Gila woodpecker	G5/S5	---	---
Picoides scalaris	Ladder-backed woodpecker	G5/S5	---	---
Sphyrapicus nuchalis	Red-naped sapsucker	G5/S4	---	---
Wood Warblers				
Emberizidae				
Dendroica caerulescens	Black-throated blue warbler	G5/S1M	---	---
Dendroica coronata	Yellow-rumped warbler	G5/S5	---	---
Dendroica nigrescens	Black-throated gray warbler	G5/S5	---	---
Dendroica occidentalis	Hermit warbler	G4G5/S4M	---	---
Dendroica petechia	Yellow warbler	G5/S4	---	---
Dendroica townsendii	Townsend's warbler	G5/S4M,S1S2N	---	---
Geothlypis trichas	Common yellowthroat	G5/S4	---	---
Icteria virens	Yellow-breasted chat	G5/S4	---	---
Myioborus pictus	Painted redstart	G5/S4	---	---

Group / Family / Scientific Name	Common Name	Global and State Rank	State Status	Federal Status
Oporornis formosus	Kentucky warbler	G5/S1M	---	---
Oporornis tolmiei	MacGillivray's warbler	G5/S4	---	---
Seiurus noveboracensis	Northern waterthrush	G5/S2S3M	---	---
Setophaga ruticilla	American redstart	G5/S1	---	---
Vermivora celata	Orange-crowned warbler	G5/S3B,S5N	---	---
Vermivora luciae	Lucy's warbler	G5/S5	---	---
Vermivora ruficapilla	Nashville warbler	G5/S4S5M	---	---
Vermivora virginiae	Virginia's warbler	G5/S5	---	---
Wilsonia pusilla	Wilson's warbler	G5/S5M	---	---
Wrens				
Troglodytidae				
Campylorhynchus brunneicapillus	Cactus wren	G5/S5	---	---
Cistothorus palustris	Marsh wren	G5/S2B,S3S4N	---	---
Salpinctes obsoletus	Rock wren	G5/S5	---	---
Thryomanes bewickii	Bewick's wren	G5/S5	---	---
Troglodytes aedon	House wren	G5/S5	---	---
MAMMALS				
Badgers and Skunks				
Mephitidae				
Mephitis mephitis	Striped skunk	G5/S5	---	---
Spilogale gracilis	Western spotted skunk	G5/S5	---	---
Bats, Free-tailed				
Molossidae				
Nyctinomops macrotis	Big free-tailed bat	G5/S2S3	---	---
Tadarida brasiliensis	Brazilian free-tailed bat	G5/S3S4	---	---
Bats, Leaf-nose				
Phyllostomidae				
Leptonycteris curasoae	Lesser long-nosed bat	G4/S2	LE	WSC
Bats, Plain-nose				
Vespertilionidae				
Antrozous pallidus	Pallid bat	G5/S4S5	---	---
Eptesicus fuscus	Big brown bat	G5/S4S5	---	---
Lasiurus blossevillei	Western red bat	G5/S2	---	WSC
Lasiurus cinereus	Hoary bat	G5/S4	---	---
Lasiurus xanthinus	Western yellow bat	G5/S1	---	WSC
Myotis auriculus	Southwestern myotis	G5/S3	---	---
Myotis californicus	California myotis	G5/S4S5	---	---
Myotis thysanodes	Fringed myotis	G4G5/S3S4	SC	---
Myotis velifer	Cave myotis	G5/S4	SC	---
Pipistrellus hesperus	Western pipistrelle	G5/S5	---	---
Plecotus townsendii	Townsend's big-eared bat	G4/S3S4	---	---

Group / Family / Scientific Name	Common Name	Global and State Rank	State Status	Federal Status
Badgers				
Mustelidae				
Taxidea taxus	American badger	G5/S5	---	---
MAMMALS (continued)				
Bears				
Ursidae				
Ursus americanus	Black bear	G5/S5	---	---
Cats				
Felidae				
Lynx rufus	Bobcat	G5/S5	---	---
Puma concolor	Mountain lion	G5/S4	---	---
Coyotes and Foxes				
Canidae				
Canis latrans	Coyote	G5/S5	---	---
Urocyon cineroargenteus	Gray fox	G5/S5	---	---
Deer				
Cervidae				
Odocoileus hemionus	Mule deer	G5/S5	---	---
Odocoileus virginianus	White-tailed deer	G5/S5	---	---
Javelina				
Tayassuidae				
Pecari tajacu	Collared peccary	G5/S5	---	---
Pocket Gophers				
Geomyidae				
Thomomys bottae	Botta's pocket gopher	G5/S5	---	---
Thomomys umbrinus	Southern pocket gopher	G5/S4	---	---
Pocket Mice and Kangaroo Rats				
Heteromyidae				
Chaetodipus baileyi	Bailey pocket mouse	G5/S5	---	---
Chaetodipus hispidus	Hispid pocket mouse	G5/S5	---	---
Chaetodipus penicillatus	Desert pocket mouse	G5/S5	---	---
Dipodomys merriami	Merriam's kangaroo rat	G5/S5	---	---
Dipodomys ordii	Ord's kangaroo rat	G5/S5	---	---
Dipodomys spectabilis	Banner-tailed kangaroo rat	G5/S5	---	---
Perognathus flavus	Silky pocket mouse	G5/S5	---	---
Porcupines				
Erethizontidae				
Erethizon dorsatum	Porcupine	G5/S4S5	---	---
Rabbits and Hares				
Leporidae				
Lepus californicus	Black-tailed jackrabbit	G5/S5	---	---

Group / Family / Scientific Name	Common Name	Global and State Rank	State Status	Federal Status
Sylvilagus audubonii	Desert cottontail	G5/S5	---	---
Raccoon and Ringtail				
Procyonidae				
Nasua narica	White-nosed coati	G5/S4	---	---
MAMMALS (continued)				
Procyon lotor	Common raccoon	G5/S4	---	---
Rats and Mice				
Muridae				
Mus musculus	House mouse	G5/SNA	---	---
Neotoma albigula	White-throated woodrat	G5/S5	---	---
Neotoma mexicana	Mexican woodrat	G5/S5	---	---
Onychomys leucogaster	Northern grasshopper mouse	G5/S5	---	---
Onychomys torridus	Southern grasshopper mouse	G5/S5	---	---
Peromyscus leucopus	White-footed mouse	G5/S5	---	---
Peromyscus maniculatus	Deer mouse	G5/S5	---	---
Reithrodontomys fulvescens	Fulvous harvest mouse	G5/S4	---	---
Reithrodontomys megalotis	Western harvest mouse	G5/S5	---	---
Sigmodon arizonae	Arizona cotton rat	G5/S4	---	---
Sigmodon hispidus	Hispid cotton rat	G5/S5	---	---
Sigmodon ochrognathus	Yellow-nosed cotton rat	G4G5/S3S4	SC	---
Shrews				
Soricidae				
Notiosorex crawfordi	Desert shrew	G5/S4S5	---	---
Squirrels				
Sciuridae				
Ammospermophilus harrisii	Yuma antelope squirrel	G5/S5	---	---
Spermophilus spilosma	Spotted ground squirrel	G5/S4	---	---
Spermophilus variegatus	Rock squirrel	G5/S5	---	---
REPTILES				
Box Turtles				
Emydidae				
Terrapene ornata	Desert box turtle	G5/S3S4	---	---
Mud Turtles				
Kinosternidae				
Kinosternon sonoriense	Sonoran mud turtle	G4/S4	---	---
Alligator Lizards				
Anguidae				

Group / Family / Scientific Name	Common Name	Global and State Rank	State Status	Federal Status
Elgaria kingii	Madrean alligator lizard	G5/S5	---	---
Beaded Lizards				
Helodermatidae				
Heloderma suspectum	Gila monster	G4/S4	---	---
REPTILES (continued)				
Collared and Leopard Lizards				
Crotaphytidae				
Crotaphytus collaris	Collared lizard	G5/S5	---	---
Gambelia wislizenii	Long-nosed leopard lizard	G5/S5	---	---
Iguanid Lizards				
Phrynosomatidae				
Holbrookia maculata	Lesser earless lizard	G5/S5	---	---
Phrynosoma cornutum	Texas horned lizard	G4G5/S3S4	----	---
Phrynosoma solare	Regal horned lizard	G5/S5	---	---
Sceloporus clarkii	Clark's spiny lizard	G5/S5	---	---
Sceloporus undulatus	Eastern fence lizard	G5/SNR	---	---
Urosaurus ornatus	Ornate tree lizard	G5/S5	---	---
Whiptail Lizards				
Teiidae				
Cnemidophorus uniparens	Desert grassland whiptail	G5/S5	---	---
Colubrid Snakes				
Colubridae				
Arizona elegans	Glossy snake	G5/S5	---	---
Diadophis punctatus	Ring-necked snake	G5/S4	---	---
Hypsiglena torquata	Nightsnake	G5/S5	---	---
Lampropeltis getula	Common kingsnake	G5/S5	---	---
Masticophis bilineatus	Sonoran whipsnake	G5/S5	---	---
Masticophis flagellum	Coachwhip	G5/S5	---	---
Pituophis catenifer	Gopher snake	G5/S5	---	---
Rhinocheilus lecontei	Long-nosed snake	G5/S5	---	---
Salvadora hexalepis	Western patch-nosed snake	G5/S5	---	---
Sonora semiannulata	Ground snake	G5/S5	---	---
Tantilla hobartsmithii	Southwestern black-headed snake	G5/S5	---	---
Thamnophis eques	Mexican garter snake	G5/S2S3	---	---
Thamnophis marcianus	Checkered garter snake	G5/S5	---	---
Coral Snakes				
Elapidae				
Micruroides euryxanthus	Sonoran coral snake	G5/S5	---	---
Rattlesnakes				

Group / Family / Scientific Name	Common Name	Global and State Rank	State Status	Federal Status
Viperidae				
Crotalus atrox	Western diamondbacked rattlesnake	G5/S5	---	---
Crotalus scutulatus	Mojave rattlesnake	G5/S5	---	---
AMPHIBIANS				
Spadefoot Toads				
Pelobatidae				
Scaphiopus couchii	Couch's spadefoot	G5/S5	---	---
Spea multiplicata	Mexican spadefoot	G5/S5	---	---
Toads				
Bufonidae				
Bufo alvarius	Colorado River toad	G5/S5	---	---
Bufo cognatus	Great Plains toad	G5/S5	---	---
Bufo debilis	Green toad	G5/S3	---	---
Bufo punctatus	Red-spotted toad	G5/S5	---	---
Bufo woodhousii	Woodhouse's toad	G5/S5	---	---
True Frogs				
Ranidae				
Rana catesbeiana	Bullfrog	G5/SNA	---	---
Rana chiricahuensis	Chiricahua leopard frog	G3/S3	LT	WSC
Rana yavapaiensis	Lowland leopard frog	G4/S4	SC	WSC
FISH				
Catfish				
Ictaluridae				
Ictalurus pricei	Yaqui catfish	G2/S1	LT	WSC
Minnows				
Cyprinidae				
Campostoma ornatum	Mexican stoneroller	G3/S1	SC	WSC
Cyprinella formosa	Beautiful shiner	G2/S1	LT	WSC
Gila purpurea	Yaqui chub	G1/S1	LE	WSC
Gila robusta	Roundtail chub	G3/S2	---	---
Rhinichthys chrysogaster	Longfin dace	G4/S3S4	SC	---
Suckers				
Catostomidae				
Catastomus bernardini	Yaqui sucker	G4/SX	---	---
Topminnows				
Poeciliidae				
Poeciliopsis occidentalis sonoriensis	Yaqui topminnow	G3T3/S1	LE	WSC

Source: USFWS 2003

San Bernardino National Wildlife Refuge Watchable Wildlife List. Global and State Rank from NatureServe 2008.

Federal and State Status from AGFD 2007.

APPENDIX E

Biological Resources Plan

BIOLOGICAL RESOURCES PLAN

FOR

CONSTRUCTION, OPERATION, AND MAINTENANCE OF TACTICAL INFRASTRUCTURE, VEHICLE FENCE 300 TUCSON SECTOR, ARIZONA

SONOITA AND DOUGLAS STATIONS

U.S. DEPARTMENT OF HOMELAND SECURITY
U.S. CUSTOMS AND BORDER PROTECTION
U.S. BORDER PATROL TUCSON SECTOR

Prepared by

GSRC

DECEMBER 2008

Abbreviations and Acronyms

BLM	Bureau of Land Management
BMP	Best Management Practice
BRP	Biological Resources Plan
CBP	U.S. Customs and Border Protection
CITES	Convention of International Trade in Endangered Species
cm	centimeters
dBA	A-weighted decibels
DHS	U.S. Department of Homeland Security
FR	Federal Register
GIS	Geographic Information System
GPS	Global Positioning System
IA	illegal alien
IIRIRA	Illegal Immigration Reform and Immigrant Responsibility Act
mm	millimeters
mph	miles per hour
NPS	National Park Service
MSO	Mexican spotted owl
PAC	Protected Activity Center
PCE	Primary Constituent Element
TI	Tactical infrastructure
TVB	temporary vehicle barrier
U.S.	United States
USACE	U.S. Army Corps of Engineers
USBP	U.S. Border Patrol
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

The U.S. Department of Homeland Security (DHS), Customs and Border Protection (CBP), U.S. Border Patrol (USBP) plans to construct, operate, and maintain tactical infrastructure (TI) consisting of primary vehicle fences, and supporting patrol and access roads in seven sections along the U.S./Mexico border in Cochise and Santa Cruz counties, Arizona. These sections will occur in three general areas along the border.

Table ES-1 outlines Federally listed species and Federally designated Critical Habitats known to occur or to potentially occur within or adjacent to the Project area and the determination of effects resulting from the Project.

Of the species listed in **Table ES-1**, the Project is likely to adversely affect the Sonora chub (*Gila ditaenia*), jaguar (*Panthera onca*), lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*) and Mexican spotted owl (*Strix occidentalis lucida*) in areas associated with each section, as noted in the table.

The Project may affect, but is not likely to adversely affect, the Huachuca water-umbel (*Lilaeopsis schaffneriana ssp. Recurva),* Pima pineapple cactus (*Coryphantha scheeri var. robustispina),* Cochise pincushion cactus (*Coryphantha robbinsorum*), Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*), and ocelot (*Leopardus pardalis*).

The remaining Federally listed species in **Table ES-1** will not be affected by the Project, and therefore, are not discussed in this Biological Resources Plan (BRP).

On April 1, 2008, the Secretary of DHS, pursuant to his authority under Section 102(c) of the Illegal Immigration Reform and Immigrant Responsibility Act (IIRIRA), exercised his authority to waive certain environmental and other laws in order to ensure expeditious construction of TI along the U.S./Mexico border. Although the Secretary's waiver means that CBP no longer has any specific legal obligations under these laws, the Secretary committed DHS to responsible environmental stewardship of our valuable natural and cultural resources. CBP strongly supports this objective and remains committed to being a good steward of the environment. To that end, CBP has prepared the following BRP, which analyzes the potential impacts on threatened and endangered species associated with construction of TI in the USBP's Tucson Sector. The BRP also discusses CBP's plans as to how potential impacts on threatened and endangered species can be mitigated. The BRP will help to guide CBP's efforts going forward.

