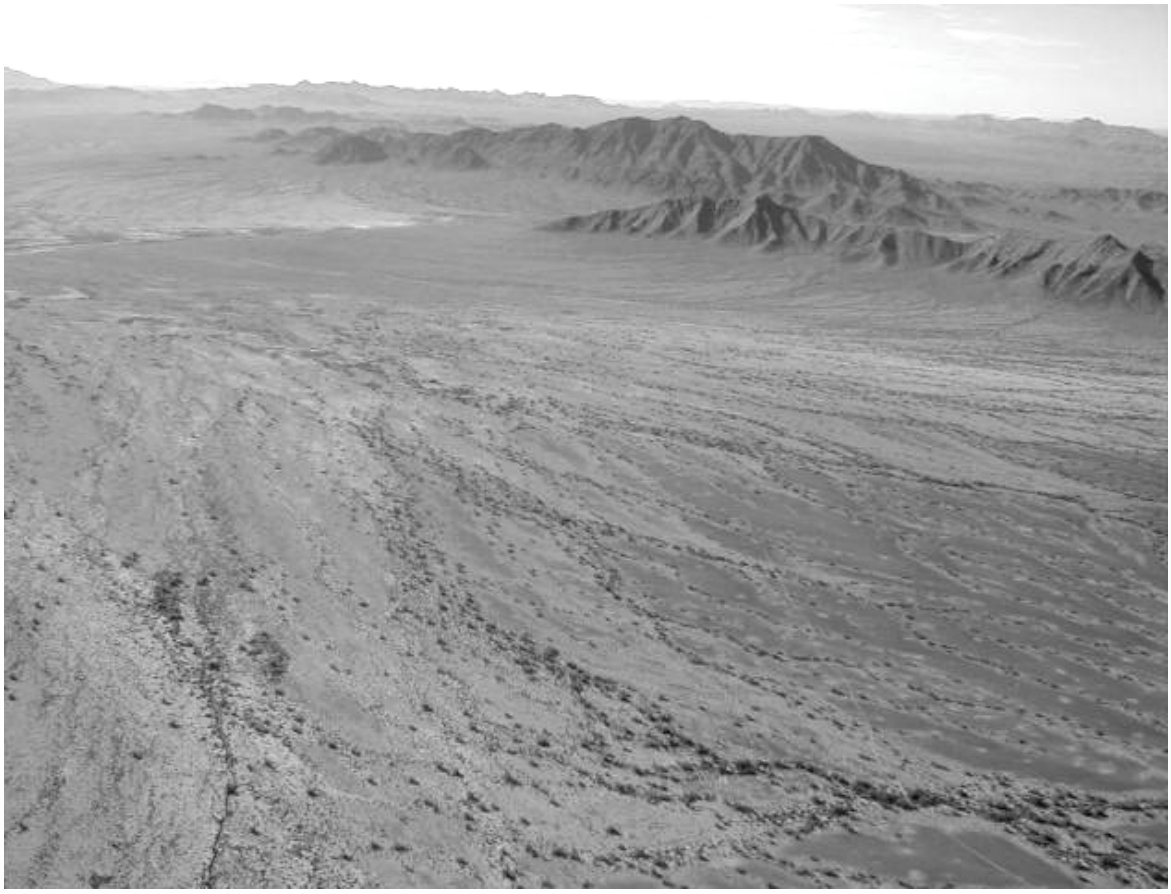
PRELIMINARY ASSESSMENT OF BIODIVERSITY VALUES AND MANAGEMENT FRAMEWORK ADAPTATION FOR THE EXPANDED KOFA COMPLEX AND YUMA RESOURCE MANAGEMENT AREA IN SOUTHWESTERN ARIZONA



The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

August 2003

(Revised Version, February 2004)

The Nature Conservancy in Arizona, Tucson

PRELIMINARY ASSESSMENT OF BIODIVERSITY VALUES AND MANAGEMENT FRAMEWORK ADAPTATION FOR THE EXPANDED KOFA COMPLEX AND YUMA RESOURCE MANAGEMENT AREA IN SOUTHWESTERN ARIZONA

Stephanie Weinstein
Conservation Planner

Anne Gondor
Geographic Information Systems Specialist

John A. Hall
Director of Public Land Conservation Strategies and
Sonoran Desert Program Manager

August 2003

(Revised Version, February 2004)

The Nature Conservancy in Arizona, Tucson

Cover photograph: Tyson Wash in the La Posa Plain, Yuma Proving Ground, Arizona. Facing south-southwest (Photo: S. Weinstein).

ACKNOWLEDGMENTS

This project was supported by funding from the Department of Defense Legacy Resource Management Program and the Bureau of Land Management. We would like to thank the many individuals and agencies that supported this project. Many datasets, including Geographic Information Systems data, were critical components of this assessment and were provided to us by Barbara Bowles and Jack Johnson (Bureau of Land Management), David Lashlee and Valerie Morrill (Yuma Proving Ground), Bob Henry (Arizona Game and Fish Department), and Susanna Henry (Kofa National Wildlife Refuge). Numerous staff from the Arizona Game and Fish Department (Region IV-Yuma), Bureau of Land Management Yuma Field Office, Kofa National Wildlife Refuge, and Yuma Proving Ground generously offered us their time and valuable advice in several meetings and subsequent correspondence. In particular, we would like to thank Karen Reichhardt and Roger Oyler (Bureau of Land Management), Russ Engel, Bob Henry, and Bill Knowles (Arizona Game and Fish Department), Ron Kearns (Kofa National Wildlife Refuge), and Valerie Morrill and Randy English (Yuma Proving Ground) for all the input they provided us with in meetings, phone calls, and emails. Bob Henry (Arizona Game and Fish Department) generously shared his knowledge of the current status and dispersal areas of desert bighorn sheep in southwestern Arizona. We would also like to thank Randy English and Tim Green for accompanying Nature Conservancy staff in the field on Yuma Proving Ground to look for the Mojave fringe-toed lizard. Finally, we thank the U.S. Army at Yuma Proving Ground for a helicopter flight over the region that gave us a glimpse of this truly inspirational landscape. Any omissions or errors in interpretation presented in this report are our own.

EXECUTIVE SUMMARY

This report documents a preliminary assessment of biodiversity values for portions of the Bureau of Land Management (BLM) Yuma Resource Management Area, including a large Sonoran Desert landscape, the "Expanded Kofa Complex." The Expanded Kofa Complex is an area of approximately 2.7 million acres (1.1 million hectares) within the BLM Yuma Resource Management Area that includes large blocks of land managed by the BLM, the U. S. Army at Yuma Proving Ground (YPG), and the U.S. Fish and Wildlife Service (USFWS) at Kofa National Wildlife Refuge. The assessment results contribute to the development of a biodiversity management framework for the Expanded Kofa Complex. The initial steps of framework development reported here—conservation element selection, status, and potential threat identification—provide the preceding federal agencies and the Arizona Game and Fish Department (AGFD) with information that can facilitate their ability to work individually and cooperatively, but still within the bounds of their individual missions, to manage and conserve the biological diversity (biodiversity) of the region.

Within this report we describe the challenge of developing a biodiversity management framework for an area, such as the BLM Yuma Resource Management Area, that includes land managed by numerous agencies and landowners. In some cases these lands also are fragmented by significant movement and dispersal barriers for the area's biota, such as by roads or incompatible land use. A first step in confronting this challenge was to delineate a functional conservation area that could serve as the focus of our analysis. A functional conservation area is a geographic domain that maintains focal ecosystems, species, and supporting ecological processes within their natural ranges of their variability. We chose to focus on a relatively contiguous block of federal land, centered around the Kofa National Wildlife Refuge and identified in this report as the Expanded Kofa Complex, to establish a starting point for delineating a functional conservation area. Information on the biodiversity of the Sonoran Desert Ecoregion provided a regional context for this area and an initial basis for determining in part what ecosystems and species should be a focus for management.

We next employed a "coarse filter-fine filter" analysis to select appropriate species, specialized habitats, and plant communities (collectively termed "conservation elements") to represent the native biodiversity of the Expanded Kofa Complex. The coarse filter-fine filter approach applies contemporary principles from conservation biology and incorporates information from the scientific literature, geospatial datasets, and expert knowledge to select conservation elements that become the focus of management. We took into account the ecoregional information mentioned above and agency management concerns for individual species, specialized habitats, and plant communities in deriving the appropriate conservation elements. The coarse filter-fine filter approach is recognized by conservation biologists as one of the most rigorous approaches to conservation planning because it takes into account the many ways in which biodiversity exists on the landscape—including its different levels of biological organization, the different spatial scales at which it occurs, and different levels of rarity. We hypothesize that with appropriate selection and management of conservation elements, most of the biodiversity of the Expanded Kofa Complex is likely to be protected over the long-term.

A total of seventeen natural communities (plant communities and physical habitats that with one exception, desert tinajas and springs, constitute the coarse filter), species, and guilds are proposed as preliminary conservation elements for the Expanded Kofa Complex (Table ES.1). The preliminary conservation elements include nine natural communities, five individual species, and three guilds (a total of 13 species contribute to the guilds). These species, guilds, and natural communities were selected from over 160 potential conservation elements. The selected conservation elements (1) are representative of biodiversity within the Sonoran Desert Ecoregion; (2) account for the occurrence of biodiversity at different spatial scales, across taxonomic categories, and different levels of rarity; (3) are relevant to natural resource management; and (4) in some cases, are most effectively managed by the cooperative efforts of multiple agencies. By accounting for scale and other patterns that shape the overall biodiversity of an area, the conservation element selection process also attempts to capture the relevant supporting ecological processes that are important in maintaining biodiversity.

We also present a preliminary map of the distribution of natural community conservation elements of the Expanded Kofa Complex (Figure ES.1). The natural community distributions are based in part on available geospatial datasets and on biophysical models that had been previously developed to map conservation element distributions on the Barry M. Goldwater Range and the Sonoran Desert National Monument. Although preliminary, the natural community map is a significant outcome of this assessment because there are no other vegetation maps for the Expanded Kofa Complex region that are mapped at a scale appropriate for natural resource management in the Yuma Resource Management Area. As a result, the preliminary natural community map provides land managers with a starting point for considering biodiversity management in a landscape context.

In addition to selecting conservation elements and mapping natural communities for the Expanded Kofa Complex, we present information on the status and regional threats of the species and natural communities and the relative importance of the Expanded Kofa Complex in their conservation. We also provide information on areas within the Yuma Resource Management Area (outside the Expanded Kofa Complex) that have significant biodiversity value, including portions of the Colorado and Gila Rivers. Some of the notable findings discussed in more detail in the report include:

- A population of Mojave fringe-toed lizards (*Uma scoparia*) is confirmed to occur on isolated sand dunes on YPG.

- The Expanded Kofa Complex and its surroundings include the largest unfragmented habitat for desert bighorn sheep in Arizona.

- Twenty-two of Arizona's twenty-eight bat species are expected or known to occur within the Yuma Resource Management Area.

- Large patches of the Mountain Upland natural community occur at the higher elevations of the Kofa Mountains in the Kofa National Wildlife Refuge and include chaparral and woodland relic species, including the globally rare Kofa barberry (*Berberis harrisoniana*).

- One of only two naturally occurring populations in Arizona of the state's only native palm, the California fan palm (*Washingtonia filifera*), is found in the rugged canyons of the Kofa Mountains.

- Extensive networks of relatively unfragmented Braided Channel Floodplain and Valley Xeroriparian Scrub occur throughout the Expanded Kofa Complex. These natural communities are the areas of greatest species richness and abundance in the Lower Colorado River Valley Subdivision of the Sonoran Desert. These natural communities provide habitat for numerous species and maintain hydrologic connections with the Colorado and Gila Rivers.

- More than 50 Special Status species (including federal listed species, BLM Sensitive Species, and Wildlife of Special Concern in Arizona) occur in the Yuma Resource Management Area. The specialized management needs of many of these species could be addressed by the biodiversity management framework proposed for the Expanded Kofa Complex.

- Portions of the Yuma Resource Management Area outside the Expanded Kofa Complex that are notable for their biodiversity values include dunes and their associated endemic plants (particularly on the Yuma and Mohawk Dunes) and native habitat and unchannelized sections of the Colorado River, which is critical for many taxa including endangered fish and wetland birds, migratory birds, and bats.

- A limited number of springs and tinajas occur in the area and provide habitat and drinking water for many species. We produced a spatially-explicit dataset on springs, tinajas, and other wildlife waters based on information received from partner agency staff. This data layer is a useful product because it combines multiple spatial datasets and their attributes into a single file that is relevant to all land managers and partners. Although it may not be complete, it can easily be updated with missing or additional information. Partner agencies will be provided with a copy of this dataset.

The information provided in this analysis can be integrated into the ongoing planning efforts taking place in the region, including YPG's Integrated Natural Resource Management Plan update and the upcoming Resource Management Plan revision for the BLM Yuma Field Office. This report provides each agency with information relevant to their individual and shared responsibilities to maintain the functional landscape of the Expanded Kofa Complex. Suggestions for coordinated management opportunities build on the existing relationships between the BLM, YPG, USFWS, and the AGFD, with the objective of maintaining this functional desert landscape given each agency's individual mission.

Table ES.1 Spatial Organization and Selection Criteria of Preliminary Conservation Elements of the Expanded Kofa Complex

Geographic Scale[1]	Level of Biological Organization		
	Species/Guild[2]	Terrestrial Natural Community	Aquatic Natural Community
Regional	None identified to date	Not applicable	Not applicable
Coarse	Bat guild (S) Desert bighorn sheep (AD, RV) Primary excavator (cavity) guild (K, S)	Creosotebush-Bursage Desert Scrub Paloverde-Mixed Cacti-Mixed Scrub on Bajadas Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes	None identified to date
Intermediate	Desert tortoise (RV) Le Conte's thrasher (S, RV) Mojave fringe-toed lizard (S)	Mountain Upland Dune Complex	None identified to date
Local	Ephemeral water-breeding amphibian guild (S) California fan palm (S)	None identified to date	Desert Tinaja/ Spring (SH)
Linear	Not applicable	Valley Xeroriparian Scrub Mountain Xeroriparian Scrub Braided Channel Floodplain	Not applicable

[1] Geographic scale definitions are provided in Figure 2.1.

[2]**Legend**: Selection criteria are provided for "fine filter" conservation elements (species, guilds, and specialized habitats). AD = area-dependent species; K = keystone species; RV = regionally vulnerable species; S = specialized species; SH = specialized habitat. Complete definitions for fine filter categories are provided in Table 2.1

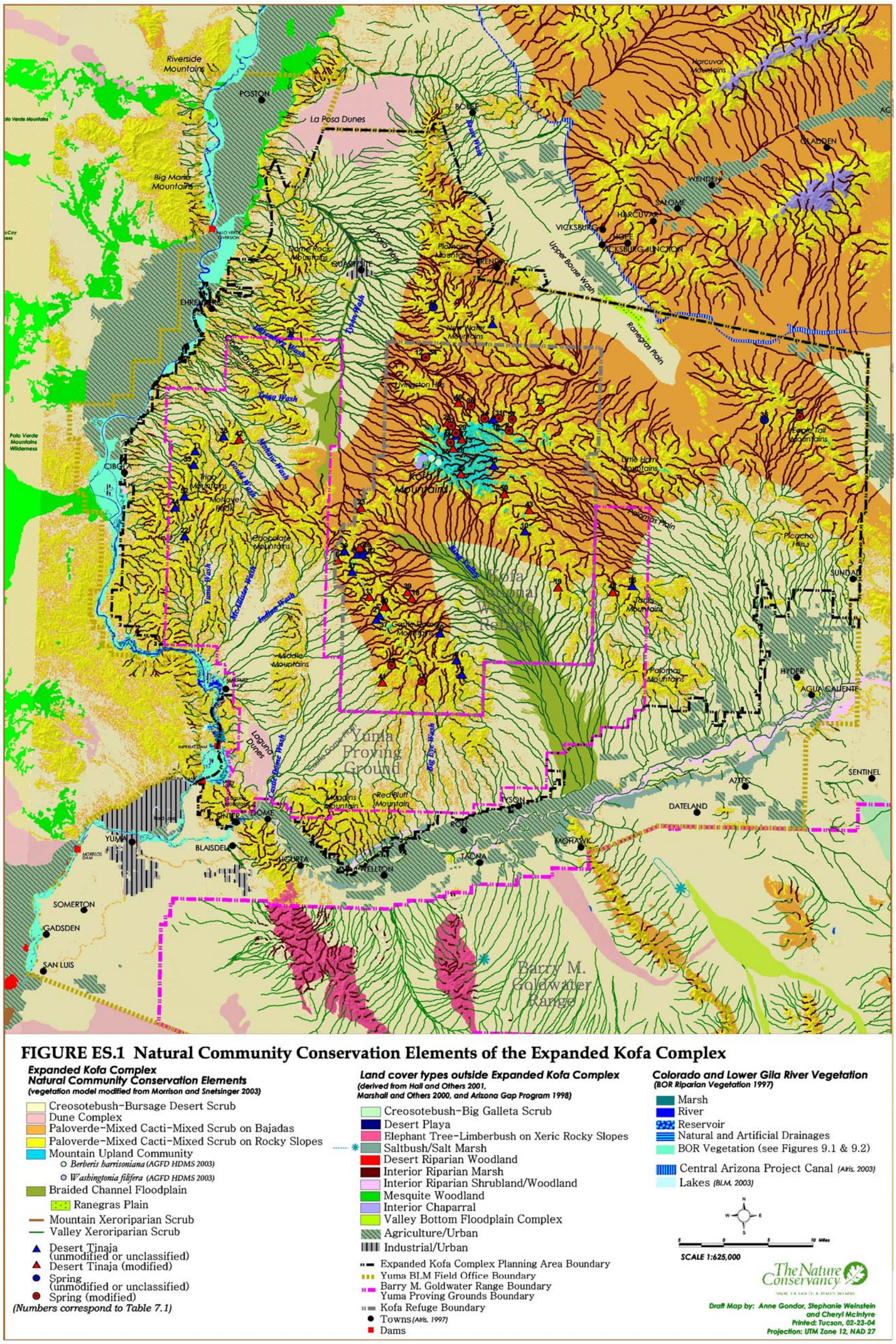


FIGURE ES.1 Natural Community Conservation Elements of the Expanded Kofa Complex

Expanded Kofa Complex Natural Community Conservation Elements
(vegetation model modified from Morrison and Snetsinger 2003)