Table ES-1. Determination of Effects on Federally Listed and Candidate Species within Tucson Sector VF300 Segments

Species	Listing Status	Determination	Segments Affected
PLANTS			
Canelo Hills ladies'-tresses, *Spiranthes delitescens*	Endangered	No effect	EV-1B, FV-1B
Cochise pincushion cactus, *Coryphantha robbinsorum*	Endangered	Not likely to adversely affect	FV-1B
Huachuca water-umbel, *Lilaeopsis schaffneriana ssp. recurva*	Endangered	Not likely to adversely affect	EV-1A, FV-1B
Pima pineapple cactus, *Coryphantha scheeri var. robustispina*	Endangered	Not likely to adversely affect	EV-1B
INVERTEBRATES			
Stephan's riffle beetle, *Hetrelmis stephani*	Candidate	No effect	FV-1B
Huachuca springsnail, *Pyrgulopsis thomsoni*	Candidate	No effect	FV-1B
FISH			
Desert pupfish, *Cyprinodon macularius*	Endangered	No effect	FV-1B
Yaqui Chub *Gila purpurea*	Endangered	No effect	FV-1B
Yaqui topminnow *Poeciliopsis accidentalis sonoriensis*	Endangered	No effect	FV-1B
Yaqui catfish *Ictalurus pricei*	Threatened	No effect	FV-1B
Beautiful shiner *Cyprinella formosa*	Threatened	No effect	FV-1B
Spikedace *Meda fulgida*	Threatened	No effect	FV-1B
Loach minnow *Tiaroga cobitis*	Threatened	No effect	FV-1B
Gila chub, *Gila intermedia*	Endangered	No effect	FV-1B
Gila topminnow, *Poeciliopsis occidentalis occidentalis*	Endangered	No effect	EV-1A

Table ES-1, continued

Species	Listing Status	Determination	Segments Affected
Sonora chub, *Gila ditaenia*	Threatened	Likely to adversely affect	FV-1B
REPTILES AND AMPHIBIANS			
Chiricahua leopard frog, *Rana chiricahuensis*	Threatened	No effect	None
Sonora tiger salamander, *Ambystoma tigrinum stebbinsi*	Endangered	Not likely to adversely affect	EV-1A, EV-1B
Ramsey canyon leopard frog *Lithobates subaquavocalis*	Conservation Agreement	No effect	FV-1B
New Mexico ridge-nosed rattlesnake *Crotalus willardi obscuras*	Threatened	No effect	FV-1B
BIRDS			
Mexican spotted owl, *Strix occidentalis lucida*	Threatened, with Critical Habitat designated within the Project corridor	Likely to adversely affect	EV-1B
Southwestern willow flycatcher, *Empidonax traillii extimus*	Endangered	No effect	FV-1B
Yellow-billed cuckoo, *Coccyzus americanus*	Candidate	No effect	FV-1B
MAMMALS			
Jaguar, *Panthera onca*	Endangered	Likely to adversely affect	All
Lesser long-nosed bat, *Leptonycteris curasoae yerbabuenae*	Endangered	Likely to adversely affect	All except EV-1B
Ocelot, *Leopardus pardalis*	Endangered	Not likely to adversely affect	All

THIS PAGE INTENTIONALLY LEFT BLANK

BIOLOGICAL RESOURCES PLAN
USBP TUCSON SECTOR,
SONOITA AND DOUGLAS STATIONS

TABLE OF CONTENTS

FIGURES

TABLES

PHOTOGRAPHS

APPENDICES

THIS PAGE INTENTIONALLY LEFT BLANK

1. PROJECT DESCRIPTION

The U.S. Department of Homeland Security (DHS), Customs and Border Protection (CBP), U.S. Border Patrol (USBP) plans to construct, operate, and maintain approximately 40.32 miles of tactical infrastructure (TI) along the U.S./Mexico border within the USBP Tucson Sector, Arizona. TI will include installation and renovations of primary vehicle fence, improvements to border access roads and construction of new construction/maintenance roads. Construction is expected to be completed by December 2008. In addition, 46 temporary staging areas will be used to facilitate construction of the TI.

On April 1, 2008, the Secretary of DHS, pursuant to his authority under Section 102(c) of the Illegal Immigration Reform and Immigrant Responsibility Act (IIRIRA), exercised his authority to waive certain environmental and other laws in order to ensure expeditious construction of TI along the U.S./Mexico border. Although the Secretary's waiver means that CBP no longer has any specific legal obligations under these laws, the Secretary committed DHS to responsible environmental stewardship of our valuable natural and cultural resources. CBP strongly supports this objective and remains committed to being a good steward of the environment. To that end, CBP has prepared this Biological Resources Plan (BRP), which analyzes the potential impacts on threatened and endangered species associated with construction of TI in the USBP's Tucson Sector. The BRP also discusses CBP's plans regarding mitigation of potential impacts to threatened and endangered species. The BRP will help to guide CBP's efforts going forward.

1.1 LOCATION

CBP plans to construct, operate, and maintain TI consisting of primary vehicle fence and new maintenance and construction access roads in three discrete sections (Sections EV-1A, EV-1B, and FV-1B) in the Tucson Sector in Cochise and Santa Cruz counties, Arizona (**Figure 1-1**). The Project includes the construction, operation, and maintenance of TI along approximately 40.32 miles of the U.S./Mexico border in Cochise and Santa Cruz counties, Arizona. The fence will be installed approximately 3 to 6 feet north of the U.S./Mexico border.

1.2 CONSTRUCTION, OPERATION, AND MAINTENANCE

The Project consists of the following components: (1) the construction, operation, and maintenance of vehicle fence along the U.S./Mexico border; (2) retrofit or replacement of temporary vehicle barriers (TVB) to permanent vehicle fence; (3) the construction of new access roads; and (4) the development of 46 temporary construction staging areas.

THIS PAGE INTENTIONALLY LEFT BLANK

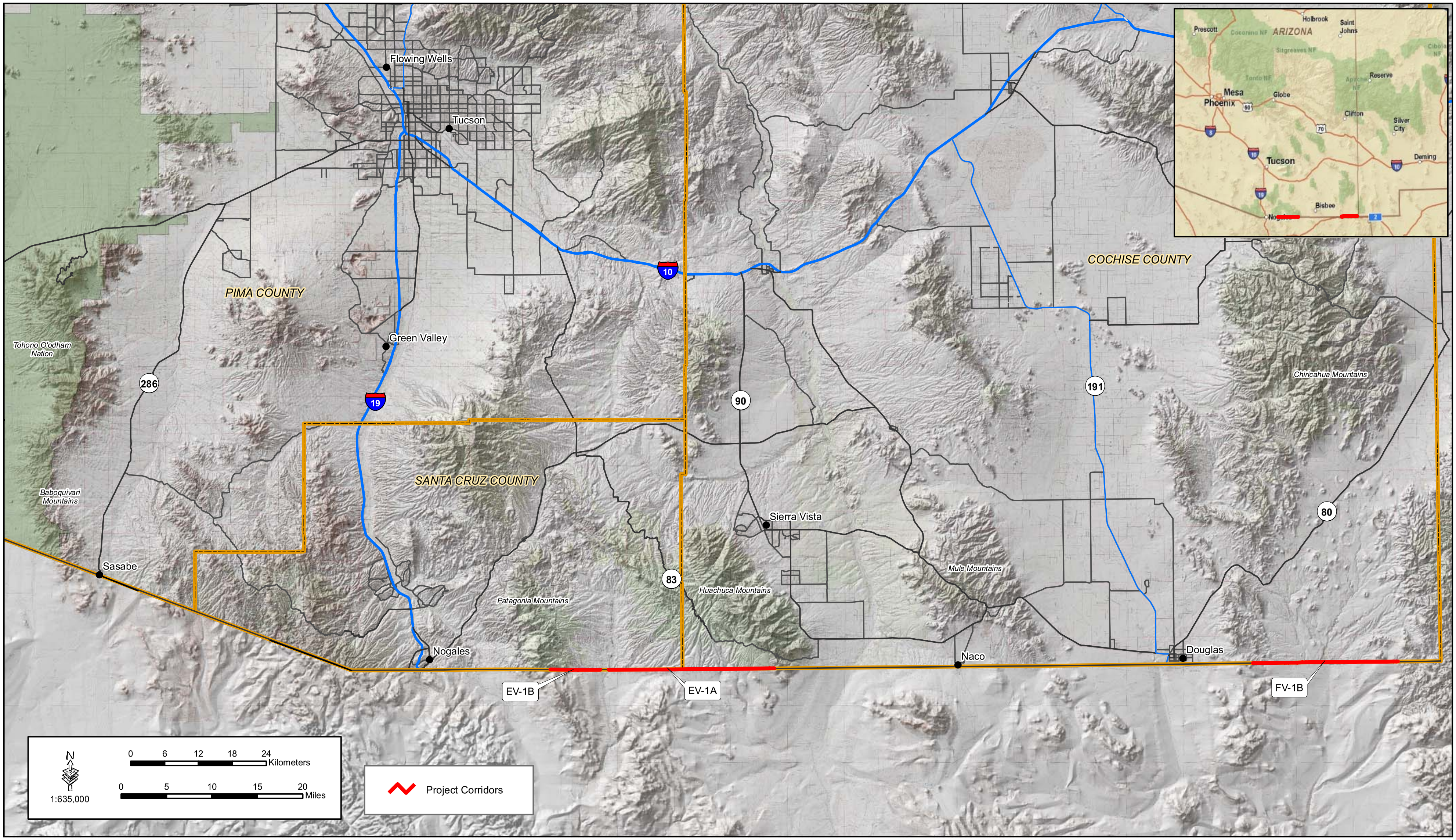


Figure 1-1: Project Vicinity Map

August 2008

THIS PAGE INTENTIONALLY LEFT BLANK

A road will be constructed along the border in a manner that will allow installation and maintenance of the fence. For most segments, the road would encompass the entire 60-foot wide Roosevelt Reservation. Due to steep terrain in the EV-1B segment the construction footprint will be up to 120 feet wide. This area constitutes the Project corridor in which all construction, operation, and maintenance activities of the vehicle fence will be conducted. Routine maintenance will occur, as needed, to preserve the integrity of the new and existing vehicle fence. The vehicle fence will be repaired, as needed, using welders and other equipment, and vegetation and debris within the Project corridor will be removed, as needed, to maintain flood prevention, visibility and mobility.

Nighttime construction activities will occur only when absolutely necessary for adequate concrete pours or if a 24-hour work day is needed to maintain the work task schedules, as Federally mandated. To facilitate construction activities during these work hours, portable lights will be used. It is estimated that no more than 10 lights will be in operation at any one time at each Project site. A 6-kilowatt self-contained diesel generator will power these. Each unit typically has four 400- to 1,000-watt lamps. The portable light systems can be towed to the desired construction location, as needed. Upon completion of construction activities, all portable lights will be removed from the Project corridor. Lights will be oriented to illuminate the work area, but the areas affected by illumination will be limited to 200 feet from the light source. Also, the lights will have shields placed over the lamps to reduce or eliminate the effects of backlighting.

1.2.1 Fence

TI includes the construction of approximately 18.76 miles of new primary vehicle fence and 21.56 miles of retrofit or replacement of TVB to permanent vehicle fence. The lengths of each fence segment and the associated road improvements or construction required to access the border (i.e., north-south access roads) are presented in Table 1-1. Construction access roads will also be built adjacent to the border in those areas where no roads currently exist to facilitate installation and maintenance of the vehicle fence. More detailed maps of these segments are presented in Appendix A. Two fence types are planned: Post on Rail Vehicle Fence and Normandy style Vehicle Fence (Photographs 1-1 and 1-2).

Table 1-1. Length of Vehicle Fence and Access Roads*

Segment	Vehicle Fence Length (miles)	Access Road (miles)
EV-1B	2.76	0
EV-1A	21.56	0
FV-1B	16	7.95

- With the exception of EV-1A, a construction access road will be built adjacent to the vehicle fence for all segments.

Photograph 1-1. Post on Rail Style Vehicle Fence

Photograph 1-2. Normandy Style Vehicle Fence

The vehicle fence will be a permanent structure designed to prevent illegal entry of vehicles across the U.S./Mexico border. It is not designed to preclude pedestrian or wildlife movement. The post-on-rail style vehicle fence entails drilling holes in the ground at 4 foot centers using a small drill truck. Hollow, square, steel posts (approximately 6 to 8 inches inside width) are placed into the holes. The steel posts and bore hole (footing) are filled with concrete. The posts are leveled and once the concrete has dried, a span of railroad rail is welded horizontally across the vertical posts.

The Normandy-style vehicle fence designed to prevent vehicle passage through various washes and major drainages. The design allows the fence to be removed during the monsoon season to avoid impeding water flow during high water events. The vehicle fence will be replaced when flood conditions are no longer imminent. Sections of the Normandy style fence will be transported to the site by small trucks with lowboy trailers. The vehicle fence will be put into place using forklifts. A construction/maintenance road will be constructed in order to install the vehicle fence; installation of Normandy style fence typically requires a 60-foot impact corridor. No pile driving will be required for construction of this fence type.

The Project will result in the permanent loss of 197.1 acres of vegetation, which includes 2.2 acres of semidesert grassland, 152.7 acres of desert scrub, 0.58 acres of cottonwood/willow riparian woodlands, 1.2 acres of cottonwood/sycamore riparian woodlands, and 40 acres of Manzanita scrub/oak woodland. Semidesert grassland is dominated by herbaceous species and, therefore, would be the most resistant to disturbance. The desert scrub communities are widespread throughout the Sonora desert and the loss of 152.7 acres would be considered a minimal to moderate impact, relative to the regional abundance of this community type. While not as abundant as the Manzanita scrub/oak woodland and the cottonwood/willow, cottonwood/sycamore communities are common both locally and regionally; thus, degradation or loss of a small portion of this community will be a moderate impact within a local or regional context.

1.2.2 Roads

As stated above, construction/maintenance roads will be constructed adjacent to the north side of the border to allow installation of the vehicle fence. In addition, construction access roads, which provide north-south access to the border from existing public roads, will be improved or constructed.

1.2.3 Staging Areas

The Project includes the establishment of 46 temporary staging areas, only two of which will be required for construction within the EV-1B / EV-1A segments. These staging areas would be approximately 0.5 to 2.1 acres in size. Storage of equipment and materials at the 46 temporary staging areas will result in the temporary disturbance of 53.2 acres of the common vegetation communities. Upon completion of construction activities, natural vegetation will be allowed to regenerate from the existing seed bank, undamaged root stocks of shrubs, and stem segments of cacti, or undergo active rehabilitation, if deemed necessary.

1.2.4 Fence Maintenance Operations

The vehicle fences will be made from non-reflective steel and will not require any painting. Fence maintenance will include removing any accumulated debris on the fence after a rain event to avoid potential future flooding. Brush removal could include mowing, removal of small trees, and application of herbicide, if needed. Within major drainages, the Normandy-style vehicle fence will be installed rather than the post-on-rail fence, because the Normandy-style fence can be easily moved and relocated. The vehicle fence within these washes will be removed prior to each monsoon season and replaced shortly after flood flows subside. Any destruction or breaches of the fence will be repaired, as needed.

1.3 BEST MANAGEMENT PRACTICES

1.3.1 General Best Management Practices

The following best management practices (BMPs) should be implemented to avoid or minimize impacts associated with the Project during construction. These represent Project objectives for implementation to the extent possible and will be incorporated into construction and monitoring contracts.

1. The perimeter of all areas to be disturbed during construction or maintenance activities will be clearly demarcated using flagging or temporary construction fence, and no disturbance outside that perimeter will be authorized.
2. CBP will develop (in coordination with U.S. Fish & Wildlife Service [USFWS]), U.S. Forest Service (USFS), and National Park Service (NPS), a training plan regarding Trust Resources for construction personnel. At a minimum, the program will include the occurrence of the listed and sensitive species in the area, their general ecology, sensitivity of the species to human activities, protection afforded these species, and Project features designed to reduce the impacts to these species and promote continued successful occupation of the Project area environments by the species.

   Included in this program will be color photos of the listed species, which will be shown to the employees. Following the education program, the photos will be posted in the office of the contractor and resident engineer, where they will remain through the duration of the Project. The selected construction contractor will be responsible for ensuring that employees are aware of the listed species.
3. Project Reports. Within 3 months of Project completion, a Project Report will be developed that details the BMPs that were implemented, identifies how well the BMPs worked, discusses ways that BMPs could be improved for either protection of species and habitats or implementation efficiency, and reports on any Federally listed species observed at or near the Project site. If site restoration was included as part of the Project, the implementation of that restoration and any follow-up monitoring will be included. Annual reports could

be required for some longer-term Projects. The Project and any annual reports will be made available to the USFWS.

4. If it is determined that salvage of plants is the best approach, a salvage plan for Federally listed plants will be developed and coordinated with USFWS. The CBP biological monitor will identify a location for storing any salvaged cactus and/or agaves. For particular actions, the USFWS will advise CBP regarding the relocation of plants.
5. Individual Federally listed animals found in the Project area will be relocated by a qualified biologist to a nearby safe location in accordance with accepted species-handling protocols to the extent practicable.
6. All construction projects in habitats of Federally listed species will have a qualified designated biological monitor on site during the work. Duties of the biological monitor will include ensuring that activities stay within designated Project areas, evaluating the response of individuals that come near the Project site, and implementing the appropriate BMP. The designated biological monitor will notify the construction manager of any activities that might harm or harass an individual of a Federally listed species. Upon such notification, the construction manager may temporarily suspend all activities in question and notify the Contracting Officer, the Administrative Contracting Officer, and the Contracting Officer's Representative of the suspense so that the key U.S. Army Corps of Engineers (USACE) personnel can be notified and apprised of the situation for resolution. The biological monitor will document implementation of construction-related BMPs designed for the Project to reduce the potential for adverse effects on the species or their habitats. Weekly reports from the biological monitor should be used for developing the Project Report.
7. Where a construction Project could be located within 1 mile of occupied species habitats, but the individuals of the species are not likely to move into the Project area, a biological monitor is not needed. However, the construction monitor will be aware of the species-specific BMPs and ensure that BMPs designed to minimize habitat impacts are implemented and maintained as planned. This category includes the lesser long-nosed bat and all protected aquatic species.
8. Particular importance is given to proper design and location of roads so that the potential for roadbed erosion into Federally listed species habitat will be avoided or minimized.
9. Particular importance is given to proper design and location of roads so that the potential for entrapment of surface flows within the roadbed due to grading will be avoided or minimized. Depth of any pits created will be minimized so animals do not become trapped.
10. Particular importance is given to proper design and location of roads so that the widening of existing or created roadbed beyond the design parameters due to improper maintenance and use will be avoided or minimized.
11. Particular importance is given to proper design and location of roads so that excessive use of unimproved roads for construction purposes that results in

their deterioration that affects the surrounding Federally listed species habitat areas will be minimized. Road construction and use for construction will be monitored and documented in the Project Report.