- Creosotebush-Bursage Desert Scrub
- Dune Complex
- Paloverde-Mixed Cacti-Mixed Scrub on Bajadas
- Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes
- Mountain Upland Community
  - *Berberis harrisoniana* (AGFD HDMS 2003)
  - *Washingtonia filifera* (AGFD HDMS 2003)
- Braided Channel Floodplain
- Ranegras Plain
- Mountain Xeroriparian Scrub
- Valley Xeroriparian Scrub
- Desert Tinaja (unmodified or unclassified)
- Desert Tinaja (modified)
- Spring (unmodified or unclassified)
- Spring (modified)

(Numbers correspond to Table 7.1)

Land cover types outside Expanded Kofa Complex
(derived from Hall and Others 2001, Marshall and Others 2000, and Arizona Gap Program 1998)

- Creosotebush-Big Galleta Scrub
- Desert Playa
- Elephant Tree-Limberbush on Xeric Rocky Slopes
- Saltbush/Salt Marsh
- Desert Riparian Woodland
- Interior Riparian Marsh
- Interior Riparian Shrubland/Woodland
- Mesquite Woodland
- Interior Chaparral
- Valley Bottom Floodplain Complex
- Agriculture/Urban
- Industrial/Urban
- Expanded Kofa Complex Planning Area Boundary
- Yuma BLM Field Office Boundary
- Barry M. Goldwater Range Boundary
- Yuma Proving Grounds Boundary
- Kofa Refuge Boundary
- Towns (Atris, 1997)
- Dams

Colorado and Lower Gila River Vegetation
(BOR Riparian Vegetation 1997)

- Marsh
- River
- Reservoir
- Natural and Artificial Drainages
- BOR Vegetation (see Figures 9.1 & 9.2)
- Central Arizona Project Canal (Atris, 2003)
- Lakes (BLM, 2003)

N W E S

5 0 5 10 Miles

SCALE 1:625,000

The Nature Conservancy

Draft Map by: Anne Gondor, Stephanie Weinstein and Cheryl McIntyre
Printed: Tucson, 02-23-04
Projection: UTM Zone 12, NAD 27

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1
BACKGROUND, PROJECT SCOPE, AND REPORT STRUCTURE

The assessment provided in this report for the "Expanded Kofa Complex" and the Yuma Resource Management Area has been accomplished as a task under the Sonoran Desert Ecosystem Initiative, a jointly funded project of the Department of Defense's (DoD) Legacy Resource Management Program and Bureau of Land Management (BLM). The Expanded Kofa Complex is a geographic area of mostly contiguous federal land that is managed jointly by the BLM (Yuma Field Office), DoD (U.S. Army at Yuma Proving Ground), and U.S. Fish and Wildlife Service (USFWS; Kofa National Wildlife Refuge). The Yuma Resource Management Area is the planning area that the BLM's Yuma Field Office uses to set resource management objectives and make land-use allocation decisions. Although funding support and deliverable requirements are limited to the DoD and BLM, it is intended that the information and analyses provided herein also be of use to the Kofa National Wildlife Refuge and Arizona Game and Fish Department (AGFD). Indeed, the latter two agencies provided their information and knowledge in support of this effort. As a result, AGFD, BLM, DoD, and USFWS are all contributors to this work and hopefully can all mutually benefit from its findings.

In the sections that follow, we: (1) provide background information on how this task came about, (2) define the scope of the assessment, and (3) briefly outline the various chapters of the report.

1.1 Background

A cooperative relationship has existed for some time between The Nature Conservancy (the Conservancy) and DoD, especially at the national scale at which the two organizations have been partnering since the late 1980s. The Sonoran Desert Ecosystem Initiative has its roots in a DoD Legacy Resource Management Program funded-effort initiated in the late 1990s that conducted an ecological analysis of conservation opportunities within the 55-million acre (22-million hectare) Sonoran Desert Ecoregion (Marshall and others 2000). DoD's interest in the analysis was in part fueled by its concern with the potential for impacts to its mission resulting from continued species endangerment in the Southwest. The outcome of the Sonoran Desert Ecoregion analysis was seen as a means to identify a shared plan for allocating conservation responsibilities throughout the ecoregion.

The Sonoran Desert Ecoregion analysis outcomes included (1) identification of conservation areas that in combination provided the best remaining on-the-ground opportunities for conserving plant communities and species within the ecoregion and (2) an assessment of some wide-ranging threats to the continued persistence of the preceding communities and species, such as invasive non-native species. One hundred landscape-scale conservation areas, ranging in size from about 400 acres (160 hectares) to 5.7 million acres (2.3 million hectares), and 79 localized special element sites were identified. The analysis also revealed that federal lands in the U.S. accounted for a significant amount, in number and area, of the network of identified conservation areas, yet in general federal lands did not receive adequate attention for biodiversity management to ensure community and species persistence.

As a follow-up to the analysis, in 2000 the Conservancy initiated the development of a biodiversity management framework through a cooperative agreement with Luke Air Force Base (AFB). The biodiversity management framework drew on the data and results from the Sonoran Desert ecoregional analysis and applied them to a scale at which natural resource management decisions would be made for the Barry M. Goldwater Range (Goldwater Range). The final framework recommendations (Hall and others 2001) were provided to Luke AFB and Marine Corps Air Station Yuma to support the Goldwater Range's development of its Integrated Natural Resources Management Plan. A brief overview of the conceptual basis for the framework and its relationship to ecoregional assessment information are provided in Chapter 2.

During the early part of federal fiscal year 2001, DoD natural resource management officials requested the Conservancy, and its partner Sonoran Institute, to develop a new Sonoran Desert project vision as a fiscal year 2002 Legacy Program proposal—now referred to as the Sonoran Desert Ecosystem Initiative. The focus of the Sonoran Desert Ecosystem Initiative was to apply the biodiversity management framework to the newly designated BLM Sonoran Desert National Monument in Arizona as input to the BLM's land use planning process for the monument. DoD's support of this project was based on the monument's proximity to the Goldwater Range and DoD's interest in improving conservation management practices across the Sonoran Desert Ecoregion. Because the BLM and the Conservancy in Arizona have had a long-standing cooperative relationship, a focus on BLM-related land use planning needs also afforded an opportunity to work together in a new capacity to share information and strategies for managing a region's biological diversity.

The Sonoran Desert National Monument is a regionally significant land management unit and an appropriate locale to further test and adapt the biodiversity management framework. However, the monument does not necessarily represent a typical resource management plan (RMP) scenario. Typically a BLM RMP area contains both large blocks and scattered parcels of BLM-administered lands amidst other types of land ownership. In addition, DoD was interested in having a new military branch partner, in this case the U.S. Army, benefit from further conservation work occurring in the Sonoran Desert region. As a result, the Legacy proposal also included conducting a preliminary assessment of the adaptation of the biodiversity management framework to an area in southwestern Arizona that included the U.S. Army's Yuma Proving Ground, Kofa National Wildlife Refuge, and BLM-administered lands associated with the Yuma Field Office.

This report documents the findings of the preliminary assessment. As such, it fulfills deliverable requirements for the Legacy Resource Management Program under Cooperative Agreement DACA87–02–H–0004 and BLM under Assistance Agreement No. AAA–02–0005, Task Order No. AAF–02–0001, Task 4. Additionally, subsequent to the identification of this task under the preceding agreements, the Conservancy and BLM signed a national-level assistance agreement and task order. One of the tasks under the national task order was to identify potential demonstration projects that could couple information and conservation strategies from the Conservancy's ecoregional and conservation area-level assessment and planning processes with the BLM's resource management planning processes. The intent of demonstration projects is to assist the BLM with identifying more efficient and effective ways to address special status species and habitat conservation for multiple species across broad landscapes. As a result, this

report also serves as background information to inform a decision regarding whether the Yuma Resource Management Area, in conjunction with its upcoming land use planning process, should serve as a continuing demonstration project.

1.2 Task Scope

As originally conceived, the task was meant to address an initial assessment of the feasibility and conservation benefit of transferring the biodiversity management framework to the "Kofa Complex". The Kofa Complex is one of the 100 landscape-scale conservation areas identified in the Sonoran Desert ecoregional analysis (Marshall and others 2000). The Kofa Complex is located east of the Colorado River and north of the Gila River in southwestern Arizona and includes lands administered by the Army's Yuma Proving Ground (YPG), U.S. Fish and Wildlife Service's Kofa National Wildlife Refuge, and the Bureau of Land Management's Yuma Field Office. At approximately 1.43 million acres (0.58 million hectares), the Kofa Complex was the third largest conservation area identified in the ecoregion. It included fourteen species and plant communities (ecoregional conservation elements) that represent the biological diversity of the Sonoran Desert. An assessment of the Kofa Complex also afforded an opportunity to work with multiple federal land managers, two of which were beginning or scheduled to soon begin their resource management planning processes (Yuma Proving Ground and BLM Yuma Field Office, respectively).

A number of additional considerations helped to define the scope of this assessment. First, the boundary of the Kofa Complex needed to be revisited. The Kofa Complex was delineated at a coarse scale (approximately 1:500,000 scale) in the Sonoran Desert Ecoregion analysis (Marshall and others 2000). We redefined the Kofa Complex boundary to address biodiversity management issues at a scale relevant to the agencies within the BLM Resource Management Area. The new conservation area—hereafter referred to as the "Expanded Kofa Complex" was a first attempt to identify an area that included the species and natural communities of concern to land managers and that encompassed a functional conservation area (Poiani and others 2000). Other Chapters of this report present additional information on the conceptual basis for the boundary modification (Chapter 2) and how the boundary was modified (Chapter 5).

Second, we wanted the assessment to build on the cooperative approach to management that already occurs in the area between federal agencies. The Kofa National Wildlife Refuge is an integral part of the Expanded Kofa Complex. Although the next revision of the refuge's Comprehensive Conservation Plan is not due until later in the decade, the refuge can benefit from the information provided in this assessment. The findings provided herein can be used to set a broader geographic context for the significance of the Kofa Refuge's biological resources and can allow the refuge to take advantage of additional opportunities for coordinated management with its neighbors. The three land management agencies in the Expanded Kofa Complex—BLM, DoD, and USFWS—work extensively with the Arizona Game and Fish Department and we also wanted to capture that relationship in our assessment.

Third, given that BLM-administered lands occur outside the Expanded Kofa Complex, we wanted to provide some ecoregional assessment information applicable to other areas within the BLM Yuma Resource Management Area. The BLM Yuma Resource Management Area is

coincident with the Yuma Field Office boundaries (hereafter termed the "Yuma Planning Area") and will be described in more detail in Chapter 4. Although the BLM Yuma Planning Area intersects several conservation areas identified in the Sonoran Desert Ecoregion analysis (Marshall and others 2000), the main focus of this report will be on the Expanded Kofa Complex because: (1) the Yuma Planning Area has minimal intersections with the conservation areas on the west side of the Colorado River (2) the Lower Colorado River Multi-Species Conservation Program is an ongoing effort involving numerous parties that is focused on management strategies related to the aquatic and riparian resources of the lower Colorado River, and (3) a large portion of BLM's original holdings in the Yuma Planning Area are at present withdrawn from the public domain under the Military Lands Withdrawal Act of 1999 for use by the Marine Corps Air Station Yuma (the land administrator of the western portion of the Goldwater Range). Because Hall and others (2001) already provided information relative to a biodiversity management framework for this area and the Yuma Field Office will not be planning for this area for the foreseeable future, we have excluded it from our analyses here.

As a preliminary assessment of biodiversity values and management framework adaptation for the Expanded Kofa Complex, the following items are addressed in this report:

- selection of natural community and species conservation elements that are appropriate for management within the Expanded Kofa Complex
- conservation status of each element
- preliminary threat analysis for each element
- opportunities for coordinated management based on the framework findings to date
- data needs and next steps that could be taken.

1.3 Structure of the Report

Subsequent Chapters of this report provide ecoregional assessment information, the scientific basis for this assessment, details on the methods used, and the main findings of the assessment. The main topics discussed in each Chapter are listed below.

- Chapter 2 provides background on development of the biodiversity management framework and the conceptual basis for how species and natural communities are selected in a coarse filter-fine filter approach.
- Chapters 3 and 4 put the assessment into a regional context and include information on the land ownership, natural resources, and predominant land uses in the Sonoran Desert Ecoregion and the BLM Yuma Planning Area.
- Chapter 5 outlines the methods employed in the assessment, including delineation of the Expanded Kofa Complex boundary and conservation element selection.

- Chapters 6 through 8 present the results of the assessment, including an overview of the selected conservation elements (Chapter 6), more detailed descriptions of the natural communities, including mapping methods and assumptions (Chapter 7), and characterization of the species conservation elements (Chapter 8). A limited number of natural communities and species that were considered as potential conservation elements but were not selected at this time are also presented in Chapters 7 and 8, respectively.

- Chapter 9 presents information on areas outside the Expanded Kofa Complex with biodiversity values, particularly the Lower Gila and Colorado River.

- Chapters 10 summarizes the ways in which agencies are partnering in the Yuma Planning Area to achieve management goals and addresses the potential for further coordinated management opportunities.

- Chapter 11 describes the principle information needs and the next steps that could be taken to develop a biodiversity management framework for the region.

Tables and Figures are found at the end of the Chapter in which they are referred. An exception to this is small tables that fit within the report text and are placed close to the point at which they were cited.

CHAPTER 2
CONCEPTUAL BASIS OF FRAMEWORK ADAPTATION TO THE EXPANDED KOFA COMPLEX AND CONSERVATION ELEMENT SELECTION

Over the last several decades and accelerating since the 1990s, a paradigm shift has been underway from single species management approaches to one based on an ecosystem approach (Franklin 1993, Poiani and others 2000). The shift perhaps reflects a changing view of what constitutes biological diversity. In the past, biological diversity was largely viewed in terms of species richness. In contrast, the contemporary view of biodiversity encompasses different levels of biological organization (for example, genes, populations and species, communities and ecosystems, and landscape types) with their associated attributes of composition, structure, and function (Noss 1990). Commensurate with this conceptual shift has been a change in federal environmental policy that recognizes native biodiversity protection and management as an important end in itself (for example, see the Council on Environmental Quality 1993) and ecosystem-based management approaches as a basis for guiding natural resource management decisions.

Prior to the shift in thinking described above, non-consumptive federal conservation efforts (that is, those not focused on maintaining sport fish and game populations for sustained recreational harvest) tended to be focused on listed species (federal listed threatened or endangered species). During this time, conservation within the private sector focused on relatively small nature preserves, whereas endangered species management and recovery planning dominated on the more extensive federal land holdings (Poiani and others 2000).

The shift to an ecosystem approach has not been without its conceptual challenges and public policy still demands that the needs of listed species are addressed. The problem can seem intractable for a federal land manager with too many species to address, limited resources with which to plan and implement management, and jurisdictional boundaries that do not conform to the actual occurrence pattern of biological resources across the landscape. Federal land managers are also sometimes confronted with conflicting mandates and mutually exclusive public values to accommodate. To resolve these difficulties, natural resource managers need: (1) access to the best available scientific information, (2) appropriate spatial and temporal contexts in which to judge the relative significance and status of particular resources, (3) a clear understanding of both the constraints and opportunities they have to resolve resource management conflicts, and (4) the capacity to engage in coordinated resource management with adjoining land managers especially in cases where successful management is dependent on a consideration of ecological rather than administrative boundaries.

In the sections that follow we will briefly describe the conceptual basis underlying some key components of the biodiversity management framework as applied to the Expanded Kofa Complex. We will address: (1) setting the regional context using ecoregional assessment information, (2) conservation area planning and defining a functional conservation area, (3) using a coarse filter-fine filter strategy to guide management within the conservation area, and (4) the conservation element selection process.

2.1 Regional Context

One of the principles of an ecosystem-based approach is that appropriate ecological units need to be considered when formulating management strategies. Ecological regions (ecoregions) can be defined as areas with relative homogeneity in ecosystems (Omernick and Bailey 1997). Ecoregions are large units of land and water that share similar climate, topography, and biological communities. Because ecoregions delimit areas in which local ecosystems reoccur more or less throughout the area in a predictable pattern, they include ecological processes, abiotic and biotic elements, and terrestrial and aquatic components that may require similar management strategies (Omernick and Bailey 1997). Ecoregions can provide a spatial framework for ecosystem assessment, research, inventory, monitoring, and management (Science Advisory Board 1991, Omernick and Bailey 1997).

The primary purpose of ecoregional planning is to identify a set of conservation areas that best represent the region's biological diversity and that capture the underlying ecological processes that sustain it. In ecoregional planning, a sample of an ecoregion's biodiversity—including vegetation communities, physical habitats, and species, including those that are endemic to the ecoregion are selected to represent the array of biodiversity found in that ecoregion (collectively termed ecoregional conservation elements or targets). The size, location, and configuration of the network of conservation areas is determined such that they incorporate ecoregional conservation elements within their boundaries. Conservation areas require appropriate management to ensure that an ecoregion's biological diversity will be maintained. Additional rationale for using the ecoregional planning framework and the steps involved are provided in Groves and others (2000, 2002).