12. Particular importance is given to proper design and location of roads so that the fewest roads needed for construction will be developed and that these are maintained to proper standards. Roads no longer needed by the government should be closed and restored to natural surface and topography using appropriate techniques. The Global Positioning System (GPS) coordinates of roads that are thus closed should be recorded and integrated into the USBP Geographic Information System (GIS) database. A record of acreage or miles of roads taken out of use, restored, and revegetated will be maintained.
13. The width of all roads that are created or maintained by CBP for construction purposes will be measured and recorded using GPS coordinates and integrated into the USBP GIS database. Maintenance actions should not increase the width of the roadbed or the amount of disturbed area beyond the roadbed.
14. Construction equipment will be cleaned using BMPs prior to entering and departing the Project corridor to minimize the spread and establishment of non-native invasive plant species.
15. Surface water from untreated sources, including water used for irrigation purposes, will not be used for construction or maintenance Projects located within 1 mile of aquatic habitat for Federally listed aquatic species. Groundwater or surface water from a treated municipal source will be used when close to such habitats. This is to prevent the transfer of invasive animals or disease pathogens between habitats in case water on the construction site were to reach the Federally listed species habitats.
16. Materials such as gravel or topsoil will be obtained from existing developed or previously used sources, not from undisturbed areas adjacent to the Project area. Fill material brought in from outside the Project area will be identified as to source location and will be weed-free to the extent practicable.
17. When available, areas already disturbed by past activities or those that will be used later in the construction period will be used for staging, parking, and equipment storage, where practicable.
18. Within the designated disturbance area, grading or topsoil removal will be limited to areas where this activity is needed to provide the ground conditions needed for construction or maintenance activities. Minimizing disturbance to soils will enhance the ability to restore the disturbed area after the Project is complete.
19. Water for construction use will be from wells or irrigation water sources at the discretion of the landowner (depending on water rights). If local groundwater pumping creates an adverse effect on aquatic-, marsh-, or riparian-dwelling Federally listed species, treated water from outside the immediate area will be utilized.

20. Surface water from aquatic or marsh habitats will not be used for construction purposes if that site supports aquatic Federally listed species or if it contains nonnative invasive species or disease vectors and there is any opportunity to contaminate a Federally listed species habitat through use of the water at the Project site.
21. Water tankers that convey untreated surface water will not discard unused water where it has the potential to enter any aquatic or marsh habitat.
22. Water storage on the Project area should be in closed on-ground containers located on upland areas, not in washes.
23. Pumps, hoses, tanks, and other water storage devices will be cleaned and disinfected with a 10 percent bleach solution at an appropriate facility before use at another site. If untreated surface water was used, measures shall be implemented to ensure that this water does not enter any surface water area. If a new water source is used that is not from a treated or groundwater source, the equipment will require additional cleaning. This is important to kill any residual disease organisms or early life stages of invasive species that could affect local populations of Federally listed species.
24. CBP will develop and implement storm water management plans for every Project, as appropriate.
25. A CBP-approved spill protection plan will be developed and implemented at construction and maintenance sites to ensure that any toxic substances are properly handled and that escape into the environment is prevented. Agency standard protocols will be used. Drip pans underneath equipment, containment zones used when refueling vehicles or equipment, and other measures are to be included.
26. Nonhazardous waste materials and other discarded materials, such as construction waste, will be contained until removed from the construction site. This will assist in keeping the Project area and surroundings free of litter and reduce the amount of disturbed area needed for waste storage.
27. To avoid attracting predators of protected animals, all food-related trash items such as wrappers, cans, bottles, and food scraps will be disposed of in closed containers and removed daily from the Project site.
28. Waste water is water used for Project purposes that is contaminated with construction materials, or was used for cleaning equipment and thus carries oils or other toxic materials or other contaminants in accordance with state regulations. Waste water will be stored in closed containers on site until removed for disposal. Concrete wash water will not be dumped on the ground, but is to be collected and moved offsite for disposal. This wash water is toxic to aquatic life.
29. Construction speed limits will not exceed 35 miles per hour (mph) on major unpaved roads (graded with ditches on both sides) and 25 mph on all other unpaved roads. Nighttime travel speeds will not exceed 25 mph, and might be

less based on visibility and other safety considerations. Construction at night will be minimized.

30. No pets owned or under the care of the construction contractor or any and all construction workers will be permitted inside the Project's construction boundaries, adjacent native habitats, or other associated work areas. This BMP does not apply to any animals under service to the USBP (such as canine and horse patrols).
31. If construction or maintenance activities continue at night, all lights will be shielded to direct light only onto the area required for worker safety and productivity. The minimum wattage needed will be used and the number of lights will be minimized.
32. Light poles and other pole-like structures will be designed to discourage roosting by birds, particularly ravens or raptors that may use the poles for hunting perches.
33. Noise levels for day or night construction and maintenance will be minimized. All generators will be in baffle boxes (a sound-resistant box that is placed over or around a generator), have an attached muffler, or use other noise-abatement methods in accordance with industry standards.
34. Transmission of disease vectors and invasive nonnative aquatic species can occur if vehicles cross infected or infested streams or other waters and water or mud remains on the vehicle. If these vehicles subsequently cross or enter uninfected or noninfested waters, the disease or invasive species could be introduced to the new area. To prevent this, crossing of streams or marsh areas with flowing or standing water will be avoided by construction vehicles and equipment, and, if not avoidable, the construction vehicle/equipment will be sprayed with a 10 percent bleach solution.
35. Materials used for on-site erosion control will be free of nonnative plant seeds and other plant parts, to the extent practicable, to limit potential for infestation. Since natural materials cannot be certified as completely weed-free, if such materials are used, there will be follow-up monitoring to document establishment of nonnative plants, and appropriate control measures will be implemented for a period of time to be determined in the site restoration plan.
36. Appropriate techniques to restore the original grade, replace soils, and restore proper drainage will be implemented for areas to be restored (e.g., temporary staging areas).
37. A site restoration plan for Federally listed species and habitat will be developed during Project planning and provide an achievement goal to be met by the restoration activity. If seeding with native plants is identified as appropriate, seeding will take place at the proper season and with native seeds.
38. During follow-up monitoring and during maintenance activities, invasive plants that appear on the site will be removed. Mechanical removal will be done in ways that eliminate the entire plant and remove all plant parts to a disposal area. All chemical applications on refuges must be used in coordination with the

USFS, Bureau of Land Management (BLM), or NPS Integrated Pest Management Coordinator to ensure accurate reporting. Herbicides can be used according to label directions. The monitoring period will be defined in the site restoration plan.

39. To prevent entrapment of wildlife species during emplacement of vertical posts/bollards, all vertical fence posts/bollards that are hollow (i.e., those that will be filled with a reinforcing material such as concrete), will be covered so as to prevent wildlife from entrapment. Covers will be deployed from the time the posts or hollow bollards are erected to the time they are filled with reinforcing material.
40. To prevent entrapment of wildlife species during the construction of the Project, all excavated, steep-walled holes or trenches will be provided with one or more escape ramps constructed of earth fill or wooden planks. The ramps will be located at no greater than 100-foot intervals and will be sloped less than 45 degrees. Each morning before the start of construction and before such holes or trenches are filled, they will be thoroughly inspected for trapped animals. Any animals so discovered will be allowed to escape voluntarily (by escape ramps or temporary structures), without harassment, before construction activities resume, or removed from the trench or hole by the biological monitor and allowed to escape unimpeded.

1.3.2 BMPs for Temporary Impacts

The following apply as offsetting conservation measures for temporary impacts.

1. Site restoration of temporarily disturbed areas such as staging areas and construction access routes will be monitored as appropriate. Where practicable, surface disturbance and removal of plant cover should be minimized in areas of temporary construction impacts and root stocks left intact.
2. During follow-up monitoring of any restoration area, invasive plants that appear on the site will be removed. Mechanical removal will be done in ways that eliminate the entire plant and remove all plant parts to a disposal area. All chemical applications on refuges must be used in coordination with the USFS, BLM or NPS Integrated Pest Management Coordinator to ensure accurate reporting. Herbicides will be used according to label directions. The monitoring period will be defined in the site restoration plan. Training to identify nonnative invasive plants will be provided for contractor personnel, as necessary.

1.3.3 Species-Specific BMPs

Pima Pineapple Cactus and Cochise Pincushion Cactus

1. Maintenance activities in Pima pineapple (*Coryphantha scheeri var. robustispina)* and Cochise pincushion cacti (*Coryphantha robbinsorum*) habitat should not increase the existing disturbed areas, subsequent to the construction of the Project.

2. Use of existing roads and trails should be maximized in areas of suitable habitat for the Pima pineapple and Cochise pincushion cacti. Maps of suitable habitat areas should be available and protection of the two cacti stressed in environmental education for contractors involved in construction or maintenance of facilities.

3. Salvage of individual Pima pineapple or Cochise pincushion cacti, if any undiscovered specimens are found, will be considered only when on-site or off-site habitat conservation is not possible and death of the individual is unavoidable.

Huachuca Water-Umbel

1. Because loss of habitat is a significant risk to the Huachuca water-umbel, (*Lilaeopsis schaffneriana ssp. recurva*) no roads, fences, structures, or other on-ground facilities will be placed within 0.25 miles of occupied or potentially suitable habitat areas. If these areas cannot be avoided, minimization and mitigation will be included in the Project design, including BMPs to control erosion and sedimentation.
2. TI must not be located within 0.25 miles of known or potential habitat, vegetation clearing will be limited, and erosion-control measures put in place to reduce sediment runoff potential. Monitoring of effects on aquatic habitat during construction may be appropriate.
3. Preconstruction surveys are not necessary as long as Projects are located at least 0.25 miles from occupied habitat areas so that watershed effects will not reach the water-umbel habitat.
4. Whenever practicable, road construction and maintenance will not create new available access to known water-umbel habitats.
5. Use of existing roads and trails in or adjacent to water-umbel habitat will be maximized. Educational briefing materials including distribution maps, on the presence of the species will be provided as part of training. Maps can be helpful for this purpose.

Chiricahua Leopard Frog

1. Exclusion fencing might be appropriate where road kill is likely or to direct species to underpasses or other passageways. Specific protocols are available for Chiricahua leopard frog (*Rana chiricahuensis)*.
2. Monitoring of effects on the frog's terrestrial and aquatic habitat during construction may be appropriate. Disease prevention protocols will be employed if the Project is in areas known or likely to harbor chytridiomycosis (consult with the USFWS to identify these areas). In such cases, if vehicles/equipment use will occur in more than one frog habitat, ensure that all equipment is clean and dry or disinfected before it moves to another habitat.

3. To the extent practicable, removal of riparian vegetation within 100 feet of aquatic habitats will be avoided to provide a buffer area to protect the habitat from sedimentation. Construction within Sycamore Canyon Creek will be avoided to the maximum extent practicable.

Sonora Tiger Salamander

1. Exclusion fencing or underpasses should be installed within 0.3 mile of occupied Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*) habitat during the migration or leching seasons.
2. Operate construction vehicle/equipment at speeds of 25 mph or less within 0.3 mile of occupied tiger salamander habitat during the migration or leching season.
3. Avoid night time construction activities, particularly construction vehicle traffic, within 0.3 mile of occupied tiger salamander habitat, to the extent practicable.
4. If a tiger salamander individual is observed, construction activities in the immediate area, including vehicular traffic, should cease until the salamander leaves the road on its own volition, or can be removed from the area by a qualified person.
5. To the extent practicable, avoid removing vegetation within 100 feet to a stream, spring or stock tank to reduce the potential of erosion or sedimentation.

Jaguar and Ocelot

1. If construction or maintenance activities continue at night, all lights will be shielded to direct light only onto the work site and the area necessary to ensure the safety of the workers.

Lesser Long-Nosed Bat

1. When planning activities, avoid areas containing columnar cacti (e.g., saguaro [*Carnegiea gigantea*] and organ pipe) or agaves that provide the forage base for the bat. If they cannot be avoided, columnar cacti and agaves will be salvaged and transplanted to the extent practicable prior to construction activity. Any restoration (e.g., planting of cacti or agaves raised off-site or purchased) would be a compensation measure (see Compensation Measures below).
2. Maintenance activities for facilities can occur at any time; however, for major work on roads or fences where significant amounts of equipment will be required, the October to April period is the preferred period for such activities
3. If construction or maintenance activities occur at night, all lights will be shielded to direct light only onto the work site and the area necessary to ensure the safety of the workers.

Mexican Spotted Owl

1. If construction or maintenance activities continue at night, all lights will be shielded to direct light only onto the work site and the area necessary to ensure the safety of the workers.
2. Vegetation cleared for construction will be left as debris piles to provide prey habitat and increase presence of primary constituent elements (PCE) for the Mexican spotted owl (*Strix occidentalis lucida*) (MSO).
3. Clearing and grubbing will be minimized to the extent practicable within designated MSO Critical Habitat. In particular, components which comprise the MSO PCEs should be avoided.

1.3.4 Compensation Measures

It is CBP's policy to reduce impacts through the sequence of avoidance, minimization, and mitigation. Current estimates of impacts for MSO, jaguar (*Panthera onca*) and lesser-long nosed bat (*Leptonycteris curasoae yerbabuenae*) habitat are presented in **Table 1-2**. Additionally, the Project may affect, but is not likely to adversely affect Cochise pincushion cactus, Pima pineapple cactus, Huachuca water-umbel, ocelot (*Leopardus pardalis*), and Sonora tiger salamander If the Project results in adverse impacts on these species, CBP will mitigate as appropriate. Actual impacts to habitats will be documented during construction by the environmental monitors and included in the Project Report which will be made available to USFWS.

Table 1-2. Summary of Permanent Impacts of the Project on Habitat

Habitat Type	Estimated Acres of Permanent Total Impact	Segment	
		EV-1B	FV-1B
Semidesert grassland (habitat for jaguar and lesser long-nosed bat)	2.2	-	2.2
Manzanita scrub/oak woodlands (habitat for jaguar and MSO)	40	40	-
Sonora desertscrub (habitat for jaguar and lesser long-nosed bat)	152.7	-	152.7
Cottonwood-willow riparian woodlands (habitat for MSO, jaguar and ocelot)	0.58	-	0.58
Cottonwood-sycamore riparian woodlands (habitat for MSO, jaguar and ocelot)	1.2	-	1.2
Totals	**197.1**	**40**	**157.7**

Using funds contributed to the compensation pool by CBP, USFWS may offset permanent direct and indirect impacts on habitat used by Federal listed species. USFWS may use these monies to fund conservation actions benefitting these species.

Jaguar

1. Using funds from the mitigation pool established by CBP, USFWS may support Jaguar Conservation Team activities or support the monitoring program, such as funding for additional trip cameras at potential jaguar locations and radio telemetry.

Lesser Long-Nosed Bat

1. Using funds from the mitigation pool established by CBP, USFWS may continue monitoring of maternity and summer roost sites to assist in documenting the status of the species. Infra-red cameras could also be purchased to document bats at roosts.
2. When salvage is not possible, USFWS or relevant land management agencies may use funds from the mitigation pool established by CBP to conduct restoration for columnar cacti and agaves.
3. Using funds from the mitigation pool established by CBP, USFWS may plant Palmer’s agave in suitable areas as part of revegetation and erosion-control actions. This would enhance foraging opportunities.
4. Using funds from the mitigation pool established by CBP, USFWS may support telemetry monitoring of foraging bats to determine the degree to which roads and fences act as barriers or increase habitat fragmentation to provide useful information for determining the effect on bat foraging and movement of future Projects.

Mexican Spotted Owl

1. Using funds from the mitigation pool established by CBP, USFWS may support monitoring of primary activity centers (PAC) to determine the degree to which roads and fences increase habitat fragmentation to provide useful information for determining the effect on owl foraging and movement of future Projects.
2. Using funds from the mitigation pool established by CBP, USFWS, and USFS may cooperate to provide intensive vegetation management to enhance the PCEs within designated Critical Habitat.

Sonora chub

1. Preconstruction surveys within the immediate footprint and downstream areas within FV-1B segments.
2. Land clearing within the watershed of occupied habitat will be minimized to the extent practicable and measures to control erosion off the construction site will

be implemented. Roads and fences that would require land clearing will be designed to avoid areas within 0.5 miles of sites containing habitat to the extent practicable.

3. If facilities must be located within 0.5 miles of occupied habitats, vegetation clearing will be limited, and erosion-control measures put in place concurrent to construction to reduce sediment runoff potential. Monitoring of effects on aquatic habitat during construction may be appropriate.
4. Removal of riparian vegetation within 100 feet of streams will be avoided to the extent practicable to provide a buffer area to protect stream banks.

2. DESCRIPTION OF SPECIES AND THEIR HABITAT

This section summarizes information regarding some of the key species and habitats addressed in this document. Some listed species are not included here because the implementation of the agreed upon BMPs and conservation measures are anticipated to provide conditions that avoid adverse effect. For more complete information and supporting citations regarding species' descriptions, distribution and abundance, habitat needs, life history, and population ecology, the local USFWS office can be contacted.