The identification of conservation areas in an ecoregional assessment is a separate process from determining how each area is best designed and managed (Scott and Csuti 1997, Groves and others 2002). As a result, the ecological data used in ecoregional assessments are best used by natural resource managers as regional context information for their land management decisions affecting biological diversity. The Sonoran Desert Ecoregion provides the appropriate regional context to assess the relative significance and status of the biological resources of the Expanded Kofa Complex. Attributes of the Sonoran Desert Ecoregion are provided in Chapter 3.

2.2 Conservation Area Planning and Functional Conservation Areas

A more detailed analysis than that provided at the ecoregion-scale is needed to develop specific natural resource management prescriptions and land-use allocations. At this finer scale of analysis— "conservation area planning"—we identify species and other biological elements that will become the focus of management based in part on those analyzed at the ecoregion-scale but adjusted to reflect the planning situation at the specific area being analyzed (TNC 2000).

The Nature Conservancy has developed a planning process for individual conservation areas that considers the species and habitats/plant communities present in an area and the threats to their persistence, and then identifies conservation (management) strategies and metrics for measuring the success of those strategies (TNC 2000). This planning process was originally designed to meet the planning needs of Conservancy bioreserves, but has since been adapted to meet the

planning needs of landscape-scale conservation areas identified during ecoregional assessments. The biodiversity management framework is a further adaptation of the planning process that is designed to meet the needs of federal land managers.

Conservation area planning can be applied at any scale (Poiani and others 1998), whether a BLM Area of Critical Environmental Concern, a DoD Special Natural Area, or at the scale of areas encompassing a few million acres such as a BLM Resource Management Planning Area (RMP). A typical RMP area, however, may include portions of one or more conservation areas. As a result, it is more important to consider the ecosystems and species that are the focus of management and the spatial scales at which they and their supporting ecological processes occur, than the size of the planning unit. That is, the conservation area boundaries should be defined on the basis of the area that is needed to maintain the biological resources contained within.

A functional conservation area is defined as "a geographic domain that maintains focal ecosystems, species, and supporting ecological processes within their natural ranges of variability." (Poiani and others 2000) Two characteristics of a functional conservation area are that (1) its size, configuration, and other design features are determined by the focal biological elements and supporting ecological processes and (2) the area is functional if it maintains focal biotic and abiotic patterns and processes within their natural ranges of variability over time frames relevant to conservation planning and management (for example, 100 to 500 years; Poiani and others 2000). In addition, functional conservation areas do not necessarily preclude human activities and in some cases, ecological management or restoration may be necessary to maintain functionality.

Functional conservation areas can exist at different spatial scales. As mentioned above, the size of a conservation area is determined by the biotic elements that are intended to be the focus of management attention. These elements themselves can occur at different scales. Poiani and others (2000) distinguish four scales at which species and ecosystems (plant communities/habitats) can occur: local, intermediate, coarse, and regional (Figure 2.1). Only species, such as migrating ungulates or top predators, occur at the regional scale. Regional species may require a network of conservation areas to meet their needs. Any particular conservation area can include a mix of species and ecosystems that in combination occur at multiple scales and that nest together in complex configurations (Poiani and others 2000). Functional conservation areas that attempt to conserve matrix communities or area-dependent species such as desert bighorn sheep will need to be large enough to address the coarse-scale requirements of these elements.

2.3 Coarse Filter-Fine Filter Strategy

Early attempts to broaden the management focus from a single-species approach used groups of species (guilds[1]) or a surrogate species (indicator, umbrella, or flagship species [Caro and O'Doherty 1999]) to represent the conservation needs of other species of interest. These approaches drew sharp criticism for their lack of biological basis and rigor of application (Caro and O'Doherty 1999, Landres and others 1988, Poiani and others 2000).

[1]A guild represents a group of species that exploit the same class of environmental resources in a similar way (Begon and others 1990).

As an answer to these problems, ecosystems gained favor within the scientific community as the unit of biodiversity management (Ecological Society of America 1995). The linkage of species- and ecosystem-level concepts in biodiversity conservation led to the development of the coarse filter-fine filter strategy (Noss and Cooperrider 1994, Poiani and others 2000). This approach stresses the importance of conserving viable examples of ecosystems—the coarse filter—to protect the vast majority of species.

When ecosystems are defined based predominately on a vegetation classification scheme their ability to act as a coarse filter has some limitations. A potentially serious limitation is that ecosystems defined on the basis of floristic composition are not stable: "they change as species respond more or less independently to environmental gradients in space and time" (Noss and Cooperrider 1994; see also Hunter and others 1988, Ecological Society of America 1995). Climate change can create such a gradient in which each species responds to environmental change in accordance with its own ecological amplitude.

Natural communities, as we use them in this assessment, represent an integration of ecosystem attributes, including biotic and abiotic composition, structure, and function, at scales that are practical and applicable to conservation planning. They encompass both traditionally defined plant communities as well as physical habitats. Natural communities capture elements that occur at different scales, are maintained by different ecological processes, or are subjected to different primary threats. If selected and mapped appropriately, natural communities should also enable capturing the full range of environmental gradients that may occur in an area. By incorporating abiotic features as part of the description for some community types, we have addressed some of the criticisms to the coarse filter approach when it is based purely on plant communities (Hunter and others 1988, Noss and Cooperrider 1994). Despite the limitations, even vegetation-based coarse filters should be useful in the shorter term because, in the absence of dramatic climate change, vegetation does integrate underlying physical habitat variables (Noss and Cooperrider 1994). Because natural communities are dynamic, however, the appropriateness of each natural community as a coarse filter for biodiversity should be periodically assessed and revised as necessary.

2.4 Conservation Element Selection

In the coarse filter-fine filter approach species and natural communities (conservation elements) are selected to represent the biodiversity of a conservation area. Conservation elements are selected such that they (1) are representative of biodiversity within the ecoregion; (2) account for the occurrence of biodiversity at different spatial scales, across taxonomic categories (plants, birds, mammals, and so on), and different levels of rarity; (3) relevant to natural resource management; and (4) inclusive of natural communities and species that have specialized management needs.

Conservation element selection is a multi-stepped process that involves many people and sources of information. We review the most recent applicable scientific literature, consult experts, and make use of geospatial information both as raw data (for example, species occurrence information) and as the components of analytical models (for example, to model the occurrence

of natural communities). The specific methods that were used to select conservation elements to represent the biodiversity of the Expanded Kofa Complex are described in Chapter 5. The steps used to select conservation elements for a conservation area in general are outlined below.

1. **Evaluate ecoregion-scale conservation elements.** In this step we determine the overlap between conservation areas and special element sites identified in the ecoregional analysis with the planning area under consideration. The ecoregional conservation elements found within each of the overlapping conservation areas can serve as an initial list of conservation elements for the planning area.

2. **Remove and add ecoregion-scale conservation elements that are absent from or present on the site.** It is likely that the boundaries of the planning area under consideration do not perfectly align with the conservation areas identified in the ecoregional analysis. Therefore, some of the ecoregional conservation elements identified in Step 1 might not be found within the planning area. Other ecoregional conservation elements may occur in the planning area but were overlooked in the ecoregional assessment because of the coarser scale at which ecoregional analyses are undertaken. In this step, we eliminate those elements that are not known, and not expected to occur in the planning area, add elements for which land managers have a particular concern, and add federal listed threatened and endangered species and candidates for listing. This step can be accomplished by consulting with natural resource managers and by reviewing element occurrence information from State Natural Heritage Programs.

3. **Evaluate natural community conservation element datasets.** As previously discussed, natural communities generally represent the coarse filter. A starting point for the selection of natural community conservation elements is to evaluate existing spatial data and vegetation maps for the site of interest. The data can be assessed for their accuracy and applicability to conservation and management by consulting with scientific experts and natural resource managers that are knowledgeable of natural communities and plant community ecology of the region. Geospatial models may be developed to predict the occurrence of natural communities based on their biophysical attributes. Aerial photographs and on-the-ground assessments can be used to refine mapping efforts.

4. **Use screening criteria to evaluate the initial conservation element list.** At this point, the preliminary list of conservation elements may have more species and natural communities than what is practical to manage at a site. In order to reduce the number of conservation elements to a suite that is biologically meaningful and practical for the land manager, we evaluate the the species conservation elements and specialized habitats—the fine filter—in relation to screening criteria (Table 2.1). These fine filter screening criteria help to discern which species or specialized habitats require additional management attention than what would be provided by considering the coarse filter alone. This step may be done by researching the appropriate scientific literature, and by consulting with natural resource managers, Game and Fish biologists, or other regional experts. Experts should identify attributes of each potential conservation element in regard to the screening criteria and determine if geospatial data are available to document the occurrence and distribution of the

element on the site of interest. Elements whose occurrence cannot be documented or do not meet at least one of the screening criteria may be eliminated from the list.

5. **Finalize the list.** The final list of conservation elements should represent the breadth of biodiversity across taxonomic groups, spatial occurrence, and rarity. Additional literature reviews and consultation with regional scientific experts can be used to further refine the conservation element list and to address specific areas of concern. For example, additional information may be needed to determine if potential conservation elements are missing from the list, if species or guilds are adequately captured by the coarse filter or if they need additional management attention, or how to accurately map natural community conservation elements.

Conservation element selection is an iterative process. We never have complete information on all the species or natural communities that are present in an area, nor all the threats that face them. During future planning exercises it may be necessary to revisit the list of conservation elements to determine if they are still suitable.

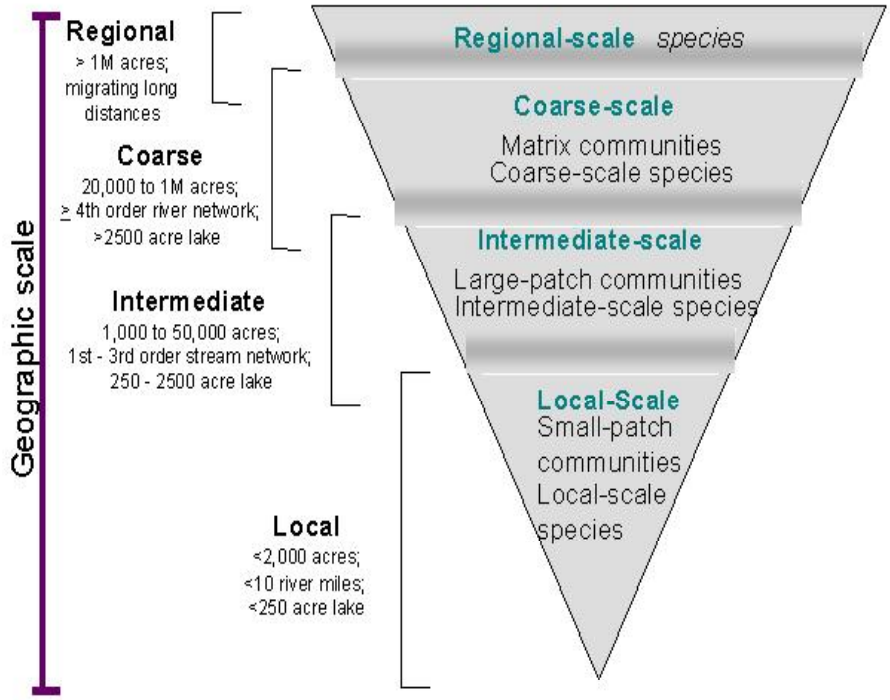


Figure 2.1 Biodiversity Expressed at Four Spatial Scales and Two Levels of Biological Organization (Species and Communities) (Adapted from Poiani and others 2000)

Table 2.1 Screening Criteria Used to Select Species and Specialized Habitat Conservation Elements (Adapted from Hall and others 2001)

Criteria	Definition
Specialized habitat	A small-patch community that often is associated with local-scale, habitat-restricted species or large-patch communities that are widely scattered and/or rare throughout the Sonoran Desert Ecoregion.
Area-dependent species	Species that require the use of a large minimum area to meet all of their life cycle and demographic requirements and that may be especially vulnerable to habitat fragmentation that isolates various natural community types from each other.
Keystone species	Species that have a disproportionately large effect on other species in a community (Meffe and Carroll 1994) or on the maintenance of critical ecological processes (Poiani and others 2000).
Specialized species	Species that may demonstrate a strong association for a particular natural community or a specific biotic or abiotic component of that community, but whose management needs are not fully met within that community type. Not to be confused with an indicator species, which is a characteristic or surrogate species for a community or ecosystem (Meffe and Carroll 1994).
Regionally vulnerable species	Species that although they may be widely distributed throughout the ecoregion, they may be regionally vulnerable if the current or predicted future threats to their viability are considered. Such species may be subject to intense collection or overharvest pressures, may be especially vulnerable to the effects of fragmentation, or may be particularly sensitive to the impacts of a particular environmental threat (for example, acid rain) that is regional in its scope.

CHAPTER 3
REGIONAL CONTEXT: THE SONORAN DESERT ECOREGION

3.1 General Description

The Sonoran Desert is the most tropical of the three North American warm deserts (Chihuahuan, Mojave, and Sonoran). The Sonoran Desert Ecoregion (as defined by Brown and Lowe 1980 and Marshall and others 2000) encompasses 55 million acres (22 million hectares) in southern Arizona, southeastern California, northern Baja California, and northwestern Sonora. It extends from approximately 23° to 35° north latitude and 110° to 116° west longitude (Figure 3.1). The Sonoran Desert Ecoregion is located within the Basin and Range physiographic province, with numerous northwest-southeast oriented mountain ranges separated by broad, expansive valleys. Most of the ecoregion lies below 2,600 feet (~800 meters) elevation, and the low rugged mountain ranges are generally below 4,000 feet (~1,200 meters). Much of the bedrock is granite and gneiss, with extensive areas of volcanic origin (Scarborough 2000). The climate of the Sonoran Desert Ecoregion is typified by a bimodal pattern of rainfall, extended periods of drought, and eight to twelve frost-free months (Turner and Brown 1994). Occasional severe frosts occur at higher elevations, and cold temperatures likely limit the distribution of some plants, including the endemic saguaro cactus (*Carnegiea gigantea*[1]) (Búrquez and others 1999).

3.2 Biotic Subdivisions

The plant communities of the Sonoran Desert are thought to be of relatively recent origin (in geologic terms) and to have evolved during a drying trend in the late Miocene, approximately eight million years ago (Van Devender 2000). Climatic fluctuations resulted in the expansion and contraction of desert vegetation during this time, until the modern geographic extent and vegetation communities were established within the last 4,500 to 9,000 years (Van Devender 2000). As originally described by Shreve (1951), the ecoregion has seven major subdivisions based on differences in vegetation. However, there is disagreement on the limits of the Sonoran Desert at its southern end where it grades into thornscrub (reviewed in Búrquez and others 1999). Some authors exclude one or more of Shreve's (1951) subdivisions (the Foothills of Sonora, Vizcaíno, and Magdalena) from the Sonoran Desert based on vegetation, plant and animal distributions, and/or climate (reviewed in Búrquez and others 1999). In this assessment, we follow Marshall and others' (2000) delineation of the Sonoran Desert Ecoregion, which closely conforms to that of Brown and Lowe (1980) (Figure 3.1). As such, the ecoregion includes four biotic subdivisions: the Lower Colorado River Valley, Arizona Uplands, Plains of Sonora and Central Gulf Coast (Figure 3.2).

The U.S. portion of the Sonoran Desert Ecoregion includes two subdivisions: the Lower Colorado River Valley and the Arizona Uplands. The Lower Colorado River Valley is the largest and most arid subdivision in the ecoregion. It occurs at low elevations on rolling plains and is dominated by the creosotebush-white bursage (*Larrea tridentata-Ambrosia dumosa*) matrix community. The Arizona Uplands Subdivision forms the transition between the plains of the Lower Colorado River Valley and the Apache Highlands Ecoregion to the north and east. It receives a significantly greater winter rainfall than the other subdivisions and is generally found

[1] Plant scientific names in this report conform to the Integrated Taxonomic Information System (ITIS 2002).

on slopes and dissected sloping plains (Turner and Brown 1994). The matrix community of the Arizona Uplands is paloverde-mixed cacti desert scrub, characterized by stands of saguaro cactus and numerous leguminous desert trees including ironwood (*Olneya tesota*), mesquite (*Prosopis spp.*), and paloverde (*Cercidium spp.*), particularly along xeroriparian corridors (dry washes or arroyos) (Turner and Brown 1994). Numerous species of cacti are best represented in this subdivision and are intermixed with numerous other species of small trees, shrubs, forbs, and grasses (Turner and Brown 1994).

3.3 Conservation Need and Land Ownership

The Sonoran Desert Ecoregion is especially rich in biological diversity, including a high proportion of endemic plants, reptiles, and fish (Nabhan and Holdsworth 1999). Over 2,500 pollinator species have been documented (invertebrates, birds, and bats), including the highest known diversity of bee species in the world (Buchmann and Nabhan 1996, Buchmann 2000). More than 500 bird species migrate through, breed, or permanently reside in the ecoregion—nearly two-thirds of all species that occur in northern Mexico, the United States, and Canada combined. The largest dune system in North America—the Gran Desierto—is contained within the Sonoran Desert. The ecoregion is equally diverse in its human populations with more than a dozen Native American Tribes represented, as well as many recent migrants to the region (Nabhan and Holdsworth 1999). Much of the ecoregion still remains as large, unfragmented landscapes. As a result, the Sonoran Desert was identified by researchers at the World Wildlife Fund as one of the top 233 ecoregions worldwide that deserved special conservation attention (Olsen and Dinerstein 1998).