2.1 JAGUAR

The U.S. population of jaguar was listed as Endangered on July 22, 1997 (62 *Federal Register* [FR] 39147) without Critical Habitat. Non-U.S. population was listed as Endangered on March 30, 1972 (37 FR 6476).

Land management/ownership for this species includes areas associated with NPS, USFS, BLM, various Native American Tribes, the State of Arizona, and private land holdings (USFWS 2000a).

2.1.1 Species Description

The species is a large, heavy-bodied, big-headed cat. Yellowish to tawny, spotted with black rosettes or rings in horizontal rows along the back and sides; most rings are tan inside, with one or two black spots. Legs, head, and tail have smaller, solid spots, usually giving way to incomplete bands near the end of the tail (USFWS 2000a).

The jaguar is the largest species of cat native to the Western Hemisphere. The species is muscular, with relatively short, massive limbs, a deep-chested body, cinnamon-buff in color with many black spots. Weight ranges widely from 90 to 300 pounds. Length is 7.8 feet from head to tail tip (USFWS 2000a).

2.1.2 Distribution and Abundance

The historic range included California, Arizona, New Mexico, Louisiana, south through Texas and into central South America. In Arizona the species was found in mountainous parts of eastern Arizona to the Grand Canyon (USFWS 2000a).

The current range includes central Mexico and into central South America as far south as northern Argentina. There are no known breeding populations in the U.S. (USFWS 2000a).

In Arizona, the general distribution of past sightings and the habitats associated with these sightings include areas of forest, woodland, and grassland vegetation types in the Baboquivari Mountains, the southern portion of the Altar Valley, a portion of the southern Santa Cruz River basin, and the San Pedro River basin south of Arivapa Creek. Recent (2001 to 2007) jaguar observations in south-central Arizona near the Mexican border have primarily occurred in Madrean oak woodland communities;

however, jaguars were also documented in open mesquite grasslands and desert scrub/grasslands on the desert valley floor (USFWS 2007a).

2.1.3 Habitat

The species is found near water in the warm tropical climate of savannah and forest. Rarely found in extensive arid areas. Individuals in Arizona have been found in Sonora desertscrub up through subalpine conifer forest (USFWS 2000a). Most jaguar detections occurred in Madrean oak woodland communities; however, jaguars were also documented in open mesquite grasslands and desert scrub/grasslands on the desert valley floor.

2.1.4 Threats

A number of threats contributed to or continue to affect the status of northern jaguar populations, including illegal shooting; overhunting of jaguar prey species; and habitat loss, fragmentation, and modification (USFWS 2000a). Changes in jaguar habitat have affected not only habitat for breeding and foraging, but also movement corridors.

2.2 HUACHUCA WATER-UMBEL

The Huachuca water-umbel was listed as Endangered on January 6, 1997 (62 FR 3) with Critical Habitat (64 FR 37441, July 12, 1999).

Land management/ownership for this species includes areas associated with the Coronado National Forest, San Bernardino National Wildlife Refuge, BLM, Fort Huachuca Military Reservation, and private land holdings (USFWS 2001a).

Critical habitat includes 51.7 miles of streams or rivers in Cochise and Santa Cruz counties, Arizona. The following general areas are included in the Critical Habitat: Sonoita Creek, Santa Cruz River, Scotia Canyon, Sunnyside Canyon, Garden Canyon, Lone Mountain Canyon, Rattlesnake Canyon, Bear Canyon, and 33.7 miles of the Upper San Pedro River (USFWS 2001a).

2.2.1 Species Description

The species is a slender, erect terrestrial perennial orchid found on slopes adjacent to marshy wetlands or cienegas intermixed with tall grasses and sedges. The water-umbel is an herbaceous semi-aquatic perennial in the parsley family (Umbelliferae) with slender erect leaves that grow from the nodes of creeping rhizomes. The leaves are segmented, hollow cylinders, and are 0.04 to 0.12 inches in diameter, but their length can vary from 1 to 9 inches, depending on the depth of the water. Tiny 3- to 10-flowered umbels arise from root nodes. The inflorescence is 0.5 to 2.0 inches long and is always shorter than the stems (USFWS 2001a).

2.2.2 Distribution and Abundance

The current range includes a number of disjunct localities in Santa Cruz, Cochise, and Pima counties, Arizona; and Sonora, Mexico. Potential range for the species could be wherever habitat conditions are met in southeastern Arizona or northern Mexico (USFWS 2001a).

2.2.3 Habitat

Typical habitat includes cienegas and associated vegetation within Sonora desertscrub, grassland or oak woodland, and conifer forest between 4,000 to 6,500 feet. *L. schaffneriana* ssp. *recurva* seems to require an intermediate level of flooding frequency to keep competition manageable, but populations can be destroyed when floods are too frequent and intense. Plants are found in unshaded or shaded sites. They require perennial water, gentle stream gradients, small- to medium-sized drainage areas, and (apparently) mild winters. Usually found in water depth from 2 to 10 inches (USFWS 2001a).

2.2.4 Threats

Wetland habitats for the species are rare and declining in the Southwest. Threats include watershed degradation due to livestock grazing and development, trampling by livestock, diversion of water and dewatering of habitats, and flash flooding (USFWS 2001a).

2.3 PIMA PINEAPPLE CACTUS

The Pima pineapple cactus was listed as Endangered on September 23, 1993 (58 FR 49875) without Critical Habitat.

Land management/ownership for this species includes areas associated with BLM, Coronado National Forest, Buenos Aires National Wildlife Refuge, State Land Department, possibly Bureau of Reclamation, and the Tohono O'odham and Pascua Yaqui Tribes (USFWS 2000b).

Protected from international trade, Pima pineapple cactus is covered by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The species is also known as Scheer's strong-spined cory cactus. *Mammillaria robustispina* is a synonym for *Coryphantha scheeri* var. *robustispina.* This species can be confused with juvenile barrel cactus (*Ferocactus*) (USFWS 2000b).

2.3.1 Species Description

The Pima pineapple cactus is a low-growing cactus species that can be found as single- or multi-stemmed plants. The species grows in the transition zone between the semi-desert grasslands and Sonora desertscrub on alluvial bajadas and slopes of less than 10 percent at elevations between 2,300 to 4,600 feet (USFWS 2000b).

The Pima pineapple cactus is an attractive hemispherical plant; the adults measure 4 to 18 inches tall and 3 to 7 inches in diameter. The spines appear in clusters with one strong, usually hooked central spine and 6 to 15 straight radial spines. The spines are very stout, usually straw-colored, but become black with age. The plants can be single-stemmed, multiheaded, or can appear in clusters. The flowers are silky yellow (rarely white) in color and appear in early July with the summer rains. Flowering continues until August. The fruit is green, ellipsoid, succulent, and sweet (USFWS 2000b).

2.3.2 Distribution and Abundance

Pima pineapple cactus are found at elevations from 2,300 to 4,500 feet in Pima and Santa Cruz counties, Arizona; and northern Sonora, Mexico. The range extends east from the Baboquivari Mountains to the western foothills of the Santa Rita Mountains. The northernmost boundary is near Tucson. Potential habitat for this species is difficult to estimate due to its habitat requirements and the topographic complexity within its range (USFWS 2000b).

2.3.3 Habitat

This cactus grows in alluvial basins or on hillsides in semi-desert grassland and Sonora desertscrub in southern Arizona and northern Mexico. Soils range from shallow to deep, and silty to rocky, with a preference for silty to gravely deep alluvial soils. The plant occurs most commonly in open areas on flat ridge tops or areas with less than 10 to 15 percent slope (USFWS 2000b).

2.3.4 Threats

Threats to this species include illegal collection; habitat degradation due to recreation and historical and present overuse of the habitat by livestock; habitat loss due to mining, agriculture, road construction, urbanization, aggressive non-native grasses, and range management practices to increase livestock forage (USFWS 2000b).

2.4 COCHISE PINCUSHION CACTUS

The Cochise pincushion cactus was listed as a threatened species on January 9, 1986 (USFWS 1986). Critical habitat was not designated. The species was listed as threatened because of its small population size and threats related to collecting, potential minerals exploration and mining, and habitat degradation from livestock and wildlife.

2.4.1 Species Description

The Cochise pincushion cactus is a small (1 to 3 inches in diameter), unbranched cactus covered by white, cottony, areoles. The radial spines overlap with the areoles, giving the cacti an overall whitish appearance. The flowers are pale yellow or light beige and are produced in early spring (March). Fruits are orange-red to scarlet and may contain up to 20 seeds. Most of the stem is underground, with only the top 2 inches visible above ground. During droughts and seasonal dry times, the cacti shrink or retract into the soil, making them difficult to see (USFWS 2007b).

2.4.2 Distribution and Abundance

The Cochise pincushion cactus is scattered among several limestone hills in southeastern Cochise County, Arizona. At least one population is known from northern Sonora, Mexico (USFWS 2007b).

2.4.3 Habitat

The cacti are located on Permian limestone hills, at elevations ranging from 4,200 to 4,700 feet. The soils are low in nutrients, with a pH of 7.9 to 8.0. Plants require well-drained substrates and grow in full sunlight. Dense colonies of the cacti occur on bedrock, with very little soil. Within their limited habitat the plants are found scattered, with a few dense clumps ranging from 100 to 1,000 individuals (USFWS 2007b).

2.4.4 Threats

Threats to the species include collecting, potential minerals exploration and development, and habit degradation from cattle, wildlife, feral animals (USFWS 1993), and invasive plant species, especially grasses (USFWS 2007b).

Southeastern Arizona has been experiencing long-term drought conditions since 2000. Survival and reproduction of the Cochise pincushion cactus seems to be affected by the ongoing lack of precipitation. It remains to be seen if populations will recover if/when the effects of the drought are over. In addition, areas along the U.S./Mexico border continue to see resource damage as a result of illegal immigration and drug smuggling. The topography of the area where the Cochise pincushion cactus occurs makes this area favorable for illegal border traffic. Trampling and ground disturbance resulting from border activities remains a potential threat to this species (USFWS 2007b).

2.5 SONORA TIGER SALAMANDER

The Sonora tiger salamander is Federally listed as endangered. There is no Critical Habitat designated in Arizona. The subspecies has been found in 53 ponds in the San Rafael Valley of Arizona (USFWS 2002a), which is where the EV-1A section is located.

2.5.1 Species Description

Sonora tiger salamanders begin their life as jelly-coated eggs laid in water. They hatch and grow as aquatic larvae with gills, and then either mature as gilled aquatic adults called branchiate adults, neotenes, or paedomorphs, or metamorphose into terrestrial salamanders without gills. Metamorphosed terrestrial Sonora tiger salamanders have a color pattern ranging from “a reticulate pattern with an irregular network of light coloration, often coupled with light spots, on a dark background color”, to a pattern of large, well-defined light or yellow spots or transverse bars, some of which encroach on the dark venter. Metamorphosed Sonora tiger salamanders measure from about 1.8 to 6 inches snout to vent length. Branchiate adults are gray to olive on the dorsum, head, and tail, and off-white to yellow on the ventral side. They have three external gills on each side of their head, and measure between 2.5 to 6.5 inches. Male and female adult salamanders can be distinguished by the presence of two black folds of tissue (cloacal folds) on the caudal side of a male's vent. Larvae are gray on the dorsum head, and tail, with little pigment on the ventral surface. They have external gills and hatch without legs, but grow hind and fore-limbs early in development (USFWS 2002a).

2.5.2 Distribution and Abundance

Most known Sonora tiger salamander populations exist in the San Rafael Valley. The San Rafael Valley lies between the Huachuca and Patagonia Mountains, is bordered by the Canelo Hills to the north, and extends from Santa Cruz County in Arizona south for approximately 18 miles into Sonora, Mexico (USFWS 2002a).

Because so few sites were sampled prior to the 1980's, it is impossible to determine the historical distribution of Sonora tiger salamanders. However, based on collections and observations of salamanders and the distribution of the plains grassland and adjacent Madrean Evergreen Woodlands in which the salamander has been found, the range of the subspecies and its occupied and potentially occupied habitat is thought to extend from the crest of the Huachuca Mountains west to the crest of the Patagonia Mountains, including the San Rafael Valley and adjacent foothills from its origins in Sonora north to the Canelo Hills.

Surveys for the Sonora tiger salamander have been conducted on public land throughout the Arizona portion of the San Rafael Valley. Surveys have also been conducted on the San Rafael Cattle Ranch. The number of salamanders supported by each pond is difficult to determine, because metamorphosed salamanders can survive outside the ponds and it is not know what proportion of metamorphs breed each year. In some years, salamanders will be completely absent from a pond, only to return the following year to breed and produce many offspring (USFWS 2002a). Tiger salamanders have also been found in areas just outside the San Rafael Valley, such as Fort Huachuca, Harshaw Canyon, Copper Canyon, and Coronado Memorial.

2.5.3 Habitat

Cattle ponds or tanks are the primary habitat for Sonora tiger salamanders. Salamanders suspected of being Sonora tiger salamanders were found in the Los Fresnos cienega in Mexico, south of the U.S./Mexico border. Tiger salamanders were also found in a cave and vertical mining shaft at the northwestern edge of the San Rafael Valley (USFWS 2002a).

The most important habitat requirement for Sonora tiger salamanders is the availability of standing water for breeding from January through June. This gives the salamanders enough time to breed, grow as larvae, and metamorphose before the pond dries. Aquatic breeding habitats are used by all life stages; however, upland habitats are also used by terrestrial adults when not at the breeding ponds. Aquatic and bank-line vegetation is missing from many ponds with salamanders, suggesting that these factors, although beneficial, are not necessary for the persistence of Sonora tiger salamanders.

Sonora tiger salamanders are tolerant of a wide range of temperatures, with temperatures in ponds varying from less than 41 degrees Fahrenheit (^{o}F) at the beginning of the year up to 86^{o} F during summer. Temperatures in the terrestrial environment range from below freezing to over 95^{o} F. Mammal burrows or loosened soils outside the pond likely provide refugia for metamorphosed salamanders in the terrestrial environment, enabling them to burrow underground to avoid extreme environmental conditions.

2.5.4 Threats

Despite the fact that Sonora tiger salamander populations face threats of introduced predators, disease, genetic swamping, restricted distribution, and habitat dependent on human management, there is little reason to assume that Sonora tiger salamanders are in immediate danger of extinction. Because Sonora tiger salamanders have such a restricted distribution, and because persistence of their habitat depends directly on human management strategies, they will always be vulnerable to changes in land management and relatively small changes in environmental variables such as drying frequency, frequency of disease outbreaks, and frequency with which fish or non-native salamanders are introduced.

2.6 MEXICAN SPOTTED OWL

The MSO was listed as a threatened species on April 15, 1993. Critical habitat was designated in Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, and Yavapai counties in Arizona on August 31, 2004 (69 FR 53182, August 31, 2004). The majority of the owls are found on National Forests lands. They are also found on tribal lands, NPS lands, and on BLM lands (USFWS 2008). The Recovery Plan for the MSO was completed in December 1995 and is currently being revised. A Final Recovery Plan is expected in November 2009. Tribal lands within Arizona are excluded from MSO Critical Habitat designation under Section 4(b)(2) of the Act (USFWS 2008).

2.6.1 Species Description

The MSO has large, dark eyes, dark to chestnut brown coloring, whitish spots on the head and neck, and white mottling on the abdomen and breast. The spots of the MSO are larger and more numerous than in the other two subspecies, giving it a lighter appearance. Several thin white bands mark an otherwise brown tail. Young owls less than 5 months old have a downy appearance. Females are larger than males.

2.6.2 Distribution and Abundance

The historical range extended from the southern Rocky Mountains in Colorado and the Colorado Plateau in southern Utah southward through Arizona, New Mexico, and far western Texas, through the Sierra Madre Occidental and Oriental, to the mountains at the southern end of the Mexican Plateau. The present range is thought to be similar to the historical range. Populations in Arizona are patchily distributed and occur where appropriate habitat is present throughout all but the arid southwestern portion of the state (USFWS 2008).

The owl occupies a broad geographical area, but does not occur uniformly throughout its range. It occurs in disjunct localities that correspond to isolated mountain systems and canyons. About 91 percent of known MSO existing in the U.S. between 1990 and 1993 occurred on land administered by the USFS, the primary administrator of lands supporting owls. Most owls have been found within the 11 National Forests of Arizona and New Mexico (USFWS 2004).

2.6.3 Habitat

The owl inhabits canyon and forest habitats across its range and is frequently associated with mature mixed-conifer, pine-oak, and riparian forests. They are also found in canyon habitat dominated by vertical-walled rocky cliffs within complex watersheds including tributary side canyons. Rock walls include caves, ledges, and other areas that provide protected nest and roost sites. Canyon habitat may include small isolated patches or stringers of forested vegetation including stands of mixed-conifer, ponderosa pine, pine-oak, pinyon-juniper, and/or riparian vegetation in which owls regularly roost and forage. Owls are usually found in areas with some type of water source (*i.e.*, perennial stream, creeks, and springs, ephemeral water, small pools from runoff, reservoir emissions) (USFWS 2004).