The Sonoran Desert is also a fragile landscape and its biodiversity is at risk. Since the end of World War II, the Sonoran Desert has been the setting for unprecedented population growth due to in-migration (Nabhan and Holdsworth 1999). Rapid, sustained population growth is anticipated to continue in the ecoregion for at least the next two decades and is expected to reach 12 million inhabitants by 2020—more than three times the population in 1970 (Nabhan and Holdsworth 1999, Marshall and others 2000). Under such human growth pressure, the threats to Sonoran Desert will only be exacerbated. Conversion of natural habitat to urban, suburban, and agricultural areas has already resulted in widespread habitat loss and will continue to occur. Overuse of natural surface water and groundwater resources and the loss of natural hydrological regimes even now threaten the viability of the diverse riparian and estuarine habitats. Other widespread threats to Sonoran Desert biodiversity include improper livestock management and the spread of invasive plants and animals, which threaten the viability of both terrestrial and aquatic systems alike (Nabhan and Holdsworth 1999).

The pattern of land ownership and management in the Sonoran Desert Ecoregion is very different across the United States-Mexico border. More than a quarter of the ecoregion is managed by U.S. federal agencies. The BLM manages the largest portion—almost 17%—of the ecoregion (9.2 million acres or 3.7 million hectares). The Department of Defense and U.S. Fish and Wildlife Service both manage significant areas of land (3.2 million acres [1.3 million hectares] and 1.6 million acres [0.7 million hectares], respectively). Less than 10% of the ecoregion is composed of private landholdings in the U.S. In contrast, the vast majority of Mexico's portion of the Sonoran Desert Ecoregion —87%—is private or communally owned

(ejido) land (Marshall and others 2000). The pattern of land ownership in the Sonoran Desert Ecoregion indicates that different conservation and protection strategies are required in the United States and Mexico. Sonoran Desert conservation simply cannot be accomplished in the United States without the assistance and support of federal land managing agencies, including the BLM.

3.4 Assessment of Conservation Priorities

In 1998 a two-year effort was launched to analyze ecological data and identify conservation priorities in the Sonoran Desert Ecoregion. The goal of the assessment was to identify a network of conservation areas that included species and natural communities representative of Sonoran Desert biodiversity that, if appropriately managed, would ensure the long-term persistence of the biodiversity of the Sonoran Desert. A brief account of the effort is outlined here and a full description of the ecoregional analysis can be found in *An Ecological Analysis of Conservation Priorities in the Sonoran Desert Ecoregion* by Marshall and others (2000).

The ecoregional assessment was conducted by a binational technical team, represented by staff from The Nature Conservancy, Sonoran Institute, Instituto del Medio Ambiente y el Desarrollo Sustentable del Estado de Sonora (IMADES), and the Arizona Game and Fish Department. It was complemented with input from more than 100 experts from public agencies, Native American Tribes, conservation organizations, academic institutions, and private resource professions. The ecoregional assessment used a science-based approach that integrated information from Geographic Information System (GIS) datasets, published literature, and from workshops with regional scientific experts. The basic unit of analysis used to identify a network of conservation areas is the *conservation element* (also termed *conservation target*). As described in Chapter 2, conservation elements at the ecoregion-scale are species and natural communities that are representative of Sonoran Desert biodiversity.

A total of 353 species from seven higher taxa (plants, invertebrates, fish, amphibians, reptiles, birds, and mammals) and 78 natural communities (including terrestrial vegetation communities and aquatic communities) were selected as conservation elements to represent Sonoran Desert biodiversity. In total, 100 large landscapes (capturing entire ecosystems and their associated ecological processes) and 79 localized areas (sites of rare plant or animal occurrences) were identified across the ecoregion based on the distribution and aggregations of the selected conservation elements (Marshall and others 2000) (Figure 3.3, Table 3.1). This network of conservation areas includes 23,108,106 acres (9,355,508 hectares) of land in the United States and Mexico. The conservation areas identified in the Sonoran Desert ecoregional assessment serve as one vision of a “conservation blueprint” that can help land managers and other interested parties to focus on areas where management and conservation action may have the best chance to successfully protect and conserve the region’s biological diversity.

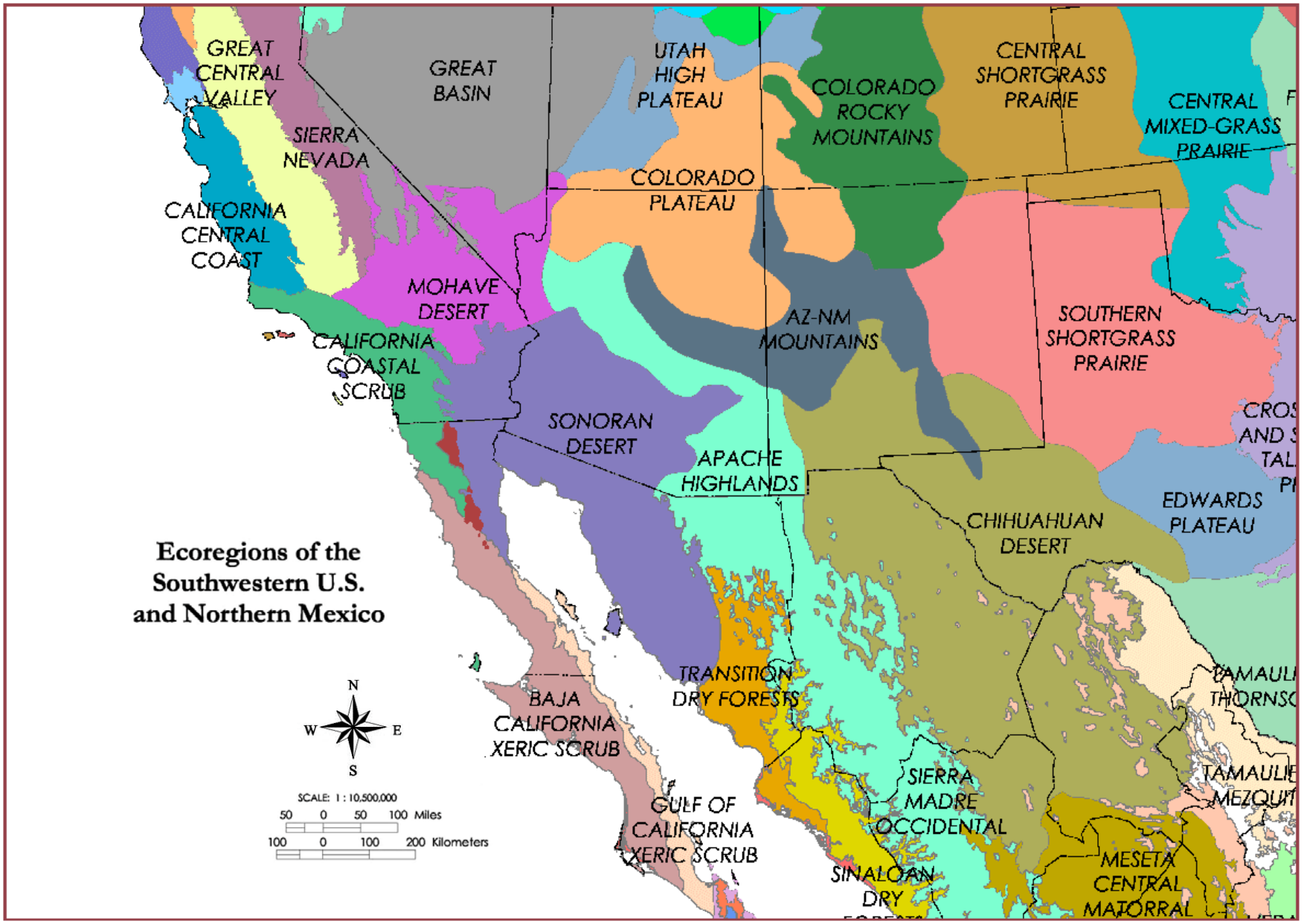


Figure 3.1 Ecoregions of the Southwestern United States and Northern Mexico (From Marshall and others 2000)

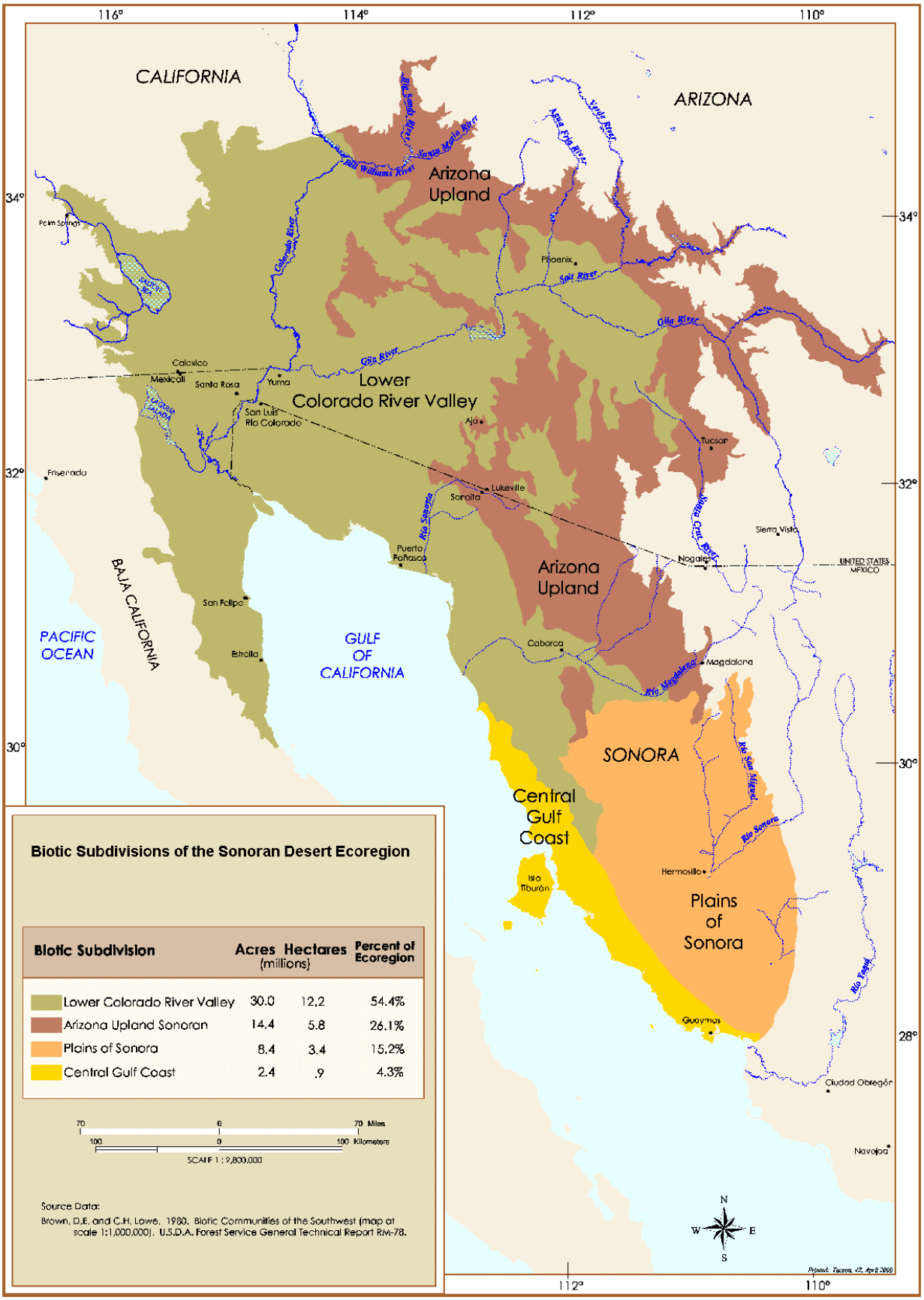


Figure 3.2 Biotic Subdivisions of the Sonoran Desert Ecoregion (From Marshall and others 2000)

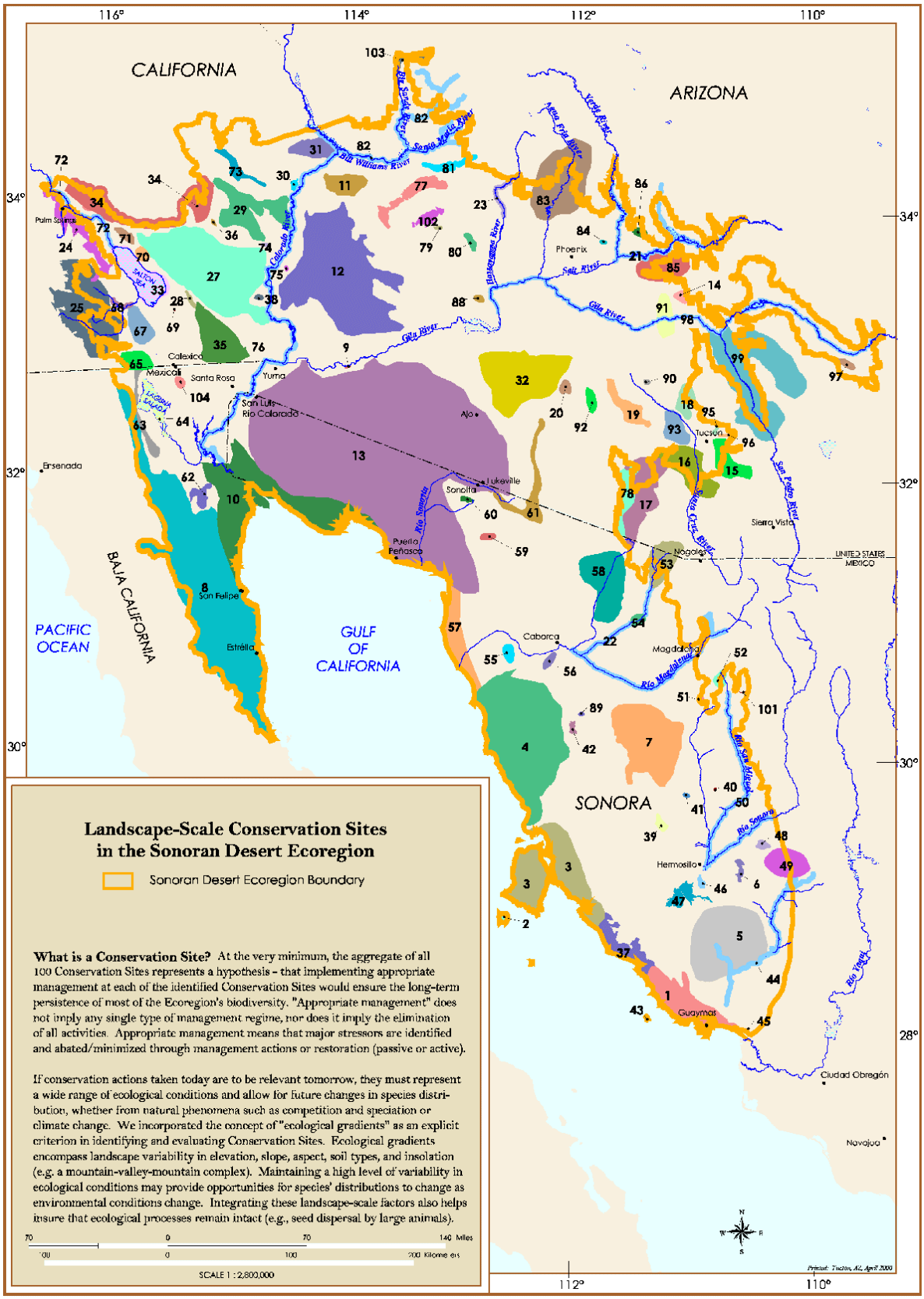


Figure 3.3 Landscape-Scale Conservation Areas in the Sonoran Desert Ecoregion
(From Marshall and others 2000).
Table 3.1 provides a list of the Conservation Areas corresponding to the numbers above.

Table 3.1 Landscape-Scale Conservation Areas in the Sonoran Desert Ecoregion

(From Marshall and others 2000) Numbers correspond to Conservation Areas mapped in Figure 3.3 Conservation Areas in **bold** have portions that overlap with the BLM Yuma Resource Management Area.