Roosting and nesting habitat exhibit certain identifiable features, including large trees with a trunk diameter of 12 inches or more, uneven aged tree stands, a multi-storied canopy, a tree canopy creating shade over 40 percent or more of the ground that overlook downed logs and snags (USFWS 2004). Owls use areas that contain a number of large trees of different types including mixed-conifer and pine-oak with smaller trees under the canopy of the larger trees. These types of areas provide vertical structure and high plant species richness that are important to owls. Owl foraging habitat includes a wide variety of forest conditions, canyon bottoms, cliff faces, tops of canyon rims, and riparian areas.

2.6.4 Threats

The USFWS (1995) cited historical alteration of the owl's habitat as the result of even-aged silviculture and the continuing practice of even-aged silviculture, and the danger of catastrophic wildfire as the two major threats to the owl.

In 1996, the Southwest Region of the USFS incorporated the Mexican spotted owl Recovery Plan guidelines as management direction into their Forest Plans. Thus, the management plans for the USFS Southwestern Region include biological goals consistent with the Recovery Plan for the owl, thereby eliminating one of the primary threats to the owl on USFS lands identified in the final listing rule (USFWS 2004).

2.7 LESSER LONG-NOSED BAT

The lesser long-nosed bat was listed as Endangered on September 30, 1988 (53 FR 38456) without Critical Habitat.

Land management/ownership for this species includes lands owned by or managed by USFWS, BLM, NPS, USFS, Department of Defense, several Tribes, the state of Arizona, and private land holdings (USFWS 2001b).

2.7.1 Species Description

The lesser long-nosed bat is a yellow-brown or cinnamon gray bat, with a total head and body measurement of approximately 3 inches. The tongue measures approximately the same length as the body. This species also has a small noseleaf. The wingspan of *L. curasoae yerbabuenae* is approximately 10 inches and the mass is roughly 0.8 ounce. Previously known as Sanborn's long-nosed bat (*Leptonycteris sanborni)*, the species is a medium-sized bat slightly smaller than the Mexican long-nosed bat (USFWS 2001b).

2.7.2 Distribution and Abundance

The species historically ranged from central Arizona and southwestern New Mexico through much of Mexico to El Salvador. Records exist for occurrences in the southern Peloncillo Mountains of New Mexico (USFWS 2001b).

The current range is similar to historic; however, the number of occupied roost sites and the number of individuals per colony have recently declined drastically. These bats are seasonal (April to September) residents of southeastern Arizona, and possibly extreme western Arizona (i.e., Cochise, Pima, Santa Cruz, Graham, Pinal and Maricopa counties, Arizona) (USFWS 2001b).

2.7.3 Habitat

Habitat for the species includes mainly desert scrub habitat in the U.S. portion of its range. In Mexico, the species occurs up into high elevation pine-oak and ponderosa pine forests. Altitudinal range is from 1,600 to 11,500 feet. Roosting is in caves, abandoned mines, and unoccupied buildings at the base of mountains where agave, saguaro, and organ pipe cacti are present. The species forages at night on nectar, pollen, and fruit of paniculate agaves and columnar cacti (USFWS 2001b).

2.7.4 Threats

Considerable evidence exists for the interdependence of *Leptonycteris* bat species and certain agaves and cacti. Excess harvest of agaves in Mexico; the collection of cacti in the U.S.; and the conversion of habitat for agricultural uses, livestock grazing, wood-cutting, and other development might contribute to the decline of long-nosed bat populations. These bats are particularly vulnerable due to many individuals using only a small number of communal roosts (USFWS 2001b).

2.8 OCELOT

The ocelot was listed as endangered on March 28, 1972.

2.8.1 Species Description

Ground colors of the short fur of the ocelot, varies from creamy, or tawny yellow, to reddish grey and grey. The underside of the body, tail, and insides of the limbs is whitish. Rather more blotched than spotted, the chain-like spots are bordered with black. Ocelots have both solid and open dark spots which sometimes run in lines along the body. The back of the ears is black with a central yellowy/white band. Solid black spots mark the head and limbs. There are two black stripes on the cheeks and one or two transverse bars on the insides of the forelegs. The tail is either ringed or marked with dark bars on its upper surface. The eye sockets or orbits are incomplete at the back, and the anterior upper premolars are present.

2.8.2 Distribution and Abundance

The historic range of the ocelot includes southern Texas and Arizona to northern Argentina (USFWS 1990). Virtually nothing is known of the ocelot in Arizona but unverified reports of ocelots in southeastern Arizona warrant further investigation of its status in Arizona and northern Sonora.

2.8.3 Habitat

The ocelot inhabits desert-scrub communities in Arizona (AGFD 2004). The critical component in suitable habitat for the ocelot is dense cover. The minimum acreage required for an area to be classified as suitable habitat is 99 acres of brush or 74 acres of two or more proximate brush stands (USFWS 1990).

2.8.4 Threats

Threats to ocelot include habitat alteration and loss (primarily due to brush clearing), and predator control activities (AESFO 2002).

2.9 SONORA CHUB

In 1986, the Sonora chub was listed as a threatened species with critical habitat by the USFWS (51 FR 16042). Designated critical habitat includes Sycamore Creek, extending downstream from and including Yank's Spring continuing to the international border. Also listed as critical habitat, are the lower 1.2 miles of Penasco Creek and the lower 0.25 miles of an unnamed stream, both are tributaries entering Sycamore Canyon approximately 1.5 miles downstream of Yanks Spring. In addition to the aquatic environment, critical habitat includes the riparian area (25 ft wide) along each side of both Sycamore and Penasco creeks. This riparian area is believed to be essential to maintaining the creek ecosystem and stream channels, and to the conservation of the species (USFWS 1992). The Sonora chub is locally abundant in Sycamore Creek; however, the habitat is limited in areal extent (AGFD 2001). All of the critical habitat, except for Yank's Spring, are located within designated wilderness areas. This critical habitat totals 7.6 miles of rivers and streams within the Tucson and Nogales stations' areas of operation.

2.9.1 Species Description

The Sonora chub can be described as a tenacious, desert adapted species, adept at exploiting small marginal habitats and can survive under severe environmental conditions (AGFD 2001). It has been determined that breeding is not limited by season, due to juvenile fish and larvae being collected in both the spring and fall. Food for the Sonora chub includes, but is not limited to, aquatic and terrestrial insects and algae. Sonora chub is most likely an opportunistic feeder that takes advantage of seasonally available food resources.

2.9.2 Distribution and Abundance

In Mexico, the Sonora chub occurs in the Rios Magdalena and Altar. In Arizona, it occurs in Sycamore Creek (Bear Canyon), a tributary of the Rio Altar, 15.5 miles west of Nogales in Santa Cruz County. In addition, it occurs in two tributaries of Sycamore Canyon (Penasco Creek and an unnamed stream) (AGFD 2001). As reported to AGFD, Sycamore Creek is at the edge of the habitat of the species, is isolated from other populations of Sonora chub, and provides marginal habitat (AGFD 2001). Although the Sonora chub is stated as having a very limited range in the U.S., it is locally abundant in Sycamore Creek (AGFD 2001).

2.9.3 Habitat

The Sonora chub is endemic to streams of the Rio de la Concepcion drainage of Sonora, Mexico and the State of Arizona. This species typically inhabits intermittent streams that occur near cliffs, boulders, or other cover in the channel and thrive in the largest, deepest, and most permanent pools, with bedrock-sand substrates and areas free of thick pads of floating algae (AGFD 2001). The associated plant community is comprised of riparian vegetation including sycamore, Fremont cottonwood (*Populus fremontii*), alder, willow, oak (*Quercus* sp.), and pine (*Pinus* sp.) (AGFD 2001).

2.9.4 Threats

The major threat to the Sonora chub is the modification of suitable habitat by human activities including grazing, mining, recreation, and the introduction of exotic taxa (USFWS 1992). This population of the Sonora chub is isolated from other populations and has marginal habitat. Potential threats to Sonora chub are related to additional watershed development, such as channel degradation, siltation, and water pollution. Predation by non-native vertebrates is also a threat to populations of the Sonora chub. For example, the predation by exotic green sunfish and small mammals is a cause for concern regarding the reason for decline of this species. Remaining populations of Sonora chub continue to be threatened by non-native fishes and alteration of habitat through various land uses.

3. ACTION AREA

The action area consists of those lands that will be directly and indirectly impacted by the Project and are known to be occupied or potentially occupied by 26 Federally listed species or species of concern. The action area is defined by a corridor that extends approximately 300 feet in all directions from construction access routes, staging areas, and construction sites. This is the area directly affected by the Project. The extension of 300 feet represents the approximate distance that Project-related noise is estimated to attenuate from approximately 80 A-weighted decibels (dBA) to approximate ambient noise levels of around 55 dBA. The action area includes areas directly and indirectly impacted by the primary vehicle fence and access roads, the access road construction activities, and the construction staging areas (see **Figure 1-1** for a map of the action area).

THIS PAGE INTENTIONALLY LEFT BLANK

4. EFFECTS OF THE PROJECT

The following is an analysis of the effects of the Project. Implementation of the Project is likely to adversely affect the jaguar, lesser long-nosed bat, MSO, and Sonora chub. The Project may affect, but is not likely to adversely affect: Huachuca water-umbel, Pima pineapple cactus, Cochise pincushion, Sonora tiger salamander, and ocelot. Potentially suitable habitat exists within the Project corridor for the species listed above. However, none of these species were observed during 2008 surveys conducted for these species and their habitats. Based on survey results and the implementation of BMPs, the Project is not likely to directly adversely affect individuals or populations of Federally listed plants, but could directly affect potential habitat for these species. Implementing general and species-specific BMPs will help to avoid impacts on these species and their habitats (see **Section 1.3.2**).

4.1 JAGUAR

The Project is likely to adversely affect the jaguar. Sightings have been documented at various locations within or near Project corridor within Coronado National Forest, Pozo Verde Mountains, and Pajarita Mountains (DHS 2008).

Project-related loss of habitat is likely to adversely affect this species. Most jaguar detections occurred in Madrean oak woodland communities; however, jaguars were also documented in open mesquite grasslands and desert scrub/grasslands on the desert valley floor (USFWS 2007a). The permanent loss of 197.1 acres of vegetation includes 2.2 acres of semidesert grassland, 152.7 desert scrub, 0.58 acres of cottonwood/willow woodlands, 1.2 acres of cottonwood/sycamore woodlands and 40 acres of Manzanita scrub/oak woodlands. These habitat types represent suitable habitat for jaguar.

TI associated with the Project would not impede movements of jaguars across the border once the vehicle fences are completed. Jaguar would be able to pass under the vehicle fence that will be installed throughout the Project corridor.

Human activity and elevated noise levels during construction would disturb any jaguar in the immediate area and possibly hinder or impede jaguar movements into the U.S. Nighttime construction can temporarily affect foraging activity; however, construction activities are expected to be conducted during daylight hours to the maximum extent practicable.

Construction and operation of TI will increase border security in the project corridor and may result in a change to illegal traffic patterns. However, changes to illegal alien (IA) traffic patterns result from a myriad of factors. Beneficial indirect impacts will be expected, as the vehicle fence will substantially reduce or eliminate IA vehicle traffic and associated trash and illegal roads in the project corridor.

4.2 HUACHUCA WATER-UMBEL

The Project may affect, but is not likely to adversely affect Huachuca water-umbel. The species was not found during surveys (DHS 2008) and there are no known occurrences of this species within the Project footprint. No TI is planned for construction across streams with intermittent or perennial flows, which would provide habitat for Huachuca water-umbel.

There is a potential for introduction of exotic plant species through construction activities and use of new and existing roads. Implementing general and species-specific BMPs will help to avoid impacts on Huachuca water-umbel in the EV-1A and FV-1B Sections.

Construction and operation of TI will increase border security in the project corridor and may result in a change to illegal traffic patterns. However, changes to IA traffic patterns result from a myriad of factors. Beneficial indirect impacts will be expected, as the vehicle fence will substantially reduce or eliminate IA vehicle traffic and associated trash and illegal roads in the project corridor.

4.3 PIMA PINEAPPLE CACTUS

The Project may affect, but is not likely to adversely affect Pima pineapple cactus in Section EV-1B. The species has the potential to occur within or near the Project corridor. Suitable habitat for the Pima pineapple cactus exists throughout the Project area; however, recent surveys of the Project corridor indicate that no Pima pineapple cactus specimens were observed within the Project footprint (GSRC 2008). Construction within section EV-1A would not require expansion of extant disturbed areas and thus, there would be no potential to affect this species in this reach.

Project-related loss of habitat is not likely to adversely affect this species because no specimens were located within the Project footprint. There is also the potential for the introduction of invasive plant species through construction activities and use of new and existing roads. Implementing general and species-specific BMPs will help to avoid direct and indirect impacts on Pima pineapple cactus associated with invasive plant species.

Construction and operation of TI will increase border security in the project corridor and may result in a change to illegal traffic patterns. However, changes to IA traffic patterns result from a myriad of factors. Beneficial indirect impacts will be expected, as the vehicle fence will substantially reduce or eliminate IA vehicle traffic and associated trash and illegal roads in the project corridor.

4.4 COCHISE PINCUSHION CACTUS

The Project may affect, but is not likely to adversely affect Cochise pincushion cactus in Section FV-1B. The species has the potential to occur within or near the Project corridor. Suitable habitat for the Cochise pincushion cactus exists throughout the

Project area; however, recent surveys of the Project corridor indicate that no Cochise pincushion cactus specimens were observed within the Project footprint (e2m 2008).

Project-related loss of habitat is not likely to adversely affect this species because no specimens were located within the Project footprint. There is potential for the introduction of invasive plant species through construction activities and use of new and existing roads. Implementing general and species-specific BMPs will help to avoid direct and indirect impacts on Cochise pincushion cactus associated with invasive plant species.

Construction and operation of TI will increase border security in the project corridor and may result in a change to illegal traffic patterns. However, changes to IA traffic patterns result from a myriad of factors. Beneficial indirect impacts will be expected, as the vehicle fence will substantially reduce or eliminate IA vehicle traffic and associated trash and illegal roads in the project corridor.

4.5 LESSER LONG-NOSED BAT

Potential foraging habitat exists within and adjacent to the Project corridor but no suitable roosting habitat is present (DHS 2008). The removal or damage of foraging plants for road and fence construction can adversely affect the species. Scattered agave plants, saguaros, and yuccas (*Yucca* sp.) were identified within the Project corridor and would be removed. Thus, the Project is likely to adversely affect the lesser long-nosed bat in all Sections except EV-1B.

Impacts on potential foraging habitat could result from (1) introduction of non-native plant species through the construction process that could prevent the recruitment of plant forage species and could also carry fire that could further reduce number of forage plants, and (2) nighttime construction that could temporarily affect foraging activity. Construction of new TI has effects related to ground or surface disturbance for the infrastructure and the construction operations. The direct footprint for the infrastructure results in ground disturbances, vegetation removal, and soil compaction. Implementing general and species-specific BMPs will help to avoid impacts on the lesser long-nosed bat. Nighttime construction can temporarily affect foraging activity; however, construction activities are expected to be conducted during daylight hours to the maximum extent practicable.

4.6 OCELOT

Recent sightings of ocelots have been reported in Mexico, about 30 miles south of Nogales, Arizona (Sky Island Alliance [SIA] 2008). There are no known occurrences of this species within or immediately adjacent to the Project corridor (NatureServe 2008).

Road construction associated with the Project can temporarily impede movement of ocelots across the border and could result in fragmentation of ocelot habitat. However, ocelots will be able to pass through vehicle fence that will be installed throughout the corridor.

Project-related loss of habitat is not likely to adversely affect this species because of the lack of occurrences in the area and the vast amount of similar habitat north of the Project corridor. The permanent loss of 197.1 acres would be a minimal loss relative to the vast amount of similar vegetation communities throughout southern Arizona. Suitable ocelot habitat exists within densely vegetated areas within the Project corridor. The minimum acreage required for an area to be classified as suitable habitat is 99 acres of brush or 74 acres of two or more proximate brush stands (USFWS 1990).

Human activity and elevated noise levels during construction would disturb any ocelot in the immediate area and possibly hinder or impede ocelot movements into the U.S. Nighttime construction can temporarily affect foraging activity; however, construction activities are expected to be conducted during daylight hours to the maximum extent practicable.

4.7 SONORA TIGER SALAMANDER

Several stock tanks are located within 0.1 miles of access roads planned to be used during construction and within 0.1 miles of the EV-1A segment. These stock tanks provide potential habitat for Sonora tiger salamander. Implementation of a Storm Water Pollution Prevention Plan as well as the use of Normandy-style vehicle fence in major washes and drainages would prevent any sedimentation of potentially occupied habitats. Because construction activity would occur during the leching season, when tiger salamander can wander up to 0.3 mile from aquatic habitats, there is some potential for individuals to be impacted on roadways. Exclusion fencing could be used to avoid these potential impacts. Use of a biological monitor for any construction activities on access roads or within the EV-1A segment will prevent harm to the Sonora tiger salamander. Implementation of a Spill Prevention Countermeasures and Containment Plan would prevent any contamination of aquatic habitats by petroleum, oil, and lubricants and hazardous materials or waste. Since no direct impacts to habitat will occur and CBP plans to implement the BMPs described herein, the project may affect, but is not likely to adversely affect, the Sonora tiger salamander.