1 Rancho El Único
2 San Esteban Island
3 Bahía de Kino/Isla Tiburón/Sierra Bacha
4 Sierra Bacha/Sierra del Viejo
5 Cañones de La Pintada /Tetabejo
6 Sierra Tordilla/Puerto el Orégano
7 Carrizo Plains/Arroyo Bacoachito
8 Cerro Borrego/San Felipe Desert
9 Tacna Marsh
10 Colorado River Delta
11 Bouse Dunes
12 Kofa Complex
13 Pinacate/Organ Pipe/Goldwater Complex
14 Arnett Creek
15 Ciénega Creek
16 Santa Rita
17 Altar Valley
18 Tortolita Mountains
19 Sawtooth-Silverbell Mountains
20 Vekol Mountains
21 Tonto Creek/Salt and Verde/Meddler Wash
22 Río Magdalena/Río Asunción
23 Hassayampa River
24 San Jacinto Foothills
25 Anza Borrego
26 Coachella Valley
27 Chocolate Mountains
28 Coachella Canal
29 McCoy Mountains
30 Riverside Mountains
31 Whipple Mountains
32 Sand Tanks/Sauceda Mountains Complex
33 Salton Sea
34 Joshua Tree
35 Algodones Dunes
36 Palen Dry Lake
37 Central Gulf Coast
38 Colorado River/Río Hardy
39 Sierra de Lopez
40 Cueva del Tigre
41 Sierra La Cobriza
42 Sierra La Jojoba
43 San Pedro Nolasco Island
44 Río Matape
45 Las Guasimas
46 Cerro Agualurca
47 La Poza/Southwest Hermosillo
48 South Ures
49 Sierra de Mazatan
50 Río Sonora/Río San Miguel
51 El Papago
52 Cañon La Palma
53 Atascosa Mountains
54 Tubutama
55 Sierra El Alamo
56 No site name designated
57 Puerto Lobos
58 Altar Valley
59 Quitovac
60 Sierra Cubabi
61 San Simon/Sonoyta Valley
62 Ejido Saldala
63 Sunrise Butte/Guadalupe Canyon
64 Laguna Salada
65 Yuha Basin
67 West Mesa/Superstition Hills
68 San Felipe Creek
69 Ramer Lake
70 Orococpa Valley
71 Mecca Hills/Painted Canyon
72 Whitewater River
73 Danby Playa
74 Carl's Dunes
75 Yuma Proving Ground Dunes
76 Deson Mine
77 Harcuvar Mountains
78 Baboquivari Mountains
79 El Tigre Mine
80 Black Pearl
81 Date Creek
82 Bill William's Complex
83 Agua Fria Watershed
84 Dixie Mine
85 Superstition Mountains
86 Tonto National Forest
88 Buckeye Copper Mine
89 La Ciénega
90 Picacho Peak
91 Unplowed Valley
92 Old Mammon Mine
93 Tucson Mountains
95 Sabino Canyon
96 East Tucson Riparian Complex
97 San Simon Springs/Ciénega
98 Upper Gila River
99 San Pedro River/Aravaipa Creek
101 Ciénega de Saracachi
102 Harquahala Mountains
103 Trout Creek
104 Cerro Prieto Ponds

No site designated for numbers 66, 87, 94, and 100

CHAPTER 4
THE PROJECT AREA: THE BLM YUMA RESOURCE MANAGEMENT AREA AND THE EXPANDED KOFA COMPLEX

4.1 General Description and Land Ownership

The BLM Yuma Resource Management Area (Yuma Planning Area) is situated in the Sonoran Desert Ecoregion in La Paz and Yuma Counties in southwestern Arizona, with some small extensions along the Colorado River into California. It includes over five million acres (two million hectares) and is bounded to the west by the Colorado River, to the south by Mexico, and extends north of Interstate 10, and as far east as the Eagletail Mountains. The Yuma Planning Area includes the lower Colorado and Gila Rivers, the growing towns of Yuma and Quartzsite, and large expanses of desert areas representing both the Lower Colorado River Valley and Arizona Upland Subdivisions of the Sonoran Desert (Figure 4.1).

Land ownership in the Yuma Planning Area is a mixture of federal, state, Tribal, and private parcels (Figure 4.1, Table 4.1). More than 80% of the area is managed by the U.S. Department of Defense, the BLM, and the U.S. Fish and Wildlife Service (USFWS). Land managed by the Department of Defense includes the Yuma Proving Ground (YPG) and the western portion of the 1 million-acre Barry M. Goldwater Range (Goldwater Range). Four National Wildlife Refuges managed by the USFWS are completely or partially within the Planning Area and were originally established to protect desert bighorn sheep (Cabeza Prieta and Kofa Refuges) and migratory birds (Cibola and Imperial Refuges). A large proportion of this landscape occurs as mostly contiguous blocks of land managed by federal agencies. This land management pattern has resulted in a relatively unfragmented landscape that is required to maintain ecosystem processes and biodiversity of the Sonoran Desert. Other areas of the Yuma Planning Area, particularly along the Colorado and Gila Rivers, consist of a patchwork pattern of lands managed by the BLM, Arizona State Land Department, and private owners (Figure 4.1).

4.2 Population Growth and Land Use

The Yuma Planning Area includes areas of significant conservation value as recognized in the Sonoran Desert Ecoregional Assessment, including portions of eight landscape-scale Conservation Areas and two Special Element Sites (Marshall and others 2000, Figures 3.3, 4.1). However, the Yuma Planning Area is not a nature preserve and many of the activities and land uses occurring within its boundaries may exert pressure on the natural resources. The population in Yuma County, Arizona grew by over 260% from 1970 to 2000, to almost 160,000 people (U.S. Census Bureau 2000). Most of the population in Yuma County lives in the city of Yuma. Yuma is the third largest city in Arizona and is growing at a rapid rate (a 50% increase since 1960; U.S. Census Bureau 2000). La Paz County was formed in 1983 after which it also has grown rapidly. The main population center in the county is Quartzsite. Although Quartzsite is a small town of approximately 3,000 in the hot summer months, it explodes to approximately 250,000 inhabitants that live at more than 70 trailer parks during the winter (Arizona Department of Commerce and others 2001). Many of these winter visitors enjoy recreational activities in the surrounding desert environment and along the Colorado River, including hiking, boating,

camping, and off-road vehicle travel. Depending on the number of visitors and the intensity of their activities, adverse impacts to natural resources may occur.

Other portions of the Yuma Planning Area are mostly uninhabited but have historic or current land uses that may impact biodiversity. A large portion of the Planning Area is used by the Department of Defense to test weapons, aircraft, and wheeled vehicles and to train troops for combat in a harsh desert climate. The portions of the Colorado and Gila Rivers found within the Yuma Planning Area provide water to a large agricultural production area, which provides jobs to more than a quarter of Yuma County residents (U.S. Department of Commerce 2002). By the time the Colorado and Gila Rivers reach southwestern Arizona they have been dammed and channelized at numerous points and are highly altered systems that vaguely resemble what they once were before European colonization. Some parts of the lower Colorado and Gila Rivers within the planning area, however, include aquatic habitat that offer a respite for desert dwellers—human and wildlife alike.

4.3 Overlap with Sonoran Desert Ecoregion Conservation Areas

An ecosystem approach facilitates the conservation of biological diversity in all its forms—from genes to species and populations to communities. The overlap between the Yuma Planning Area and Conservation Areas that were identified as priority landscapes for biodiversity conservation within the Sonoran Desert Ecoregion serve as a starting point for conservation planning in the region (Marshall and others 2000).

Eight Landscape-scale conservation areas, or portions thereof, are within the Yuma Planning Area (Figure 4.1, Table 4.1).

Table 4.1 Conservation Areas in the BLM Yuma Resource Management Area (Marshall and others 2000). Areas are calculated by GIS analysis.

Area #	Conservation Area Name	Total Area (acres)	Area (acres) in Yuma Planning Area	% of Total
9	Tacna Marsh	2, 417	2, 417	100%
12	Kofa Complex	1,434,006	1,434,006	100%
13	Pinacate/Organ Pipe/Goldwater Complex	1,298,702	5,748,909	23%
27	Chocolate Mountains	6,692	1,143,211	<1%
29	McCoy Mountains	2,510	332,799	<1%
30	Riverside Mountains	91	9,612	<1%
38	Colorado River/Rio Hardy	215,590	434,141	50%
75	Yuma Proving Ground Dunes	3,158	3,158	100%

In addition to the above conservation areas, two localized Special Element Sites are within the Yuma Planning Area (Figure 4.1), including (1) #235, Southwestern willow flycatcher and (2) #264, Fremont cottonwood-Goodding's black willow riparian woodland.

Each of these areas was identified as a priority site for Sonoran Desert biodiversity based on the occurrence of ecoregion-scale conservation elements found within its boundaries. The conservation elements found within each of these conservation areas named above are listed in Appendix A. It is important to note that the species in Appendix A are known from somewhere within the conservation area. But as shown in Table 4.1, large portions of some of the conservation areas occur outside the Yuma Planning Area, indicating that many of the species listed in Appendix A may not actually occur within the boundaries of the planning area.

The information on conservation areas and the ecoregional conservation elements found within them provide a useful regional context on the biological resources of the Yuma Planning Area. In the next Chapter we describe how we built on the ecoregional data and conducted a more refined analysis of the biodiversity values of the planning area.

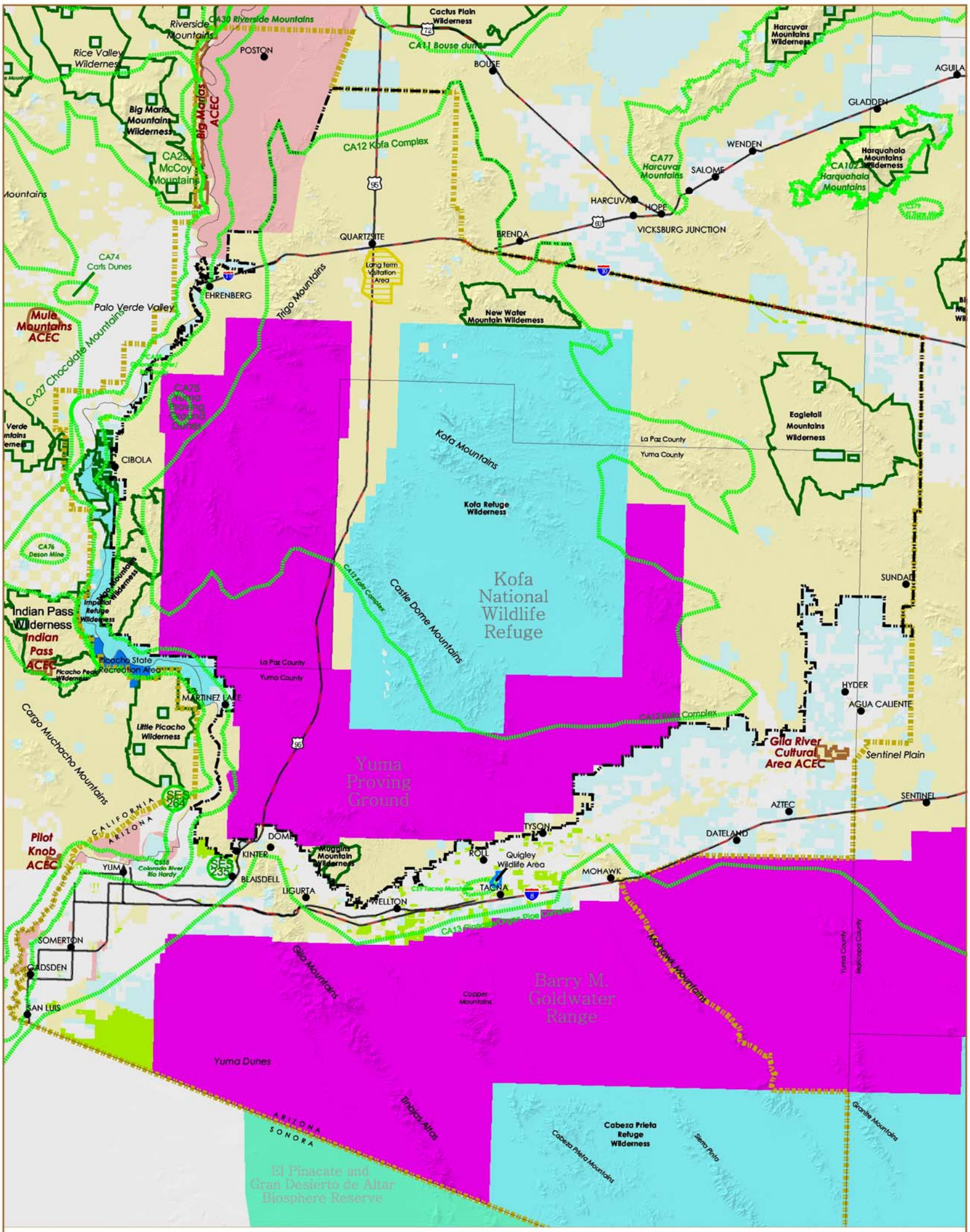


FIGURE 4.1 Land Management in the BLM Yuma Resource Management Area

Land Management Categories

(theme derived from Marshall and Others 2000, ALRIS 1997 and Hall and Others 2001)

- BLM
- BOR
- County Land
- Native American Reservation
- Military
- NPS
- Parks and Recreation
- Private
- State Trust
- USFS
- USFWS
- Mexico Biosphere Reserve

- TNC Landscape Conservation Areas
- TNC Special Element Sites
- Expanded Kofa Complex Boundary
- Blm Yuma Field Office Boundary
- Wilderness Boundary
- Blm ACEC Boundary
- Roads
- Towns

5 0 5 10 Miles

SCALE 1:625,000

The Nature Conservancy

Draft Map by: Anne Gondor and Stephanie Weinstein
Printed: Tucson, 02-24-04
Projection: UTM Z-one 12, NAD 27

Table 4.2 Land Management in the BLM Yuma Resource Management Area
(Area calculated by GIS.)

Land Manager	*Acres*	*Hectares*	*% of RMA*
Land Management in Arizona			
Arizona Game and Fish Department	1,284	520	<1
Bureau of Land Management (AZ Total)	1,286,440	520,606	25.6
BLM Wilderness	160,298	64,871	3.2
BLM ACEC (Gila River Cultural Area)	2,013	814	<1
Bureau of Reclamation	42,738	17,296	<1
Department of Defense (AZ Total)	1,551,523	627,881	30.8
Yuma Proving Ground	830,217	335,978	16.5
Barry M. Goldwater Range	718,492	290,764	14.3
Other Military Reservation	2,814	1,139	<1
Native American (AZ Total)	159,837	64,684	3.2
Colorado River Indian Reservation	152,098	61,552	3
Fort Yuma Indian Reservation	1,006	407	<1
Cocopah Indian Reservation	6,733	2,725	<1
Private	431,331	174,554	8.6
State Trust Land	264,017	106,845	5.2
U.S. Fish and Wildlife Service (AZ Total)	1,152,294	466,319	22.9
Kofa NWR	663,852	268,653	13.2
Imperial NWR	20,760	8,401	<1
Cibola NWR	12,849	5,200	<1
Cabeza Prieta NWR	454,833	184,065	9
Arizona Total	***4,886,603***	***1,977,547***	***97.1***
Land Management in California			
Bureau of Land Management (CA Total)	51,936	21,017	1
BLM Wilderness	6,258	2,532	<1
BLM ACEC (Big Marias)	7,501	3,035	<1
Native American	19,391	7,847	<1
Private	50,371	20,385	1
State Park (Picacho State Recreation Area)	5,395	2,183	<1
State Trust Land (AZ Department)	2,954	1,196	<1
State Trust Land (CA Department)	709	287	<1
U. S. Fish and Wildlife Service (CA Total)	13,119	5,308	<1
Cibola NWR	2,944	1,191	<1
Imperial NWR (Wilderness)	10,175	4,117	<1
California Total	***143,875***	***58,223***	***2.9***
Resource Management Area Total	***5,030,478***	***2,035,770***	***100.0***

CHAPTER 5
METHODS

In this Chapter we briefly describe how the analysis area—the Expanded Kofa Complex—was delineated and summarize the methods for selecting and characterizing the conservation elements.

5.1 Define the Boundaries of the Expanded Kofa Complex

In order to select appropriate conservation elements, we first needed to delineate the boundaries of our analysis area—an area that would be meaningful for resource management planning for the partner agencies and that also would encompass a functional conservation area, as described in Chapter 2. As previously discussed, a starting point for delineating the analysis area was the boundary of the Kofa Complex conservation area (Site #12; Figure 3.3), which was identified as a priority landscape-scale site for Sonoran Desert biodiversity conservation (Marshall and others 2000). We modified the boundaries of the Kofa Complex to be more relevant to natural resource management within the Yuma Planning Area based on input from partner agency staff. For example, BLM Yuma Field Office staff emphasized that the Kofa Complex conservation area excluded the Eagletail Mountains and the Palomas Plain, which are areas that are ecologically important and functionally connected to the Kofa Complex. As a result, we expanded the analysis area—the "Expanded Kofa Complex"—to the eastern boundary of the Yuma Field Office.

Other portions of the Yuma Planning Area were excluded from the boundaries of the Expanded Kofa Complex, including:

- **The Barry M. Goldwater Range and Cabeza Prieta National Wildlife Refuge.** These areas were excluded because they were evaluated using a coarse filter-fine filter approach in a previous effort (Hall and others 2001).

- **The Colorado River corridor**. This area was excluded because (1) it would be a challenge to focus only on the ecologically functional portions of this system within the Yuma Planning Area without considering upstream effects and uses and (2) it is the focus of the Multi-Species Conservation Program.

- **Urbanized and agricultural lands.** These areas, located mostly along the Gila River and south of Yuma (Figure 4.1), are primarily in private ownership or managed by the Arizona State Land Department. They were excluded from the Expanded Kofa Complex because they may represent highly fragmented habitat and/or altered land cover that is essentially disconnected from the functional conservation area.

- **The Colorado River Indian Reservation** The Reservation is over 150,000 acres (over 60,000 hectares) and is part of the functional desert landscape of the Expanded Kofa Complex. However, it was excluded for the purpose of this analysis because at present we lack a partnership with the Tribes. The Reservation could be added to the analysis in

the future provided that the Tribes are interested in a collaboration and sharing natural resource information with adjoining land managers.

In sum, the Expanded Kofa Complex includes the majority of the contiguous lands within the Yuma Planning Area that are managed by the agency partners in this project: the BLM at the Yuma Field Office, U. S. Fish and Wildlife Service on the Kofa Refuge, and U. S. Army at Yuma Proving Ground. The Expanded Kofa Complex is not defined by a "hard boundary", but rather is a new starting point to delineate a functional desert landscape. It is within the Expanded Kofa Complex that we select natural community and species conservation elements to represent the biodiversity within the Yuma Planning Area. The boundary of the functional conservation area certainly extends in some areas outside of the Yuma Planning Area. Management of this area may require future coordination with adjoining land managers, including the BLM Lake Havasu Field Office and the Colorado River Indian Tribes. The natural community map developed in this analysis extends beyond the boundaries of the Expanded Kofa Complex and could assist land managers in identifying coordinated management opportunities.