Construction and operation of TI will increase border security in the project corridor and may result in a change to illegal traffic patterns. However, changes to IA traffic patterns result from a myriad of factors. Beneficial indirect impacts will be expected, as the vehicle fence will substantially reduce or eliminate IA vehicle traffic and associated trash and illegal roads in the project corridor.

4.8 MEXICAN SPOTTED OWL

Suitable habitat for the MSO occurs within both segments of EV-1B. Approximately 1.9 miles of the western section of this segment and all of the eastern section are located within Critical Habitat for the MSO. Additionally, the 2 acre staging area associated with the western segment of EV-1B is within Critical Habitat. The nearest known MSO PACs are located 1.7 miles north of planned construction activity within the western section of the EV-1B segment (see Appendix A), and would be affected by construction noise or lighting. Furthermore, the breeding season for the MSO lasts from March 1 to August

31. Construction is scheduled to begin on October 3, 2008, after the end of the MSO nesting season; thus, nesting activity would not be interrupted. Some PCEs of the Critical Habitat, such as the presence of large trees, would be affected. However, any trees removed would be left within rehabilitated areas, and would improve other PCEs (i.e., presence of large woody debris). Consequently, the project may adversely affect the MSO and its Critical Habitat.

4.9 SONORA CHUB

Suitable habitat for the Sonora chub exists within FV-1B segment. Exact footprints and designs for the drainage crossings have not been developed as yet, so definitive statements can not be made regarding the potential effects. However, direct and downstream impacts to Sonora chub habitat is likely and, therefore, CBP has determined that the project will adversely affect the Sonora chub. BMPs, as presented on page 1-18, will be implemented to reduce these impacts.

THIS PAGE INTENTIONALLY LEFT BLANK

5. DETERMINATION OF EFFECT

A total of 26 Federally listed species are known to occur or potentially occur within 25 miles of the Project corridor in Cochise and Santa Cruz counties, Arizona. **Table 5-1** outlines Federally listed species and Federally designated Critical Habitats known to occur or to potentially occur within or adjacent to the Project area and the determination of effects resulting from the Project. The Project may affect, and is likely to adversely affect the MSO, jaguar, lesser long-nosed bat and Sonora chub. The Project may affect, but is not likely to adversely affect, the Huachuca water-umbel, Pima pineapple cactus, Sonora tiger salamander, Cochise pincushion cactus, and ocelot. The remaining species will not be affected by the Project.

Table 5-1. Determination of Effects on Federally Listed and Candidate Species within Tucson Sector VF300 Segments

Species	Listing Status	Determination	Segments Affected
PLANTS			
Canelo Hills ladies'-tresses, *Spiranthes delitescens*	Endangered	No effect	EV-1B, FV-1B
Cochise pincushion cactus, *Coryphantha robbinsorum*	Endangered	Not likely to adversely affect	FV-1B
Huachuca water-umbel, *Lilaeopsis schaffneriana ssp. Recurva*	Endangered	Not likely to adversely affect	EV-1A, FV-1B
Pima pineapple cactus, *Coryphantha scheeri var. robustispina*	Endangered	Not likely to adversely affect	EV-1B
INVERTEBRATES			
Stephan's riffle beetle, *Hetrelmis stephani*	Candidate	No effect	FV-1B
Huachuca springsnail, *Pyrgulopsis thomsoni*	Candidate	No effect	FV-1B
FISH			
Desert pupfish, *Cyprinodon macularius*	Endangered	No effect	FV-1B
Yaqui Chub *Gila purpurea*	Endangered	No effect	FV-1B
Yaqui topminnow *Poeciliopsis accidentalis sonoriensis*	Endangered	No effect	FV-1B
Yaqui catfish *Ictalurus pricei*	Threatened	No effect	FV-1B

Table 5-1, continued

Species	Listing Status	Determination	Segments Affected
Beautiful shiner *Cyprinella formosa*	Threatened	No effect	FV-1B
Spikedace *Meda fulgida*	Threatened	No effect	FV-1B
Loach minnow *Tiaroga cobitis*	Threatened	No effect	FV-1B
Gila chub, *Gila intermedia*	Endangered	No effect	FV-1B
Gila topminnow, *Poeciliopsis occidentalis occidentalis*	Endangered	No effect	EV-1A
Sonora chub, *Gila ditaenia*	Threatened	Likely to adversely affect	FV-1B
REPTILES AND AMPHIBIANS			
Chiricahua leopard frog, *Rana chiricahuensis*	Threatened	No effect	None
Sonora tiger salamander, *Ambystoma tigrinum stebbinsi*	Endangered	Not likely to adversely affect	EV-1A, EV-1B
Ramsey canyon leopard frog *Lithobates subaquavocalis*	Conservation Agreement	No effect	FV-1B
New Mexico ridge-nosed rattlesnake *Crotalus willardi obscuras*	Threatened	No effect	FV-1B
BIRDS			
Mexican spotted owl, *Strix occidentalis lucida*	Threatened, with Critical Habitat designated east of the Project corridor	Likely to adversely affect	EV-1B
Southwestern willow flycatcher, *Empidonax traillii extimus*	Endangered	No effect	FV-1B
Yellow-billed cuckoo, *Coccyzus americanus*	Candidate	No effect	FV-1B
MAMMALS			
Jaguar, *Panthera onca*	Endangered	Likely to adversely affect	All
Lesser long-nosed bat, *Leptonycteris curasoae yerbabuenae*	Endangered	Likely to adversely affect	All except EV-1B
Ocelot, *Leopardus pardalis*	Endangered	Not likely to adversely affect	All

Source: GSRC 2008

The determination of no effect for impacts on particular species was based on the absence of known occurrences or suitable habitat in any Sections of the Project.

Construction and operation of TI will increase border security in the project corridor and may result in a change to illegal traffic patterns. However, changes to IA traffic patterns result from a myriad of factors and therefore are considered unpredictable and beyond the scope of this BRP. Besides any potential adverse environmental impacts already mentioned, beneficial indirect impacts will be expected for all protected species known or presumed to occur near the action area, as the vehicle fence will substantially reduce or eliminate IA vehicle traffic and associated trash and illegal roads in the project corridor.

THIS PAGE INTENTIONALLY LEFT BLANK

6. REFERENCES

AESFO 2002 — Arizona Ecological Services Field Office (AESFO). 2002. General Species Information. Available online: http://www.fws.gov/southwest/es/arizona/Ocelot.htm. Last accessed: December 4, 2008.

AGFD 2001 — Arizona Game and Fish Department (AGFD). 2001. *Gila ditaenia*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona. 5 pp.

AGFD 2004 — Arizona Game and Fish Department (AGFD). 2004. *Loepardus pardalis*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

DHS 2008 — U.S. Department of Homeland Security (DHS). 2008. Draft Environmental Stewardship Plan for Construction, Operation and Maintenance of TI, U.S. Border Patrol Tucson Sector, Nogales Station, Arizona. May 2008.

e2M 2008 — Final Biological Survey Report for Construction, Operation and Maintenance of Vehicle Fence and Related Tactical Infrastructure, U.S. Border Patrol Tucson Sector, Douglas Station, Arizona. September 2008.

GSRC 2008 — Gulf South Research Corporation (GSRC). 2008. Biological Field Survey Reports Supporting the Environmental Stewardship Plan for Construction, Operation, and Maintenance of TI, U.S. Border Patrol Tucson Sector, Nogales Station, Tucson Station, and Sonoita Station.

NatureServe 2008 — NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available online: <*http://www.natureserve.org/explorer*>. Accessed: June 3, 2008.

SIA 2008 — Sky Island Alliance (SIA). 2008. Available online: <*http://www.skyislandalliance.org/jaguars.htm*>. Accessed June 2008.

USFWS 1986 — U.S. Fish and Wildlife Service (USFWS). 1986. Endangered and Threatened Wildlfie and Plants; Determination of Threatened Status for *Coryphantha robbinsorum*, Final Rule. Federal Register/ Vol. 51, No. 6/ Thursday, January 9, 1986.

USFWS 1990	USFWS. 1990. "Listed Cats of Texas and Arizona Recovery Plan (with emphasis on the ocelot)." Available online: <http://www.fws.gov/southwest/es/arizona/Documents/RecoveryPlans/CatsTexasArizona.pdf >. Accessed 23 July 2008. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
USFWS 1992	USFWS. 1992. Recovery Plan for Sonora Chub (*Gila ditaenia*). U.S. Fish and Wildlife Service, Region 2, Albuquerque, New Mexico. pp. 50.
USFWS 1993	USFWS. 1993. Cochise Pincushion Cactus (*Coryphantha robbinsorum*) Recovery Plan. USDI Fish and Wildlife Service, Albuquerque, New Mexico. 44 pp.
USFWS 1995	USFWS. 1995. Recovery Plan for the Mexican Spotted Owl *(Strix occidentalis lucida)*. Vol. I, Albuquerque, New Mexico. 172 pp.
USFWS 2000a	USFWS. 2000. "General Species Information: Jaguar. Arizona Ecological Services Field Office." Available online: < http://www.fws.gov/southwest/es/arizona/Documents/Redbook/Jaguar%20RB.pdf>. Accessed 23 July 2008. June 2000.
USFWS 2000b	USFWS. 2000. "General Species Information: Pima pineapple cactus." Available online: <http://www.fws.gov/southwest/es/arizona/Documents/Redbook/Pima%20Pineapple%20cactus%20RB.pdf>. Accessed 23 July 2008. Arizona Ecological Services Field Office. June 2000.
USFWS 2001a	USFWS. 2001. "General Species Information: Huachuca water umbel." Available online: <http://www.fws.gov/southwest/es/arizona/Documents/Redbook/Huachuca%20Water%20Umbel%20RB.pdf>. Accessed 23 July 2008. Arizona Ecological Services Field Office. June 2001.
USFWS 2001b	USFWS. 2001. "General Species Information: Lesser long-nosed bat." Arizona Ecological Services Field Office. Available online: <http://www.fws.gov/southwest/es/arizona/Documents/Redbook/Lesser%20Long-nosed%20bat%20RB.pdf>. Accessed 23 July 2008. July 2001.
USFWS 2002a	USFWS. 2002. Sonora Tiger Salamander Recovery Plan. U.S. Fish and Wildlife Service, Phoenix, Arizona. iv + 67 pp.
USFWS 2004	USFWS 2004. Endangered and Threatened Wildlife and Plants; Final Designation of Critical Habitat for the Mexican Spotted Owl; Final Rule. Federal Register / Vol. 69, No. 168 / Tuesday, August 31, 2004
USFWS 2007a	USFWS. 2007. Biological Opinion for Pedestrian Fence in Pima, Santa Cruz, and Cochise counties. Phoenix, Arizona. August 2007.

USFWS 2007b	USFWS. 2007. Cochise Pincushion Cactus *(Coryphantha robbinsorum)* 5-Year Review: Summary and Evaluation.
USFWS 2008	USFWS. 2008. Mexican Spotted Owl (*Strix occidentalis lucida*).

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A
Detailed Maps

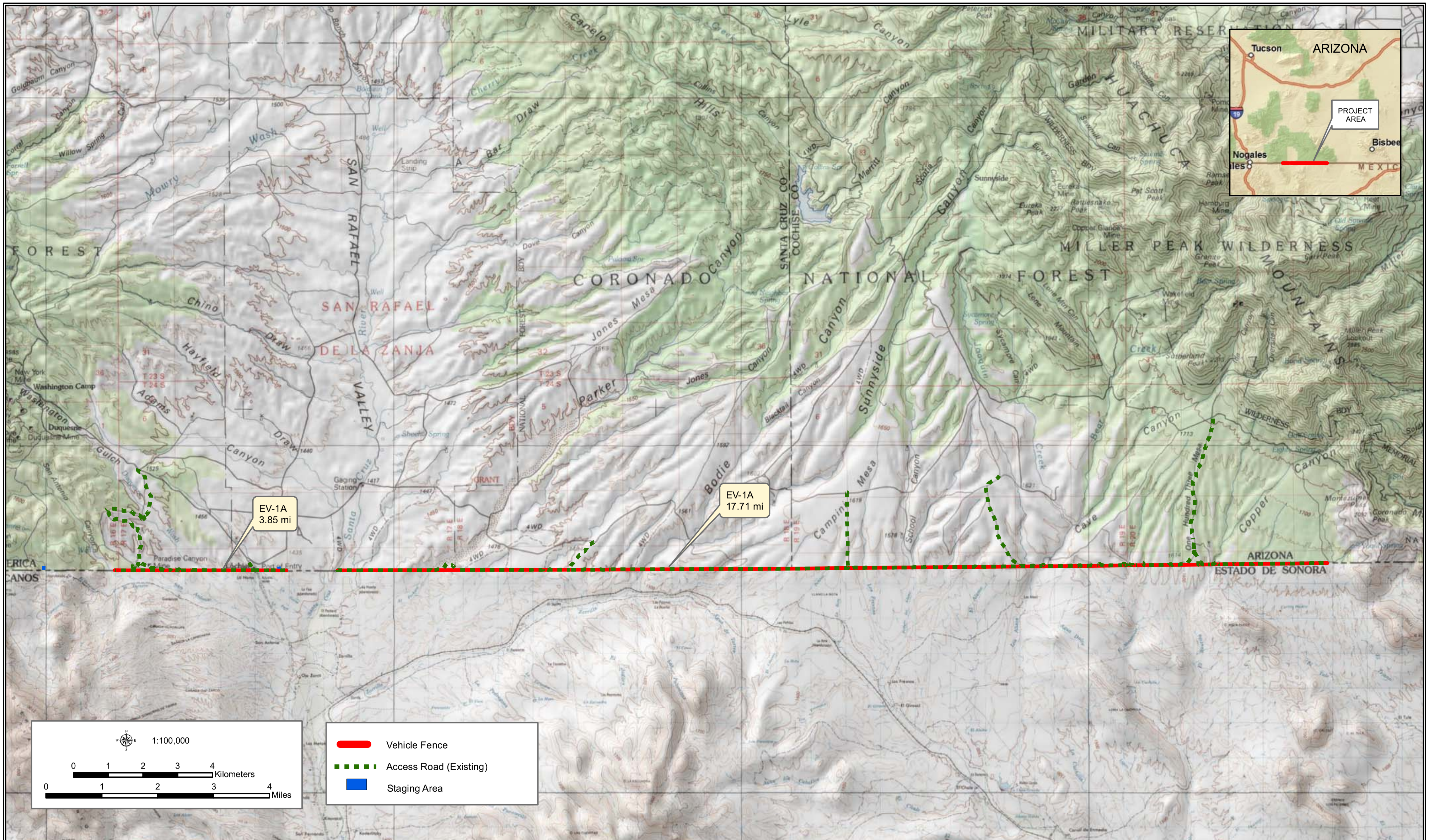


Figure A-1: Project Corridor for EV-1A

GSRC

August 2008

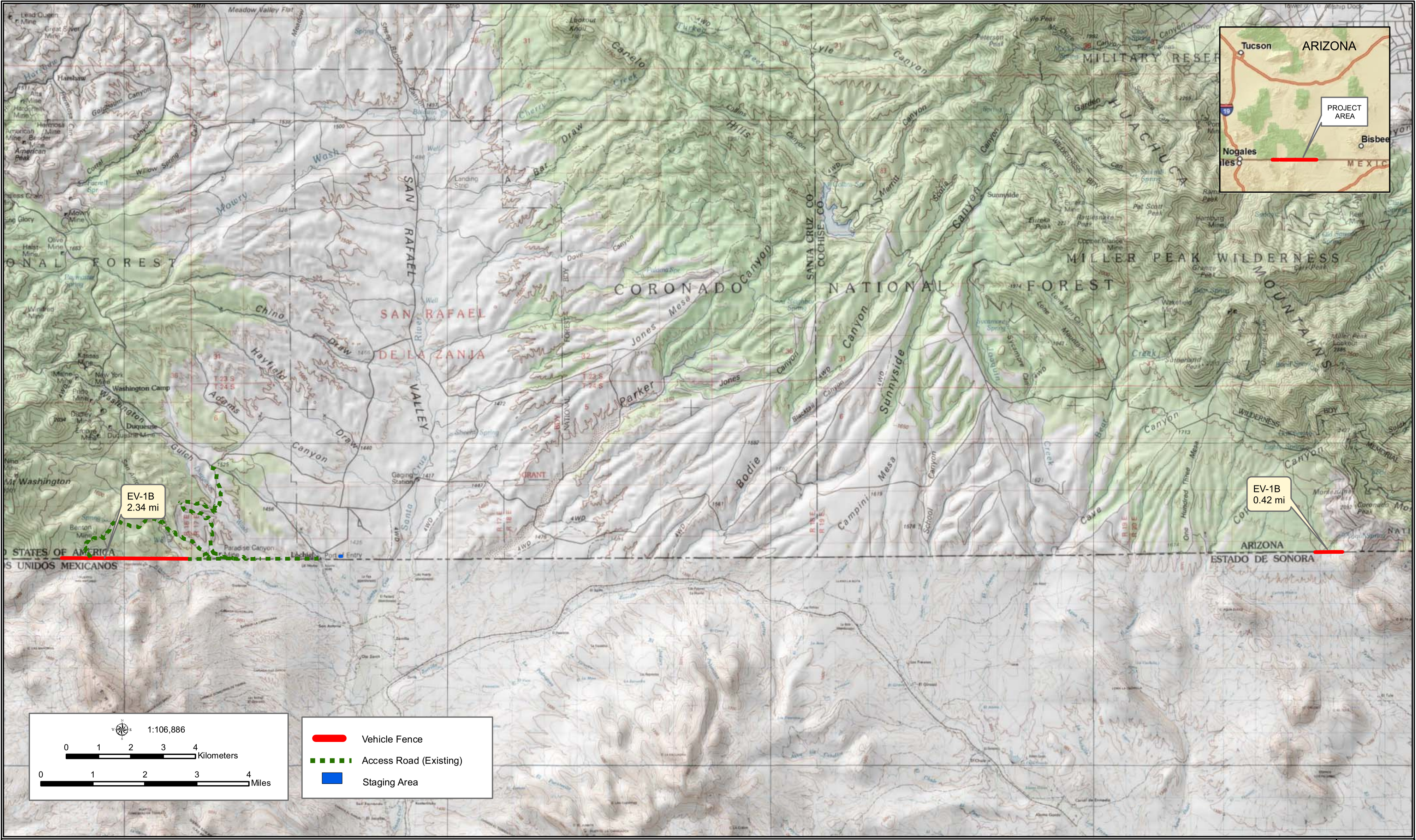


Figure A-2: Project Corridor for EV-1B

GSRC

August 2008

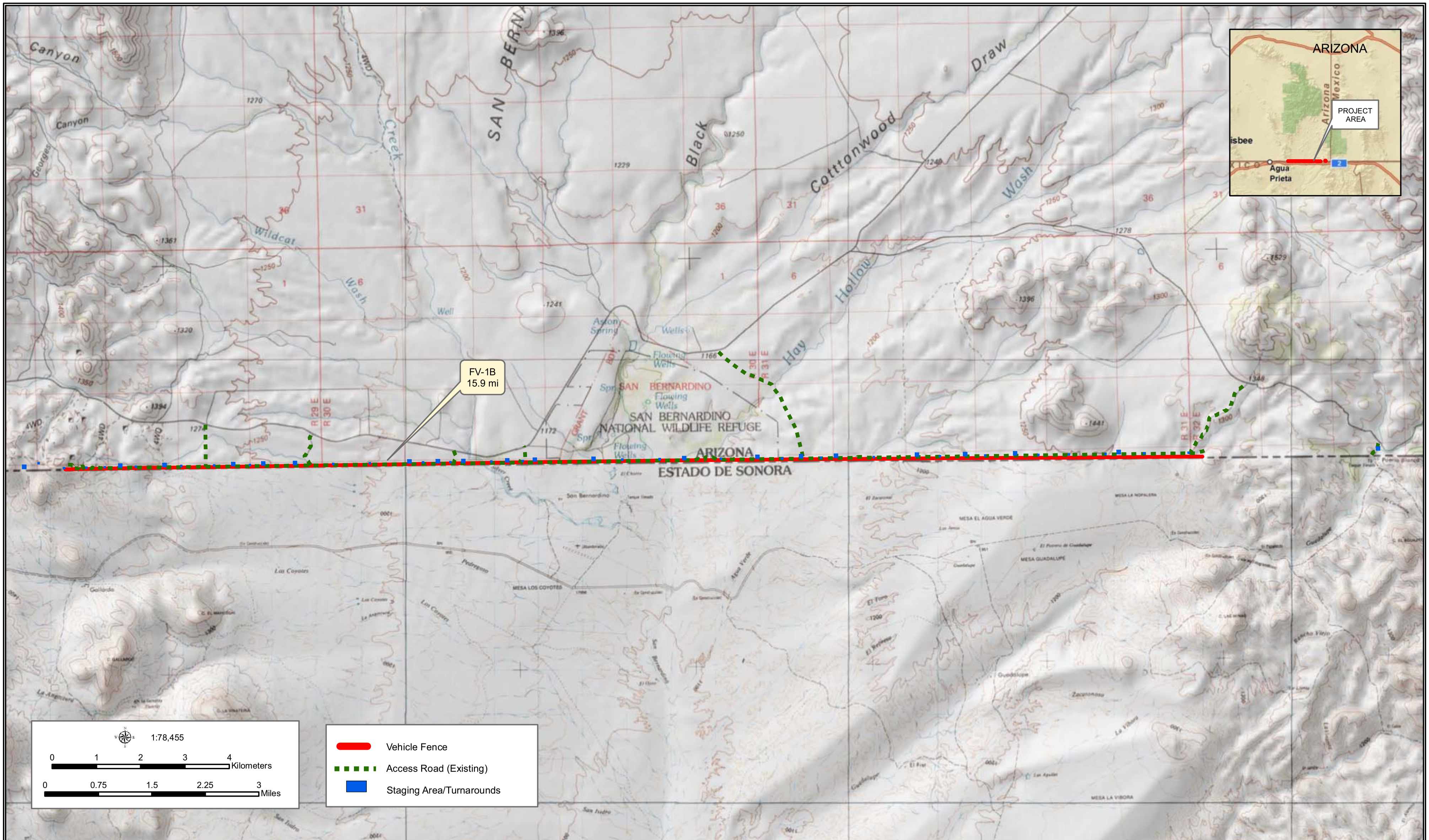


Figure A-3: Project Corridor for FV-1B

GSRC

August 2008

APPENDIX F

Air Quality Calculations/
Emissions Calculations

Southeast Arizona Intrastate Air Quality Control Region

			Area Source Emissions						Point Source Emissions					
Row #	State	County	CO	NOx	PM10	PM2.5	SO2	VOC	CO	NOx	PM10	PM2.5	SO2	VOC
SORT														
1	AZ	Cochise County	62,153	9,064	10,865	2,904	456	8,380	723	8057	1604	959	6236	78.1
2	AZ	Graham County	15,744	1,376	5,879	1,620	105	2,257	0	0	122	122	0	0
3	AZ	Greenlee County	5,356	419	2,934	767	38	597	278	1,139	1,921	1,022	1	617
4	AZ	Santa Cruz County	19,248	2,194	3,619	877	106	2,917	0	0	0	0	0	0
Grand Total			102,501	13,053	23,297	6,168	705	14,151	1,001	9,196	3,647	2,103	6,237	695

SOURCE:
http://www.epa.gov/air/data/geosel.html
USEPA - AirData NET Tier Report
*Net Air pollution sources (area and point) in tons per year (2001)
Site visited on 8 July 2008.

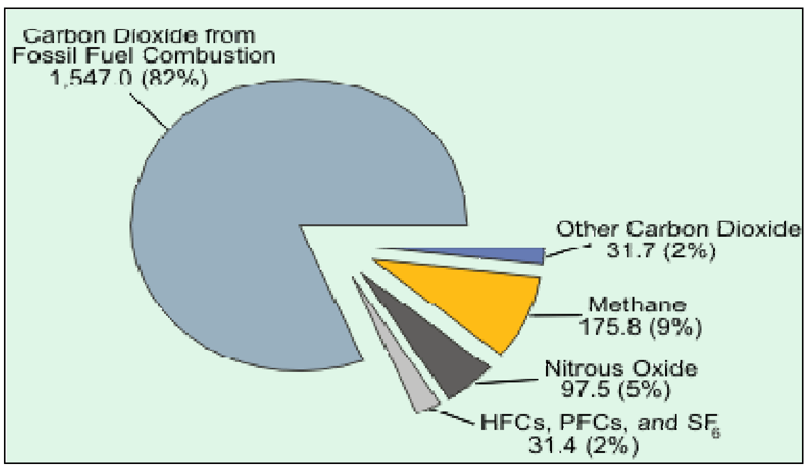
Southeast Arizona Intrastate AQCR (40 CFR 81.272): Cochise County, Graham County, Greenlee County and Santa Cruz County, Arizona

Greenhouse Gases

In April 2007, the U.S. Supreme Court declared that carbon dioxide (CO_2) and other greenhouse gases are air pollutants under the Clean Air Act (CAA). The Court declared that the U.S. Environmental Protection Agency (USEPA) has the authority to regulate emissions from new cars and trucks under the landmark environment law.

Many chemical compounds found in the Earth's atmosphere act as "greenhouse gases." These gases allow sunlight to enter the atmosphere freely. When sunlight strikes the Earth's surface, some of it is reflected back towards space as infrared radiation (heat). Greenhouse gases absorb this infrared radiation and trap the heat in the atmosphere. Over time, barring other influences, the trapped heat results in the phenomenon of global warming.

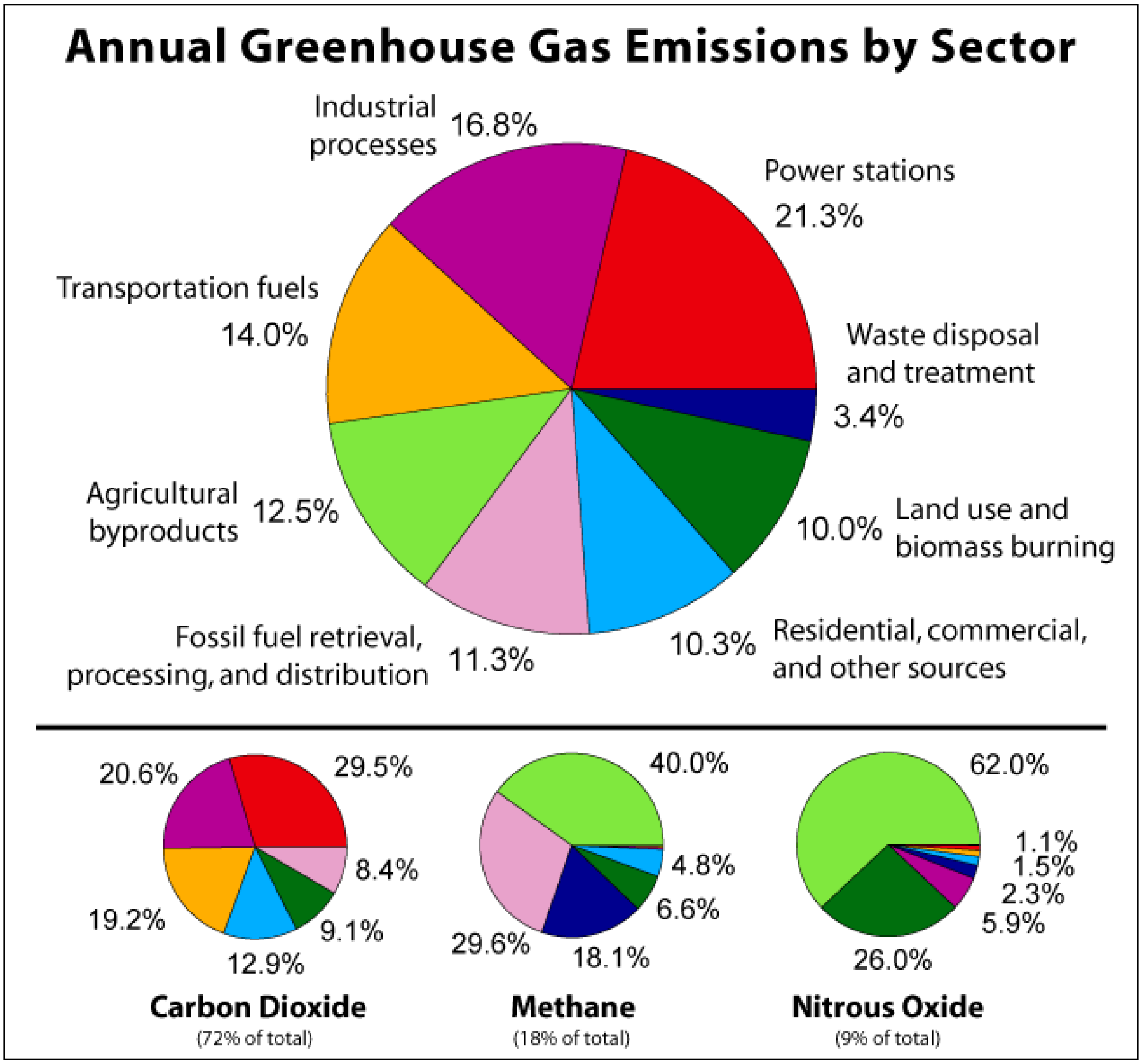
Many gases exhibit these "greenhouse" properties. The sources of the majority of greenhouse gases come mostly from natural sources but are also contributed to by human activity and are shown in **Figure F-1**. It is not possible to state that a specific gas causes a certain percentage of the greenhouse effect because the influences of the various gases are not additive.



Source: Energy Information Administration 2003

Figure F-1. Greenhouse Gas Emissions From Burning of Gas (Million Metric Tons of Carbon Equivalent)

Figure F-2 displays the annual greenhouse gas emissions by sector in the United States. Most government agencies and military installations are just beginning to establish a baseline for their operations and their impact on the greenhouse effect. Since the USEPA has not promulgated an ambient standard or *de minimis* level for CO_2 emissions for Federal actions, there is no standard value to compare an action against in terms of meeting or violating the standard.



Source: Rosmarino 2006

Figure F-2. Annual Greenhouse Gas Emissions by Sector

References

Energy Information Administration. 2003. "Greenhouse Gases, Climate Change, and Energy." EIA Brochure. 2003. Available online: <*http://www.eia.doe.gov/oiaf/1605/ggccebro/chapter1.html*>. Last updated April 2, 2004. Accessed November 4, 2007.

Tanyalynnette Rosmarino, Director of Field Engineering, Northeast, BigFix, Inc. 2006. "A Self-Funding Enterprise Solution to Reduce Power Consumption and Carbon Emissions." Slide presentation for the NYS Forum's May Executive Committee Meeting Building an Energy Smart IT Environment. 2006. Available online: <*http://www.nysforum.org/documents/html/2007/execcommittee/may/enterprisepowerconsumptionreduction_files/800x600/slide1.html*>. Accessed November 4, 2007.

Summary	Summarizes total emissions by calendar year.
Combustion	Estimates emissions from non-road equipment exhaust as well as painting.
Fugitive	Estimates fine particulate emissions from earthmoving, vehicle traffic, and windblown dust
Grading	Estimates the number of days of site preparation, to be used for estimating heavy equipment exhaust and earthmoving dust emissions
Generators	Estimates emissions from diesel-powered generators used during Project implementation.
Operations and Maintenance	Estimates emissions from maintenance equipment and from operational use of roads
AQCR Tier Report	Summarizes total emissions for the Southeast Arizona Intrastate AQCR Tier Reports for 2001, to be used to compare project to regional emissions.

Air Quality Emissions from Proposed Action

CY2008

	NO_x (ton)	VOC (ton)	CO (ton)	SO_2 (ton)	PM_{10} (ton)	$PM_{2.5}$ (ton)	CO_2 (ton)
Construction Combustion	2.1237	0.1314	0.8012	0.0425	0.1298	0.1259	252.0178
Construction Fugitive Dust	-	-	-	-	73.1569	7.3157	-
Construction Generators	6.0300	0.4922	1.2990	0.3965	0.4239	0.3965	224.2450
TOTAL CY2008	***8.1537***	***0.6237***	***2.1002***	***0.4390***	***73.7106***	***7.8381***	***476.2628***

Note: Total CY2008 $PM_{10}/_{2.5}$ fugitive dust emissions are assuming USEPA 50% control efficiencies.

CY2009

	NO_x (ton)	VOC (ton)	CO (ton)	SO_2 (ton)	PM_{10} (ton)	$PM_{2.5}$ (ton)	CO_2 (ton)
Operations & Maintenance	0.3080	0.0390	0.2850	0.0003	0.0110	0.0100	35.3530
TOTAL CY2009	***0.3080***	***0.0390***	***0.2850***	***0.0003***	***0.0110***	***0.0100***	***35.3530***

Since future year budgets were not readily available, actual 2001 air emissions inventories for the counties were used as an approximation of the regional inventory. Because the Proposed Action is several orders of magnitude below significance, the conclusion would be the same, regardless of whether future year budget data set were used.

Southeast Arizona Intrastate Air Quality Control Region

	Point and Area Sources Combined					
Year	**NO_x (tpy)**	**VOC (tpy)**	**CO (tpy)**	**SO_2 (tpy)**	**PM_{10} (tpy)**	**$PM_{2.5}$ (tpy)**
2001	22,249	14,846	103,502	6,942	26,944	8,271

Source: USEPA-AirData NET Tier Report (http://www.epa.gov/air/data/geosel.html). Site visited on 8 July 2008.