5.2 Select and Map the Occurrence of Natural Community Conservation Elements

Natural communities are useful conservation elements only to the extent that they are capable of being mapped. Therefore, we select natural community conservation elements by evaluating the existing mapping efforts and available spatial data. Although some vegetation maps are available for the planning area, such as Brown and Lowe (1994) and Arizona Gap Vegetation (Arizona Gap Program 1998), these mapping efforts were done at a coarser scale than what is meaningful for management within the Yuma Planning Area. Furthermore, a natural community map is different than a vegetation map in that its units—natural communities—are meaningful for conservation and management and are not necessarily based on a vegetation classification hierarchy.

Many of the biophysical parameters that were used to define and map the natural communities of the Expanded Kofa Complex were based on information derived from previous work to map natural communities in the Sonoran Desert Ecoregion. A natural community map was developed for the Barry M. Goldwater Range (Hall and others 2001) and was refined based on fieldwork and a more detailed analysis of satellite imagery and aerial photography for these natural communities on the Sonoran Desert National Monument (Morrison and Snetsinger 2003). Other spatial data that aided in mapping the natural communities of the Yuma Planning Area (including the Expanded Kofa Complex) included:

- The Soil Survey of the U. S. Army Yuma Proving Ground, Arizona—parts of La Paz and Yuma Counties (Soil Conservation Service [SCS] 1991)
- State Soils Geographic database of Arizona (STATSGO, 1:250,000 scale; SCS 1994).

- Bureau of Reclamation Vegetation of the Lower Colorado River (1997, based on Anderson and Ohmart 1984).
- Vegetation in the Sonoran Desert Ecoregion (Marshall and others 2000)
- Biotic Communities of the Southwest (Brown and Lowe 1994)
- Arizona Gap Vegetation (Arizona Gap Program 1998)
- Hydrography from Arizona State Land Department, Arizona Land Resources Information System (ALRIS) (converted in 1988 from U. S. Geological Survey 1:100,000 scale, digital line graph data).
- Digital Orthophoto Quadrangle Quadrants (DOQQs) of the Yuma Planning Area
- LandSat Mosaic satellite image of the planning area (GeoCover, circa 1992).
- Species occurrence data (HDMS 2003) helped to refine the boundaries of some natural communities (for example, dunes) that have specialist species associated with them.

A helicopter flight provided by the U.S. Army at YPG imparted us with a landscape view of the natural communities in the region and ideas on what features might be important to map. Meetings were held with staff from the AGFD, BLM Yuma Field Office, Kofa Refuge, and YPG to review draft versions of the natural community map and get input on missing features, boundary refinements, and the ecological characteristics of the natural communities.

5.3 Select Species Conservation Elements

Species are selected as conservation elements if they have additional management needs than what might be provided by the coarse filter (natural communities) alone. A starting point for evaluating potential species conservation elements of the Expanded Kofa Complex came from the Sonoran Desert Ecoregional Assessment (Marshall and others 2000). We compiled a list of all conservation elements occurring in the eight Conservation Areas that are within or overlap with the Yuma Planning Area (Appendix A). In addition to the species in Appendix A, other species were evaluated as potential conservation elements. These included BLM Sensitive Species (BLM 2000) and other Special Status species in the Yuma Planning Area, species selected as conservation elements for the Goldwater Range (Hall and others 2001) or the Sonoran Desert National Monument (Weinstein and others 2002), and species tracked by the Heritage Data Management System of the Arizona Game and Fish Department. We also distributed Appendix A to partner agencies and met with numerous staff to obtain input on any additional species that are of concern that were not on the list.

More than 160 species were considered as potential conservation elements. Several steps were taken to reduce this list to a reasonable number of species and determine which species are require additional management attention, outlined below.

- Eliminate species that occur only outside the Expanded Kofa Complex. Because large portions of some of the Sonoran Desert Ecoregion Conservation Areas lie outside the Yuma Planning Area, many species in Appendix A are unlikely to be found within the Expanded Kofa Complex. We confirmed whether species in Appendix A were present in or absent from the Expanded Kofa Complex by consulting with partner agency staff, evaluating spatial data associated with the Sonoran Desert Ecoregion assessment (Marshall and others 2000), and by referring to available species lists compiled for the

region (for example, BLM and USFWS 1996, Center for Ecological Management of Military Lands 1995, and numerous brochures with lists of plants and animals known to occur on YPG or within the boundaries of the BLM Yuma Field Office).

- Eliminate species that are known from the Expanded Kofa Complex but that are more closely associated with habitat found outside this area, such as along the Colorado or Gila Rivers or on portions of the Goldwater Range.

- Consult with partner agency staff and numerous scientific experts to acquire the most up-to-date information available on the status of species whose distribution and habitat are not well known (or not available in the published literature).

- Conduct a field assessment to confirm the presence of a potential conservation element—the Mojave fringe-toed lizard (*Uma scoparia*)—in the Expanded Kofa Complex. The presence of the Mojave fringe-toed lizard on YPG had not been confirmed in over a decade so Conservancy staff and YPG biologists conducted a survey for the lizards. (Additional details on this trip are discussed in the section on the Mojave fringe-toed lizard in Chapter 8.)

- Evaluate whether the potential species conservation elements occurring within the Expanded Kofa Complex require additional management attention. We evaluated the potential conservation elements against the fine-filter criteria (Table 2.1) based on information from the scientific literature, spatially-explicit databases (such as HDMS element occurrence and the Arizona Breeding Bird Atlas[2001]), and input from partner agency staff and other scientific experts (Appendix B includes a list of some experts consulted).

5.4 Characterize the Conservation Elements

Using the steps outlined above, the number of conservation elements was reduced from over 160 to nine natural communities and seventeen species conservation elements (some of which are grouped together as guilds). We described the conservation status, regional threats, and relative importance of the Expanded Kofa Complex to each of the conservation elements by reviewing numerous data sources. Sources of information included the relevant scientific literature, management plans for the area, spatial datasets with occurrence information on the species, and personal communications with land managers, wildlife biologists, natural resource specialists, and other experts including staff from the partner agencies.

5.5 Review Biologically Important Areas Found Outside the Expanded Kofa Complex

The majority of the information presented in this report is relevant to biodiversity and management of the Expanded Kofa Complex. We also, however, provide some input on biodiversity values of other localities within the Yuma Planning Area. This input is based on the following analyses and sources of data:

- Heritage Data Management System element occurrence information (HDMS 2003)

- Vegetation of the lower Colorado River (BOR 1997)
- Input from experts, principally from BLM Yuma Field Office staff
- A limited review of the relevant scientific literature and resource management plans for portions of the Yuma Planning Area

CHAPTER 6
AN OVERVIEW OF THE CONSERVATION ELEMENTS OF THE EXPANDED KOFA COMPLEX

Nine natural communities and eight individual species or guilds were selected as preliminary conservation elements to represent the biodiversity of the Expanded Kofa Complex (Table 6.1). A map of the natural community conservation elements within the Expanded Kofa Complex is displayed in Figure 6.1. The selected conservation elements are representative of different spatial scales, levels of biological organization, and degrees of rarity (Tables 6.2, 6.3). None of the selected species are globally rare (G1 or G2 species[1]), because aside from Nichol's turk's head cactus (*Echinocactus horizonthalonius var nicholii*), a G1 species that was found on YPG but has not since been relocated, globally rare species are not known from the Expanded Kofa Complex.

The preliminary list of seventeen conservation elements was narrowed down from over 160 potential elements. Narrowing down the list of conservation elements is a time consuming and challenging process, particularly when confronted with a lack of data on the status of a species or community. Some species and natural communities are discussed in subsequent sections of this report but were not selected as one of the seventeen preliminary elements at this time. Some of these species require further evaluation against the fine-filter criteria to determine if they would be appropriate conservation elements. Likewise, some natural communities might serve as effective coarse filter conservation elements but we lacked sufficient data to map their occurrence as part of this project. Other species that were considered as potential conservation elements of the Expanded Kofa Complex are the Special Status species found within the Yuma Planning Area (Table 6.4). Many of the Special Status species were not selected as conservation elements because they are found outside the Expanded Kofa Complex boundaries, such as on the Colorado River or the Yuma Dunes. Table 6.4 offers information on occurrence of these species and a rationale for their selection or non-selection as conservation elements.

In Chapters 7 and 8 we provide more detailed information on the species and natural communities that were selected as preliminary conservation elements of the Expanded Kofa Complex. We include sections on the conservation status of the conservation elements, including a preliminary assessment of broadly occurring threats to their persistence within the Sonoran Desert, and the relative importance of the Expanded Kofa Complex to their conservation. The threats described in the following sections are a preliminary assessment of regional threats and are not necessarily relevant to the conservation elements as they occur within the Expanded Kofa Complex or the Yuma Planning Area, unless stated otherwise. We also provide justification for why the species were selected as conservation elements and describe mapping assumptions and limitations for each natural community. Descriptions of the natural community conservation elements should be considered preliminary, as they are based primarily on pre-existing literature or expert knowledge and not on quantitative field studies.

[1] Global and State Rank definitions are found in Appendix C.

Table 6.1 Preliminary Conservation Elements of the Expanded Kofa Complex

Conservation Element Type	Common Name	Scientific Name	G Rank[1] (Combined)	S Rank[2] (AZ)	Selection Criteria[3]	Status and comparison to other planning efforts[4]
Vegetation Community	Creosotebush-Bursage Desert Scrub				Coarse filter	BMGR, SDNM
Vegetation Community	Paloverde-Mixed Cacti-Mixed Scrub on Bajadas				Coarse filter	BMGR, SDNM
Vegetation Community	Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes				Coarse filter	BMGR, SDNM
Vegetation Community	Valley Xeroriparian Scrub				Coarse filter	BMGR, SDNM
Vegetation Community	Mountain Xeroriparian Scrub				Coarse filter	BMGR, SDNM
Vegetation Community	Braided Channel Floodplain				Coarse filter	SDNM
Vegetation Community	Mountain Upland				Coarse filter	BMGR, SDNM
Vegetation Community	Dune Complex				Coarse filter	BMGR
Specialized Habitat	Desert Tinaja/Spring				Specialized habitat	BMGR, SDNM
Plant	California Fan Palm	*Washingtonia filifera*	G4	S1	Specialized species	SDEA
Amphibian Guild: Ephemeral water-breeding amphibian guild	Sonoran Desert toad	*Bufo alvarius*	G5	S5	Specialized species	BMGR, SDNM
	Great Plains toad	*Bufo cognatus*	G5	S5	Specialized species	BMGR, SDNM
	Red spotted toad	*Bufo punctatus*	G5	S5	Specialized species	BMGR, SDNM
	Couch's spadefoot	*Scaphiopus couchii*	G5	S5	Specialized species	BMGR, SDNM
Reptile	Mojave Fringe-toed Lizard	*Uma scoparia*	G3G4Q (G3)	S2S3	Specialized species	SDEA, WSCA
Reptile	Desert Tortoise	*Gopherus agassizii*	G4T? (G4)	S4	Regionally vulnerable	SDEA, BMGR, SDNM, WSCA

Table 6.1 Preliminary Conservation Elements of the Expanded Kofa Complex

Conservation Element Type	Common Name	Scientific Name	G Rank[1] (Combined)	S Rank[2] (AZ)	Selection Criteria[3]	Status and comparison to other planning efforts[4]
Bird Guild: Primary excavator (cavity) guild	Gilded Flicker	*Colaptes chrysoides*	G5	S5	Specialized species, Keystone species	SDEA, BMGR, SDNM, PIF, BCC
	Gila Woodpecker	*Melanerpes uropygialis*	G5	S5	Specialized species, Keystone species	BMGR, SDNM, BCC
	Ladderbacked woodpecker	*Picoides scalaris*	G5	S5	Specialized species, Keystone species	BMGR, SDNM
Bird	Le Conte's Thrasher	*Toxostoma lecontei*	G3	S3	Specialized species, Regionally vulnerable	SDEA, BMGR, SDNM, PIF, BCC
Mammal Guild: Bat guild	Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	G4T4 (G4)	S4	Specialized species	WBWG-High
	California Leaf-nosed Bat	*Macrotus californicus*	G4	S3S4	Specialized species	SDEA, BMGR, SDNM, BLM, WSCA, WBWG-High
	Cave Myotis	*Myotis velifer*	G5	S4	Specialized species	SDEA, BMGR, SDNM, WBWG-Medium, BLM
	Pocketed Free-tailed Bat	*Nyctinomops femorosaccus*	G4	S2S3	Specialized species	SDEA, WBWG-Medium, BLM
	Mexican Free-tailed bat	*Tadarida brasiliensis*	G5	S3S4	Specialized species	WBWG -Low
Mammal	Desert Bighorn Sheep	*Ovis canadensis mexicana*	G4T3T4? (G4)	S3S4	Area-dependent, Regionally vulnerable	SDEA, BMGR, SDNM

[1] Global Ranks and Combined Global Ranks. See Appendix C for definitions.
[2] State Rank in Arizona; See Appendix C for definitions.
[3] See Table 2.1 for fine filter selection criteria definitions.
[4] Species or natural community was selected as a conservation element in another planning effort, or the species or natural community is being tracked by an agency or conservation initiative. **Legend: BCC**: Bird of Conservation Concern (USFWS 2002); **BMGR:** chosen as conservation element for the Barry M. Goldwater Range (Hall and others 2001); **PIF**: a priority species in the Arizona Partners in Flight Bird Conservation Plan (Latta and others 1999); **SDEA**: chosen as an ecoregional conservation element in the Sonoran Desert Ecoregion assessment (Marshall and others 2000); **SDNM**: chosen as a conservation element of the Sonoran Desert National Monument (Weinstein and others 2002); **WBWG**: Western Bat Working Group Regional Priority Matrix. See Section 8.7 for definitions (WBWG 1998); **WSCA**: Wildlife of Special Concern in Arizona (AGFD 1996)

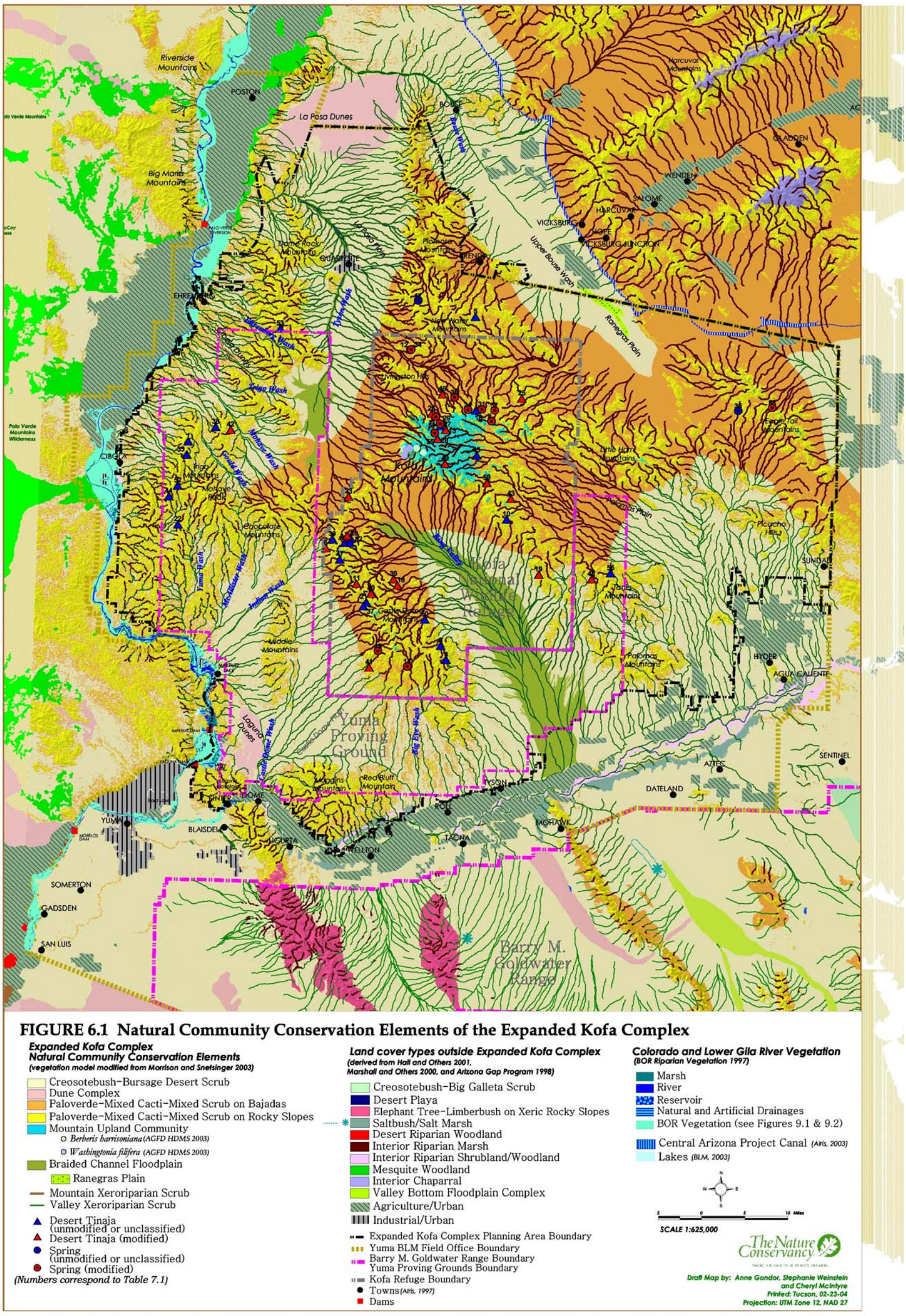


FIGURE 6.1 Natural Community Conservation Elements of the Expanded Kofa Complex

Expanded Kofa Complex Natural Community Conservation Elements
(vegetation model modified from Morrison and Snetsinger 2003)

- Creosotebush-Bursage Desert Scrub
- Dune Complex
- Paloverde-Mixed Cacti-Mixed Scrub on Bajadas
- Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes
- Mountain Upland Community
  - *Berberis harrisoniana* (AGFD HDMS 2003)
  - *Washingtonia filifera* (AGFD HDMS 2003)
- Braided Channel Floodplain
- Ranegras Plain
- Mountain Xeroriparian Scrub
- Valley Xeroriparian Scrub
- Desert Tinaja (unmodified or unclassified)
- Desert Tinaja (modified)
- Spring (unmodified or unclassified)
- Spring (modified)

(Numbers correspond to Table 7.1)

Land cover types outside Expanded Kofa Complex
(derived from Hall and Others 2001, Marshall and Others 2000, and Arizona Gap Program 1998)

- Creosotebush-Big Galleta Scrub
- Desert Playa
- Elephant Tree-Limberbush on Xeric Rocky Slopes
- Saltbush/Salt Marsh
- Desert Riparian Woodland
- Interior Riparian Marsh
- Interior Riparian Shrubland/Woodland
- Mesquite Woodland
- Interior Chaparral
- Valley Bottom Floodplain Complex
- Agriculture/Urban
- Industrial/Urban
- Expanded Kofa Complex Planning Area Boundary
- Yuma BLM Field Office Boundary
- Barry M. Goldwater Range Boundary
- Yuma Proving Grounds Boundary
- Kofa Refuge Boundary
- Towns (Airs, 1997)
- Dams

Colorado and Lower Gila River Vegetation
(BOR Riparian Vegetation 1997)

- Marsh
- River
- Reservoir
- Natural and Artificial Drainages
- BOR Vegetation (see Figures 9.1 & 9.2)
- Central Arizona Project Canal (Airs, 2003)
- Lakes (BLM, 2003)

N W E S

5 0 5 10 Miles

SCALE 1:625,000

The Nature Conservancy

Draft Map by: Anne Gondor, Stephanie Weinstein and Cheryl McIntyre
Printed: Tucson, 02-23-04
Projection: UTM Zone 12, NAD 27

Table 6.2 Spatial Organization and Selection Criteria of Preliminary Conservation Elements of the Expanded Kofa Complex

Geographic Scale[1]	Level of Biological Organization		
	Species/Guild[2]	Terrestrial Natural Community	Aquatic Natural Community
Regional	None identified to date	Not applicable	Not applicable
Coarse	Bat guild (S) Desert bighorn sheep (AD, RV) Primary excavator (cavity) guild (K, S)	Creosotebush-Bursage Desert Scrub Paloverde-Mixed Cacti-Mixed Scrub on Bajadas Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes	None identified to date
Intermediate	Desert tortoise (RV) Le Conte's thrasher (S, RV) Mojave fringe-toed lizard (S)	Mountain Upland Dune Complex	None identified to date
Local	Ephemeral water-breeding amphibian guild (S) California fan palm (S)	None identified to date	Desert Tinaja/ Spring (SH)
Linear	Not applicable	Valley Xeroriparian Scrub Mountain Xeroriparian Scrub Braided Channel Floodplain	Not applicable

[1] Geographic scale definitions are provided in Figure 2.1.

[2]**Legend**: Selection criteria are provided for "fine filter" conservation elements (species, guilds, and specialized habitats). AD = area-dependent species; K = keystone species; RV = regionally vulnerable species; S = specialized species; SH = specialized habitat. Complete definitions for fine filter categories are provided in Table 2.1

Table 6.3 Global Ranks of Preliminary Species Conservation Elements of the Expanded Kofa Complex.

Taxon	Total A[1]	Total B[2]	Combined Global Rank[3]				
			G1 (rarest)	G2	G3	G4	G5 (most common)
Plants	1	2	0	1	0	1	0
Amphibians	1	4	0	0	0	0	4
Reptiles	2	2	0	0	1	1	0
Birds	2	4	0	0	1	0	3
Mammals	1	6	0	0	0	4	3
Total	7	18	0	1	2	6	9

[1]Total A only includes species conservation elements, where a guild is tallied as a single taxon.

[2]Total B includes all species within guilds and a rare plant, Kofa barberry (*Berberis harrisoniana*), which is associated with the Mountain Upland natural community in the Kofa Mountains.

[3]Global ranks are defined in Appendix C. Global Ranks are provided for the species in the Total B column.

Table 6.4 Special Status Species Verified or Expected to Occur in the BLM Yuma Resource Management Area
(Within each higher-level taxon, sorted taxonomically and then alphabetically by scientific name).

Taxon	Common Name	Scientific Name	G Rank[1]	Status[2]	Comments/Occurrence Notes[3]
Plant	Kofa Mountain barberry	*Berberis harrisoniana*	G1G2	BLM	Found in the Kofa Mountains. There are no management concerns or major threats to this species where it occurs (R. Kearns pers. comm.). It is included in the coarse filter within the Mountain Upland natural community.
Plant	Nichol turk's head cactus	*Echinocactus horizonthalonius var nicholii*	G4T2	LE, NPL (HS)	A flowering individual was photographed and positively identified on YPG in the early 1990s but has not since been relocated. It was found in an area lacking military activities (White Tanks Cultural Area), so it is not threatened on YPG (V. Morrill, pers. comm.). Although it was positively identified, the lack of a specimen causes some to be skeptical of its presence on YPG because the YPG locality is disjunct from the main part of its range in Arizona (southwestern Pinal and north-central Pima counties) and it was not found on limestone soils, which are thought to be its preferred habitat (YPG 1997).
Plant	Sand food	*Pholisma sonorae*	G2	BLM, NPL (HS)	Restricted to active dunes of the Gran Desierto in northwestern Sonora and the portion (Yuma Dunes) within southwestern Arizona (Warren and Laurenzi 1987)
Plant	Kearney sumac	*Rhus kearneyi ssp kearneyi*	G4T3?	BLM	Found in the Tinajas Altas Mountains on Cabeza Prieta NWR and the Gila Mountains, at elevations from 1,000 to 1,500 feet.
Plant	Schott's wire-lettuce	*Stephanomeria schottii*	G2	BLM	This species grows on dunes and sandy flats and is endemic to southwestern Arizona. It was known from a single specimen collected in 1855 and was thought to be extinct until it was rediscovered on the Pinta Sands on Cabeza Prieta NWR in 1978. It has since been found on the Mohawk Dunes, northern Sonora west of Sonoyta, and Fortuna Road near Interstate 8. It may be found on sandy soils in other areas of the Field Office (Warren and Laurenzi 1987).

Table 6.4 Special Status Species Verified or Expected to Occur in the BLM Yuma Resource Management Area
(Within each higher-level taxon, sorted taxonomically and then alphabetically by scientific name).

Taxon	Common Name	Scientific Name	G Rank[1]	Status[2]	Comments/Occurrence Notes[3]
Plant	Blue sand lily	*Triteleiopsis palmeri*	G3	BLM, NPL (SR)	The entire known range of this species in the United States is in extreme southwestern Yuma County where it is restricted to sand dunes (both active shifting areas and stabilized flats) (Warren and Laurenzi 1987).
Invertebrate	MacNeill sooty wing skipper	*Hesperopsis gracielae*	G1G3	BLM	Expected to occur in the Yuma Field Office (BLM 2000). A potential conservation element of the Expanded Kofa Complex discussed in Section 8.9 of the report.
Invertebrate	Cheese-weed moth lacewing	*Oliarces clara*	G2G3	BLM	Expected to occur in the Yuma Field Office (BLM 2000). A potential conservation element of the Expanded Kofa Complex discussed in Section 8.9 of the report.
Fish	Bonytail	*Gila elegans*	G1	WSCA, ESA (LE)	Found in the Colorado River at the Palo Verde Valley (HDMS 2003).
Fish	Razorback sucker	*Xyrauchen texanus*	G1	WSCA, ESA (LE)	Found in the Colorado River at the Palo Verde Valley and near Imperial Dam (HDMS 2003).
Reptile	Desert tortoise	*Gopherus agassizii*	G4T4	WSCA	Selected as a preliminary conservation element for the Expanded Kofa Complex (discussed in Section 8.4).
Reptile	Banded Gila monster	*Heloderma suspectum cinctum*	G4T4	BLM	Only populations north and west of the Colorado River are considered BLM sensitive species. Found on the northern portion of the Kofa Refuge (HDMS 2003).
Reptile	Chuckwalla	*Sauromalus ater*	G5	BLM	Found amongst rocky outcrops. This species is presumed to be captured by the coarse filter within the Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes and the Mountain Upland natural communities within the Expanded Kofa Complex..
Reptile	Flat-tail horned lizard	*Phrynosoma mcallii*	G3	WSCA	Restricted to the Yuma Dunes on the Barry M. Goldwater Range in the southwestern portion of the BLM Yuma Field Office.
Reptile	Cowles fringe-toed lizard	*Uma notata rufopunctata*	G3QT2 T3	BLM, WSCA	Found outside the Expanded Kofa Complex on the BMGR in the Mohawk Mountains
Reptile	Mojave fringe-toed lizard	*Uma scoparia*	G3G4Q	WSCA	Selected as a preliminary conservation element for the Expanded Kofa Complex (discussed in Section 8.3).

Table 6.4 Special Status Species Verified or Expected to Occur in the BLM Yuma Resource Management Area
(Within each higher-level taxon, sorted taxonomically and then alphabetically by scientific name).

Taxon	Common Name	Scientific Name	G Rank[1]	Status[2]	Comments/Occurrence Notes[3]
Reptile	Rosy boa	*Lichanura trivirgata*	G4G5	BLM	Found amongst rocky outcrops. This species is presumed to be captured by the coarse filter within the Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes and the Mountain Upland natural communities within the Expanded Kofa Complex..
Bird	Clark's grebe	*Aechmophorus clarkii*	G5	WSCA	Common year-round resident within the Yuma Field Office associated with aquatic habitats.
Bird	American bittern	*Botaurus lentiginosus*	G4	WSCA	Rare winter resident/migrant within the Yuma Field Office associated with wetlands.
Bird	American redstart	*Setophaga ruticilla*	G5	WSCA	Rare transient/migrant within the Yuma Field Office
Bird	Great egret	*Ardea alba*	G5	WSCA	Common year-round resident within the Yuma Field Office associated with lakes, canals, and other natural or artificial waters near the Colorado River..
Bird	Snowy egret	*Egretta thula*	G5	WSCA	Common year-round resident within the Yuma Field Office. Associated with wetland habitats and agriculture in the southwestern portion of the Yuma Field Office.
Bird	Western least bittern	*Ixobrychus exilis hesperis*	G5TU	WSCA	Uncommon year-round resident within the Yuma Field Office. Associated with marshes.
Bird	White-faced ibis	*Plegadis chihi*	G5	BLM	Found along the Colorado River in the Cibola NWR (HDMS 2003).
Bird	Ferruginous hawk	*Buteo regalis*	G4	WSCA	Uncommon winter resident/migrant within the Yuma Field Office.
Bird	Common black hawk	*Buteogallus anthracinus*	G4G5	WSCA, USFS, MEX (A)	Rare summer resident/migrant within the Yuma Field Office. Found along waterways, particularly with native riparian habitat.
Bird	Bald eagle	*Haliaeetus leucocephalus*	G4	WSCA, ESA (LT), USFS, MEX (P)	Uncommon year-round resident within the Yuma Field Office.
Bird	Osprey	*Pandion haliaetus*	G5	WSCA	Uncommon year-round resident within the Yuma Field Office. Relies on fresh or saltwater aquatic habitat for foraging needs.

Table 6.4 Special Status Species Verified or Expected to Occur in the BLM Yuma Resource Management Area
(Within each higher-level taxon, sorted taxonomically and then alphabetically by scientific name).

Taxon	Common Name	Scientific Name	G Rank[1]	Status[2]	Comments/Occurrence Notes[3]
Bird	Peregrine falcon	*Falco peregrinus*	G4	WSCA	Rare transient/migrant within the Yuma Field Office, including Kofa NWR.
Bird	California black rail	*Laterallus jamaicensis coturniculus*	G4T1	WSCA	Uncommon year-round resident within the Yuma Field Office. Listed Threatened in California (CDFG 2003). Associated with habitat along the Colorado River
Bird	Yuma clapper rail	*Rallus longirostris yumanensis*	G5T3	ESA (LE), WSCA	Found in backwater marshes along the Colorado and Gila Rivers.
Bird	Snowy plover	*Charadrius alexandrinus*	G4	WSCA	Rare transient/migrant within the Yuma Field Office
Bird	Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	G5T3	WSCA	Found in riparian habitat along the Colorado and Gila Rivers in the Yuma RMA.
Bird	Western burrowing owl	*Athene cunicularia hypugea*	G4	BLM	Generally found near agricultural lands in the southwestern portion of the field office (Figure 8.13). A potential conservation element of the Expanded Kofa Complex (discussed in Section 8.9).
Bird	Belted kingfisher	*Ceryle alcyon*	G5	WSCA	Common winter resident/migrant within the Yuma Field Office. Associated with open water and riparian systems.
Bird	Southwestern willow flycatcher	*Empidonax traillii extimus*	G5T2	ESA (LE), WSCA	Found in riparian habitat along the Colorado and Gila Rivers in the Yuma RMA.
Bird	Grey catbird	*Dumetella carolinensis*	G5	WSCA	Rare in Arizona (S1). Rare on Kofa NWR.
Bird	Loggerhead shrike	*Lanius ludovicianus*	G5	BLM	Confirmed breeding in most Breeding Bird Survey blocks throughout the Yuma Field Office (ABBA 2001). It is assumed that the management needs of this species will be captured by a focus on the natural communities (coarse filter) in the Expanded Kofa Complex.
Bird	Large-billed savannah sparrow	*Passerculus sandwichensis rostratus*	G5T?	BLM, MEX (R)	Observed (non-breeder or migrant) in one breeding bird block in the field office on the Colorado River Indian Reservation (ABBA 2001).

Table 6.4 Special Status Species Verified or Expected to Occur in the BLM Yuma Resource Management Area
(Within each higher-level taxon, sorted taxonomically and then alphabetically by scientific name).

Taxon	Common Name	Scientific Name	G Rank[1]	Status[2]	Comments/Occurrence Notes[3]
Mammal	Mexican long-tongued bat	*Choeronycteris mexicana*	G4	BLM, WSCA	Verified in the Yuma Field Office (BLM 2000) but there are no tracked occurrences from Heritage (HDMS 2003). Sightings may have been of males or non-reproductive females. A migratory bat that is primarily found in oak woodlands.
Mammal	Spotted bat	*Euderma maculatum*	G4	BLM, WSCA	This species roosts in cliff crevices. In the Yuma Field Office it is known from near the Gila River (HDMS 2003).
Mammal	Allen's (Mexican) big-eared bat	*Idionycteris phyllotis*	G3G4	BLM	Expected to occur in the Yuma Field Office but has not been located at present.
Mammal	Western red bat	*Lasiurus blossevillii*	G5	WSCA	Closely associated with cottonwood-willow riparian areas in the desert. It is expected to occur in the Yuma Field Office, but has not been confirmed at present.
Mammal	Southern yellow bat	*Lasiurus ega*	G5	WSCA	Roosts in palms and tree foliage. Was caught on YPG (Castner and others 1995)
Mammal	Lesser long-nosed bat	*Leptonycteris curasoae yerbabuenae*	G4T3T4	ESA (LE), WSCA	Occurs in the field office on the Barry M. Goldwater Range and Cabeza Prieta National Wildlife Refuge.
Mammal	California leaf-nosed bat	*Macrotus californicus*	G4	BLM, WSCA	Selected as a preliminary conservation element for the Expanded Kofa Complex (Bat Guild, discussed in Section 8.7).
Mammal	Small-footed myotis	*Myotis ciliolabrum*	G5	BLM	Verified in the Yuma Field Office (BLM 2000) but sightings likely did not include colonies or reproductive individuals as there are no occurrences reported in the area by Heritage (HDMS 2003).
Mammal	Arizona myotis	*Myotis lucifugus occultus*	G5T3T4	BLM	Rare or uncommon in the Yuma Field Office. Generally found at higher elevations in Arizona.
Mammal	Fringed myotis	*Myotis thysanodes*	G4G5	BLM	Verified in the Yuma Field Office (BLM 2000) but sightings likely did not include colonies or reproductive individuals. More commonly found in oak and pinyon woodlands.

Table 6.4 Special Status Species Verified or Expected to Occur in the BLM Yuma Resource Management Area
(Within each higher-level taxon, sorted taxonomically and then alphabetically by scientific name).