Determination Significance (Significance Threshold = 10%)

CY2008	Point and Area Sources Combined					
	NO_x (tpy)	**VOC (tpy)**	**CO (tpy)**	**SO_2 (tpy)**	**PM_{10} (tpy)**	**$PM_{2.5}$ (tpy)**
Regional Emissions	22,249	14,846	103,502	6,942	26,944	8,271
CY2008 Emissions (Highest Year)	8.1537	0.6237	2.1002	0.4390	73.7106	7.838
CY2008 %	**0.0366%**	**0.0042%**	**0.0020%**	**0.0063%**	**0.2736%**	**0.0948%**

Determination Significance (Significance Threshold = 10%)

CY2009	Point and Area Sources Combined					
	NO_x (tpy)	**VOC (tpy)**	**CO (tpy)**	**SO_2 (tpy)**	**PM_{10} (tpy)**	**$PM_{2.5}$ (tpy)**
Regional Emissions	22,249	14,846	103,502	6,942	26,944	8,271
CY2009 and beyond Emissions	0.3080	0.0390	0.2850	0.0003	0.0110	0.0100
CY2009 %	**0.0014%**	**0.0003%**	**0.0003%**	**0.000005%**	**0.00004%**	**0.0001%**

Combustion Emissions for CY 2008

Combustion Emissions of VOC, NO_x, SO_2, CO, $PM_{2.5}$, and PM_{10}, and CO_2 due to Construction

Includes:
Assumption: Constuction corridor for new access roads is 7.95 miles long by 60 feet wide.
Assumption: Constuction corridor for vehicle fence and access road is 16 miles long by 60 feet wide.

All Construction for vehicle fence and roads 7,587,360 ft^2 174.18 acres

Total Disturbed Area: 7,587,360 ft^2
Construction Duration: 2.0 months
Annual Construction Activity: 60 days/yr

Emission Factors Used for Construction Equipment

References: Guide to Air Quality Assessment, SMAQMD, 2004; and U.S. EPA NONROAD Emissions Model, Version 2005.0.0
Emission factors are taken from the NONROAD model and were provided to e²M by Larry Landman of the Air Quality and Modeling Center (Landman.Larry@epamail.epa.gov) on 12/14/07. Factors provided are for the weighted average US fleet for CY2007.
Assumptions regarding the type and number of equipment are from SMAQMD Table 3-1 unless otherwise noted.

Grading

Equipment	No. Reqd.[a] per 10 acres	NO_x (lb/day)	VOC[b] (lb/day)	CO (lb/day)	SO_2[c] (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	CO_2 (lb/day)
Bulldozer	1	13.60	0.96	5.50	1.02	0.89	0.87	1456.90
Motor Grader	1	9.69	0.73	3.20	0.80	0.66	0.64	1141.65
Water Truck	1	18.36	0.89	7.00	1.64	1.00	0.97	2342.98
Total per 10 acres of activity	3	41.64	2.58	15.71	0.83	2.55	2.47	4941.53

a) The SMAQMD 2004 guidance suggests a default equipment fleet for each activity, assuming 10 acres of that activity, (e.g., 10 acres of grading, 10 acres of paving, etc.). The default equipment fleet is increased for each 10 acre increment in the size of the construction project. That is, a 26 acre project would round to 30 acres and the fleet size would be three times the default fleet for a 10 acre project.
b) The SMAQMD 2004 reference lists emission factors for reactive organic gas (ROG). For the purposes of this worksheet ROG = VOC. The NONROAD model contains emissions factors for total HC and for VOC. The factors used here are the VOC factors.
c) The NONROAD emission factors assume that the average fuel burned in nonroad trucks is 1100 ppm sulfur. Trucks that would be used for the Proposed Actions will all be fueled by highway grade diesel fuel which cannot exceed 500 ppm sulfur. These estimates therefore over-estimate SO2 emissions by more than a factor of two.
d) Typical equipment fleet for building construction was not itemized in SMAQMD 2004 guidance. The equipment list above was assumed based on SMAQMD 1994 guidance.

PROJECT-SPECIFIC EMISSION FACTOR SUMMARY

Source	Equipment Multiplier*	Project-Specific Emission Factors (lb/day)						
		NO_x	VOC	CO	SO_2**	PM_{10}	$PM_{2.5}$	CO_2
Grading Equipment	17	707.901	43.809	267.068	14.158	43.274	41.976	84005.948

*The equipment multiplier is an integer that represents units of 10 acres for purposes of estimating the number of equipment required for the project.

**Emission factor is from the evaporation of solvents during painting, per "Air Quality Thresholds of Significance", SMAQMD, 1994

Example: SMAQMD Emission Factor for Grading Equipment NOx = (Total Grading NOx per 10 acre)*(Equipment Multiplier)

Summary of Input Parameters

	Total Area (ft^2)	Total Area (acres)	Total Days	
Grading:	7,587,360	174.18	6	(from "CY2008 Grading" worksheet)

Total Project Emissions by Activity (lbs)

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Grading Equipment	4,247.41	262.85	1,602.41	84.95	259.64	251.85	504,036
Total Emissions (lbs):	**4,247.41**	**262.85**	**1,602.41**	**84.95**	**259.64**	**251.85**	**504,036**

Results: Total Project Annual Emission Rates

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Total Project Emissions (lbs)	4,247.41	262.85	1,602.41	84.95	259.64	251.85	504,036
Total Project Emissions (tons)	2.1237	0.1314	0.8012	0.0425	0.1298	0.1259	252.0178

Construction Fugitive Dust Emissions

Construction Fugitive Dust Emission Factors

	Emission Factor	Units	Source
General Construction Activities	0.19	ton PM_{10}/acre-month	MRI 1996; EPA 2001; EPA 2006
New Road Construction	0.42	ton PM_{10}/acre-month	MRI 1996; EPA 2001; EPA 2006
$PM_{2.5}$ Emissions			
$PM_{2.5}$ Multiplier	0.10	(10% of PM_{10} emissions assumed to be $PM_{2.5}$)	EPA 2001; EPA 2006
Control Efficiency	0.50	(assume 50% control efficiency for PM_{10} and $PM_{2.5}$ emissions)	EPA 2001; EPA 2006

Conversion Factors

0.00002296	acres per square feet (ft^2)
5,280	feet per mile

Project Assumptions

Fence and New Road Construction (0.42 ton PM_{10}/acre-month)

Duration of Construction Project	2	months
Length	23.95	miles
Length (converted)	126,456	feet
Width	60	feet
Area	174.18	acres

Assumptions:
Constuction corridor for new access roads is 7.95 miles long by 60 feet wide.
Constuction corridor for vehicle fence and access road is 16 miles long by 60 feet wide.

	Project Emissions (tons/year)			
	PM_{10} uncontrolled	**PM_{10} controlled**	**$PM_{2.5}$ uncontrolled**	**$PM_{2.5}$ controlled**
Fence and New Road Construction	146.31	73.16	14.63	7.32
Total	**146.31**	**73.16**	**14.63**	**7.32**

Construction Fugitive Dust Emission Factors

General Construction Activities Emission Factor

0.19 ton PM_{10}/acre-month Source: MRI 1996; EPA 2001; EPA 2006

The area-based emission factor for construction activities is based on a study completed by the Midwest Research Institute (MRI) Improvement of Specific Emission Factors (BACM Project No. 1), March 29, 1996. The MRI study evaluated seven construction projects in Nevada and California (Las Vegas, Coachella Valley, South Coast Air Basin, and the San Joaquin Valley). The study determined an average emission factor of 0.11 ton PM_{10}/acre-month for sites without large-scale cut/fill operations. A worst-case emission factor of 0.42 ton PM_{10}/acre-month was calculated for sites with active large-scale earth moving operations. The monthly emission factors are based on 168 work-hours per month (MRI 1996). A subsequent MRI Report in 1999, Estimating Particulate Matter Emissions From Construction Operations, calculated the 0.19 ton PM_{10}/acre-month emission factor by applying 25% of the large-scale earthmoving emission factor (0.42 ton PM_{10}/acre-month) and 75% of the average emission factor (0.11 ton PM_{10}/acre-month). The 0.19 ton PM_{10}/acre-month emission factor is referenced by the EPA for non-residential construction activities in recent procedures documents for the National Emission Inventory (EPA 2001; EPA 2006). The 0.19 ton PM_{10}/acre-month emission factor represents a refinement of EPA's original AP-42 area-based total suspended particulate (TSP) emission factor in Section 13.2.3 Heavy Construction Operations. In addition to the EPA, this methodology is also supported by the South Coast Air Quality Management District as well as the Western Regional Air Partnership (WRAP) which is funded by the EPA and is administered jointly by the Western Governor's Association and the National Tribal Environmental Council. The emission factor is assumed to encompass a variety of non-residential construction activities including building construction (commercial, industrial, institutional, governmental), public works, and travel on unpaved roads. The EPA National Emission Inventory documentation assumes that the emission factors are uncontrolled and recommends a control efficiency of 50% for PM_{10} and $PM_{2.5}$ in PM nonattainment areas.

New Road Construction Emission Factor

0.42 ton PM_{10}/acre-month Source: MRI 1996; EPA 2001; EPA 2006

The emission factor for new road construction is based on the worst-case conditions emission factor from the MRI 1996 study described above (0.42 tons PM10/acre-month). It is assumed that road construction involves extensive earthmoving and heavy construction vehicle travel resulting in emissions that are higher than other general construction projects. The 0.42 ton PM10/acre-month emission factor for road construction is referenced in recent procedures documents for the EPA National Emission Inventory (EPA 2001; EPA 2006).

$PM_{2.5}$ Multiplier **0.10**

$PM_{2.5}$ emissions are estimated by applying a particle size multiplier of 0.10 to PM_{10} emissions. This methodology is consistent with the procedures documents for the National Emission Inventory (EPA 2006).

Control Efficiency for PM_{10} and $PM_{2.5}$ **0.50**

The EPA National Emission Inventory documentation recommends a control efficiency of 50% for PM_{10} and $PM_{2.5}$ in PM nonattainment areas (EPA 2006). Wetting controls will be applied during project construction.

References:

EPA 2001. *Procedures Document for National Emissions Inventory, Criteria Air Pollutants, 1985-1999.* EPA-454/R-01-006. Office of Air Quality Planning and Standards, United States Environmental Protection Agency. March 2001.

EPA 2006. *Documentation for the Final 2002 Nonpoint Sector (Feb 06 version) National Emission Inventory for Criteria and Hazardous Air Pollutants.* Prepared for: Emissions Inventory and Analysis Group (C339-02) Air Quality Assessment Division Office of Air Quality Planning and Standards, United States Environmental Protection Agency. July 2006.

MRI 1996. *Improvement of Specific Emission Factors (BACM Project No. 1).* Midwest Research Institute (MRI). Prepared for the California South Coast Air Quality Management District, March 29, 1996.

Grading Schedule for CY 2008

Estimate of time required to grade a specified area.

Input Parameters

Construction area: 174.18 acres/yr (from Combustion Worksheet)

Qty Equipment: 53.00 (calculated based on 3 pieces of equipment for every 10 acres)

Assumptions.

Terrain is mostly flat.
An average of 6" soil is excavated from one half of the site and backfilled to the other half of the site; no soil is hauled off-site or borrowed.
200 hp bulldozers are used for site clearing.
300 hp bulldozers are used for stripping, excavation, and backfill.
Vibratory drum rollers are used for compacting.
Stripping, Excavation, Backfill and Compaction require an average of two passes each.
Excavation and Backfill are assumed to involve only half of the site.

Calculation of days required for one piece of equipment to grade the specified area.

Reference: Means Heavy Construction Cost Data, 19th Ed., R. S. Means, 2005.

Means Line No.	Operation	Description	Output	Units	Acres per equip-day)	equip-days per acre	Acres/yr (project-specific)	Equip-days per year
2230 200 0550	Site Clearing	Dozer & rake, medium brush	8	acre/day	8	0.13	174.18	21.77
2230 500 0300	Stripping	Topsoil & stockpiling, adverse soil	1,650	cu. yd/day	2.05	0.49	174.18	85.16
2315 432 5220	Excavation	Bulk, open site, common earth, 150' haul	800	cu. yd/day	0.99	1.01	87.09	87.82
2315 120 5220	Backfill	Structural, common earth, 150' haul	1,950	cu. yd/day	2.42	0.41	87.09	36.03
2315 310 5020	Compaction	Vibrating roller, 6 " lifts, 3 passes	2,300	cu. yd/day	2.85	0.35	174.18	61.09
TOTAL								291.86

Calculation of days required for the indicated pieces of equipment to grade the designated acreage.

(Equip)(day)/yr: 291.86

Qty Equipment: 53.00

Grading days/yr: 5.51

Emissions from Diesel Powered Generators for Construction Equipment & Portable Lights

Diesel Powered Generator Emission Factors

NO_x	4.41	lb/MMBtu
VOC	0.36	lb/MMBtu
CO	0.95	lb/MMBtu
SO_x	0.29	lb/MMBtu
PM_{10}	0.31	lb/MMBtu
$PM_{2.5}$	0.29	lb/MMBtu
CO_2	164	lb/MMBtu

Note: Generators horsepower output capacity is only 0.363 percent efficient (AP-42 Chapter 3.3).
Source: USEPA AP-42 Volume I, Stationary Internal Combustion Sources, Table 3.3-1 (http://www.epa.gov/ttn/chief/ap42/ch03/final/c03s03.pdf)
As per Appendix A of SCAQMD's "Final Methodology to Calculate PM2.5 and PM2.5 Significance Thresholds" (October 2006), the PM2.5/PM10 fraction for gasoline combustion is assumed to be 0.920 for off-road diesel equipment.

Emissions from Generators for Construction Equipment

The Proposed Action would require six diesel powered generators to power construction equipment. These generators would operate approximately 8 hours per day for 60 working days.

Number of Generators	6	
Maximum Hours of Operation	8	hrs/day
Number of Construction Days	60	

Total Generator Capacity	75	hp
Hourly Rate	0.5262	MMBtu/hr
Annual Use	1,515	MMBtu/yr

Example: 1hp=0.002546966 MMBtu/Hr
Hourly Rate (MMBtu) = (75 Hp/0.363)*(0.002546699 MMBtu/hr) =0.5262 MMBtu/hr
Annual Use (MMBtu) = (Number of Generators * Hours Operation/Day * Number of Construction Days) = (6*8*60*0.5262) = 1,515 MMBtu/yr

Emissions (Diesel)

NO_x	3.341	tpy
VOC	0.273	tpy
CO	0.720	tpy
SO_x	0.220	tpy
PM_{10}	0.235	tpy
$PM_{2.5}$	0.220	tpy
CO_2	124.262	tpy

Example: Total NOx Emissions = (Annual MMBtu/year*(EF)/2000 = (1,515*4.41)/2000 = 3.341 tpy

Emissions from Generators for Portable Lights

To be conservative, it was assumed that up to 30 portable light units would be needed for construction. These portable lights are powered by a 6-kilowatt self-contained diesel generators. Portable lights would generally operate continuously every night (approximately 12 hours) 60 days per year.

Number of Generators	30	
Maximum Hours of Operation	12	hrs/day
Number of Operational Days	60	
Total Generator Capacity	8	hp
Hourly Rate	0.0564	MMBtu/hr
Annual Use	1,219	MMBtu/yr

Example: 1hp=0.002546966 MMBtu/Hr
Hourly Rate (MMBtu) = (8 Hp/0.363)*(0.002546699 MMBtu/hr) = 0.0564 MMBtu/hr
Annual Use (MMBtu) = (Number of Generators * Hours Operation/Day * Number of Operational Days) = (30*12*60*0.0564) = 1,219 MMBtu/yr

Emissions (Diesel)

NO_x	2.689	tpy
VOC	0.219	tpy
CO	0.579	tpy
SO_x	0.177	tpy
PM_{10}	0.189	tpy
$PM_{2.5}$	0.177	tpy
CO_2	99.983	tpy

Example: Total NOx Emissions = (Annual MMBtu/year*(EF)/2000 = (1,219*4.41)/2000 = 2.689 tpy

Operations & Maintenance

Following completion of construction activities at the end of CY 2008, border patrol operations along the proposed fence sections would occur. The combined total of all proposed fence sections, once contructed, would total approximately 16 miles. It is anticipated that operations would be similar to ongoing operations in the El Centro Sector.

Project Assumptions:

5 maintenance vehicles operate per day
100 miles traveled per vehicle per workday, round trip
52 workdays per year
>8,500 Largest class of maintenance vehicle used

Annual Vehicle Miles Traveled (VMT): **26,000 miles/year**
VMT in miles/year = (5 vehicles) * (100 miles/vehicle/day) * (365 days/year)

Vehicle Class: >8,500 pounds
Vehicle Year: 2008

Emissions Factors (in pounds/mile)						
NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
2.37E-02	2.99E-03	2.19E-02	2.56E-05	8.56E-04	7.39E-04	2.72E+00

Source: South Coast Air Quality Management District. EMFAC 2007 (ver 2.3) On-Road Emissions Factors. Last updated November 9, 2007. Available online: <http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html>. Accessed January 23, 2008.

Note: Assumed that ROG = VOC, for purposes of analysis.

Estimated Air Pollutant Emissions Associated with Operations & Maintenance Activities (2009 and beyond):

Proposed Emissions (in tons per year)						
NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
0.308	0.039	0.285	0.0003	0.011	0.010	35.353

Emissions in tons/year = (Vehicle miles/year) * (Emissions Factor in pounds/mile) * (1 ton/2000 pounds)