Taxon	Common Name	Scientific Name	G Rank[1]	Status[2]	Comments/Occurrence Notes[3]
Mammal	Cave myotis	*Myotis velifer*	G5	BLM	Selected as a preliminary conservation element for the Expanded Kofa Complex (Bat Guild, discussed in Section 8.7).
Mammal	Pocketed free-tailed bat	*Nyctinomops femorosaccus*	G4	BLM	Selected as a preliminary conservation element for the Expanded Kofa Complex (Bat Guild, discussed in Section 8.7).
Mammal	Big free-tailed bat	*Nyctinomops macrotis*	G5	BLM	Generally found in rocky areas or riparian areas. It has been verified in the Yuma Field Office, but localities need to be confirmed.
Mammal	Yuma puma	*Puma concolor browni*	G5T1T2	WSCA	Taxonomic status is questionable (NatureServe Explorer 2002). A potential conservation element of the Expanded Kofa Complex discussed in Section 8.9 of the report.
Mammal	Sonoran pronghorn	*Antilocapra americana sonoriensis*	G5T1	ESA (LE), MEX (P), USFS, WSCA,	Known recently from within the Field Office from the BMGR and Cabeza Prieta NWR (HDMS 2003), but population in the United States has declined dramatically in recent years. A potential conservation element of the Expanded Kofa Complex discussed in Section 8.9 of the report.

[1]Global Rank definitions are found in Appendix C
[2]**Legend:** BLM: BLM Sensitive Species (BLM 2000), NPL: Arizona Native Plant Law, WSCA: Wildlife of Special Concern in Arizona (AGFD 1996), MEX: federal protection in Mexico, ESA: federal protection in the U.S., USFS: USFS Sensitive Species. See Appendix D for management status codes and definitions.
[3]Information on birds comes from brochures produced by BLM on Birds in the Yuma Field Field Office, supplemented by BLM and USFWS (1996). Additional information on all the bats species can be found in Table 8.3, Bats in the Yuma Resource Management Area.

CHAPTER 7
CONSERVATION ELEMENT STATUS: NATURAL COMMUNITIES

Nine natural communities**,** including eight plant communities and one specialized habitat, were selected as conservation elements of the Expanded Kofa Complex. Descriptions of each natural community is provided below and their mapped distributions within the Expanded Kofa Complex are displayed in Figure 6.1.

7.1 Creosotebush-Bursage Desert Scrub

General Description: Creosotebush-Bursage Desert Scrub is the matrix community of the Lower Colorado River Valley biotic Subdivision of the Sonoran Desert. Creosotebush-Bursage Desert Scrub occupies the lower elevations of the Expanded Kofa Complex on flat to gentle or moderate slopes in valley bottoms and plains, low rolling hills, and lower bajadas extending from surrounding mountain ranges. This community occurs in the most arid regions of the Sonoran Desert, where rainfall is often less than five inches per year (Turner and Brown 1994). Within the planning area, characteristic vegetation is composed of a sparse cover of shrubs, dominated by creosotebush (*Larrea tridentata)* and white bursage (*Ambrosia dumosa*). The matrix typically includes large patches of desert pavement and extensive networks of Valley Xeroriparian Scrub and Braided Channel Floodplain natural communities. Creosotebush-Bursage Desert Scrub grades into Paloverde-Mixed Cacti-Mixed Scrub on Bajadas with increasing elevation and annual precipitation. In the extremely arid, westernmost portions of the Expanded Kofa Complex, even the upper bajadas of the desert mountain ranges are dominated by these systems.

Conservation Status and Regional Threats: Creosotebush-Bursage Desert Scrub covers many thousands of acres throughout the Sonoran Desert. The Expanded Kofa Complex includes approximately 1.3 million acres (0.5 million hectares) of this natural community. Because this community is located on easily accessible terrain, large portions of its historic extent have been lost or degraded due to past and current human activities. This loss or degradation of Creosotebush-Bursage Desert Scrub has been the result of inappropriate levels of livestock grazing, urban development, road development, recreational activities such as off-road vehicle use, and agricultural development (Hall and others 2001). These uses may result in soil erosion, entrenchment, and compaction, and may provide entry corridors for invasive non-native plants, including Mediterranean grass (*Schismus spp.*), red brome (*Bromus rubens*), buffelgrass (*Pennisetum ciliare*), and Sahara mustard (*Brassica tournefortii*). Invasive non-native plants can increase fine fuel loads in this community, and under certain conditions can increase fire frequency and intensity. Fires carried by invasive non-native plants can cause the death of native vegetation, including creosotebush, which is not fire adapted.

Desert pavements found within this natural community typically have high runoff and funnel water from the interfluves to Xeroriparian Scrub systems located along adjacent runnels (Turner and Brown 1994). However, soil disturbances caused by off-road vehicle use or livestock grazing may lead to degradation of desert pavements and biological soil crusts. Impacts to desert pavements and biological soil crusts in turn effect soil surface erosion, water runoff and infiltration rates, soil chemical properties, plant germination and establishment, and plant density and foliar cover (Webb and Wilshire 1983, Belnap and Lange 2001, Belnap and Warren 2002,

Kade and Warren 2002). Soil disturbances are extremely long-lasting in the arid southwest where estimated recovery times range from less than a century up to several millennia depending on the nature and intensity of the disturbance and site characteristics, including soil properties (Belnap and Eldridge 2001, Kade and Warren 2002, Webb 2002).

Compared to its occurrence in other regions of the Sonoran Desert, the Creosotebush-Bursage Desert Scrub community is relatively unfragmented and undeveloped within the Expanded Kofa Complex. Spatially-explicit land use information within the Expanded Kofa Complex was not available for this analysis, but would be necessary data to evaluate the conservation status of this community and map areas where unfragmented Creosotebush-Bursage Desert Scrub or intact desert pavements are likely to be found. There are some activities and uses within the Expanded Kofa Complex that could potentially impact this natural community, such as grazing and off-road vehicle use (by recreationists and the military). Although there is minimal grazing by domestic livestock in the Yuma Planning Area, the Expanded Kofa Complex includes over 840,000 acres of the 1 million acre Cibola-Trigo wild horse and burro Herd Management Area (HMA; the location of the HMA is shown on the map of desert tortoise habitat, Figure 8.4). The HMA contains mostly Cresotebush-Bursage Desert Scrub and Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes natural communities on land managed by the BLM, YPG, and the Cibola and Imperial National Wildlife Refuges. The BLM manages wild horses and burros such that populations are maintained at an "appropriate management level" (AML), and animals are rounded up and auctioned to the public if populations exceed the AML. The AML for the Arizona side of the Cibola-Trigo herd is 165 burros and 130 wild horses (R. Oyler, pers. comm.), and is 120 for burros on the California side along the Colorado River (including the Chocolate/Mule Mountains HMA; BLM and California Fish and Game 2002). At last census, the wild horse and burro populations in Arizona were slightly exceeding the AMLs, with approximately 150 horses and 200 burros (R. Oyler, pers. comm.). The BLM Yuma Field Office and the U.S. Fish and Wildlife Service are preparing a Wilderness Management Plan for the Trigo and Imperial Wilderness areas that will also include an Amendment/Environmental Assessment to the Yuma District RMP to revise wild horse and burro management provisions in Arizona. Proposed changes to the Cibola-Trigo HMA Plan may include a revision of the HMA boundary such that burros are removed from portions east of Interstate 95, including on the Kofa live fire range of YPG (R. Oyler, pers. comm.).

Other areas within the Expanded Kofa Complex have uses that may impact the integrity of the Creosotebush-Bursage natural community and desert pavements, such as off-road vehicle use on the La Posa Plain (BLM 1997), and testing of wheeled and tracked vehicles on the Mobility Test Area in the Laguna Region of YPG (YPG 1997, Gutierrez-Palmenberg and Jason Associates 2001).

Relative Importance of the Expanded Kofa Complex: The Expanded Kofa Complex includes the most western, arid portions of this community in the Sonoran Desert in Arizona, where desert pavements and xeroriparian vegetation may be particularly well-developed. Within the Expanded Kofa Complex, this natural community occurs on large blocks of land under federal management where it is relatively unfragmented by roads, agriculture, and urban development. . An analysis of land uses within the Expanded Kofa Complex and field data collection would be necessary in order to evaluate the conservation status of this community and map areas where

unfragmented Creosotebush-Bursage Desert Scrub or intact desert pavements are likely to be found.

Mapping Comments: Creosotebush-Bursage Desert Scrub is difficult to map accurately because it tends to intergrade with Paloverde-Mixed Cacti-Mixed Scrub on Bajadas. Therefore, transition zones between these communities may exist even in areas where distinct breaks are evident in Figure 6.1. Creosotebush-Bursage Desert Scrub was mapped using a 30-meter digital elevation model (DEM) and selecting areas lower than 400 meters elevation (1312 feet) with slopes less than 3 degrees. This model was based, in part, on work by Morrison and Snetsinger (2003) to map this natural community where it occurs on the Sonoran Desert National Monument. However, Morrison and Snetsinger (2003) mapped Creosotebush-Bursage Desert Scrub at elevations lower than 650 meters, and they distinguished between Creosotebush-Bursage Desert Scrub and Paloverde-Mixed Cacti-Mixed Scrub on Bajadas at elevations between 250 and 650 meters by analyzing vegetation cover from digital orthophoto quarter quadrants (DOQQs). We were unable to apply this method for the Expanded Kofa Complex because we did not evaluate DOQQs for the entire planning area. Furthermore, vegetation cover would not likely differentiate these natural communities in such a sparsely vegetated, arid environment. Instead, an elevation break at 400 meters was selected to define Creosotebush-Bursage Desert Scrub because it corresponds most closely to the break between of the Lower Colorado River Valley and the Arizona Upland Subdivisions of the Sonoran Desert as mapped by Brown and Lowe (1994). The modeling assumptions used to map Creosotebush-Bursage Desert Scrub within the Expanded Kofa Complex is a starting point and could be refined with additional fieldwork and aerial photography interpretation.

7.2 Paloverde-Mixed Cacti-Mixed Scrub on Bajadas

General Description: This natural community is endemic to the Sonoran Desert and is one of two matrix communities identified within the Arizona Upland Subdivision of the Sonoran Desert, the other being Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes. These two matrix communities were split primarily due to differences in accessibility (bajadas being more accessible than rocky slopes), and therefore differences in uses or threats, such as road development (Hall and others 2001). The Paloverde-Mixed Cacti-Mixed Scrub on Bajadas natural community is located on the upper bajadas of desert mountain ranges. It gradually transitions into Creosotebush-Bursage Desert Scrub on the lower bajadas and valley bottoms. The lowest, most arid regions of the planning area are found within the Lower Colorado River Valley subdivision. In these areas, the Paloverde-Mixed Cacti-Mixed Scrub on Bajadas natural community may be localized and patchy near rocky slopes, or it may be completely absent from the upper bajadas where the drought-hardy plants characteristic of the Creosotebush-Bursage Desert Scrub persist instead. Paloverde-Mixed Cacti-Mixed Scrub systems are typically composed of a sparse canopy of saguaro cacti and/or leguminous trees and a patchy understory of large (often arborescent) and small cacti, shrubs, herbs, and grasses. Networks of Valley Xeroriparian Scrub and Braided Channel Floodplain systems are embedded within the matrix of the Paloverde-Mixed Cacti-Mixed Scrub community on Bajadas (Hall and others 2001).

Conservation Status and Regional Threats: The Expanded Kofa Complex includes approximately 830,000 acres (336,000 hectares) of this natural community. Paloverde-Mixed

Cacti-Mixed Scrub on Bajadas covers extensive areas throughout the Sonoran Desert. However, there are few areas in the Sonoran Desert where large, unfragmented and compositionally intact examples remain. Much of the historic range of this community has been reduced due to human activities in the accessible bajadas, such as the ongoing residential development in the foothills surrounding Tucson and Phoenix. Other examples of this natural community have been degraded due to historic and current overgrazing. Overgrazing affects composition and structure of plants in this community and can affect saguaro recruitment rates (Goldberg and Turner 1986, Abouhaidar 1992). Other stressors to these systems in the Sonoran Desert include displacement of native vegetation, soil erosion, and alteration of the natural hydrologic regime caused by the spread of invasive non-native species, altered fire regimes, road construction and maintenance, and illegal collection of cacti (Hall and others 2001).

Relative Importance of the Expanded Kofa Complex: The largest unfragmented example of this community in the Sonoran Desert occurs on the Goldwater Range (Hall and others 2001). However, the Expanded Kofa Complex also includes large examples of this community, particularly on the Kofa Refuge. The Expanded Kofa Complex is important due to the lack of threats that impact these systems elsewhere in the Sonoran Desert, such as domestic livestock grazing pressures and urban development. This area includes the most western extension of Arizona Upland in the Sonoran Desert and so the composition and structure of the Paloverde-Mixed Cacti-Mixed Scrub community on bajadas is likely to be distinct from other regions.

Mapping Comments: Paloverde-Mixed Cacti-Mixed Scrub on Bajadas was mapped using a 30-meter DEM for areas with slopes between three and six degrees and elevations between 400 and 1200 meters (1312 to 3937 feet). This model was based, in part, on work by Morrison and Snetsinger (2003) to map this natural community where it occurs on the Sonoran Desert National Monument. As discussed above, in Mapping Comments for the Creosotebush-Bursage Desert Scrub natural community, we did not use vegetation cover to distinguish between Paloverde-Mixed Cacti-Mixed Scrub and Creosotebush-Bursage Desert Scrub natural communities. Paloverde-Mixed Cacti-Mixed Scrub on Bajadas is difficult to map accurately because it tends to intergrade with Creosotebush-Bursage Desert Scrub. Therefore, transition zones between these communities may exist even in areas where distinct breaks are evident in Figure 6.1. The modeling assumptions used to map Paloverde-Mixed Cacti-Mixed Scrub on Bajadas within the Expanded Kofa Complex is a starting point and could be refined with additional fieldwork and aerial photography interpretation. Land Condition Trend Analysis (LCTA) data on YPG could also be used to confirm the presence of particular natural communities at transect locations (points). Teddybear cholla (*Opuntia bigelovii*) may be a possible indicator that could differentiate Paloverde-Mixed Cacti-Mixed Scrub on Bajadas from Creosotebush-Bursage Desert Scrub (V. Morrill, pers. comm.).

7.3 Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes

General Description: Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes is a matrix community that is endemic to the Sonoran Desert. Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes was defined as a large patch community on the BMGR (Hall and others 2001), but was redefined as a matrix community after its extent was found to be more expansive based on revised modeling assumptions and fieldwork on the Sonoran Desert National Monument

(Snetsinger and Morrison 2003). Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes occurs on bedrock outcrops throughout low mountain ranges. The composition of this community is similar to its occurrence on the bajadas, but with additional associates and variation related to aspect, slope, elevation, and geology (Morrison and Snetsinger 2003). Vegetation cover may be sparse or absent, particularly on large rock outcrops and in the more western, arid portions of the Sonoran Desert, including many mountain ranges within the Expanded Kofa Complex. On some canyons and north facing slopes of select higher elevation mountain ranges, Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes may include species that are characteristic of the Mountain Upland natural community.

Conservation Status and Regional Threats: The Expanded Kofa Complex includes approximately 680,000 acres (275,000 hectares) of the Paloverde-Mixed Cacti-Mixed Scrub natural community on Rocky Slopes. This natural community is important in watershed protection. Paloverde-Mixed Cacti-Mixed Scrub natural community on Rocky Slopes is less threatened than the corresponding natural community on bajadas because it occurs in more isolated and inaccessible areas where there is limited access, road development, and fewer human activities in general. However, the historic extent of this community has been reduced or fragmented by urban expansion into the mountains surrounding Tucson and Phoenix. In other regions of the Sonoran Desert the vegetation composition of these systems may be altered by recreational activities and cactus collection (Hall and others 2001).

Rock outcrops are scattered throughout this natural community and provide a distinct microclimate and shelter from the surrounding dry, hot desert that is important in the survival of many species of desert plants and animals. Numerous species are closely associated with rock outcrops, including Special Status species such as the common chuckwalla (*Sauromalus ater*), rosy boa (*Lichanura trivirgata*), and desert tortoise (*Gopherus agassizii*) (Goode and others 1995). Rock outcrop microhabitats are threatened by vandalism that occurs as a result of destructive collection methods for commercially valuable reptiles (Goode and others 1995), collection of boulders for landscaping and recreational shooting (Weinstein and others 2002). The destruction of geologically ancient rocky outcrops is irreparable, permanently limiting their ecological function as thermal refugia, basking sites, and shelter for numerous species (Goode and others 1995, Goode and others 1998). Rock outcrops were identified and mapped as a conservation element distinct from the Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes on the Sonoran Desert National Monument (Weinstein and others 2002, Morrison and Snetsinger 2003). We lacked sufficient data to map rock outcrops within the Expanded Kofa Complex, but include them as part of the definition of the Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes natural community.

Relative Importance of the Expanded Kofa Complex: Because the Expanded Kofa Complex includes numerous mountain ranges that are distributed across a precipitation and ecological gradient, the species composition of the Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes natural community is expected to be variable across these gradients. In the western portion of the planning area on some arid mountain ranges on YPG, this natural community includes unique plant assemblages that are more characteristic of the Mojave Desert (V. Morrill, pers. comm.). The planning area represents an opportunity to conserve a significant portion of the

natural range in variation of this community and its hydrological and ecological connections with embedded Mountain Xeroriparian Scrub and Paloverde-Mixed Cacti-Mixed Scrub on Bajadas.

Mapping Comments: Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes was mapped using a 30-meter DEM for areas with slopes greater than six degrees. This model is concordant with that developed by Morrison and Snetsinger (2003). Some small areas, such as mountaintops and mesas, may be excluded by the model because their slopes are less than six degrees. These areas are classified as Paloverde-Mixed Cacti-Mixed Scrub on Bajadas, but most are found in rocky areas and may be compositionally more similar to the Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes natural community.

7.4 Valley Xeroriparian Scrub

General Description: The Valley Xeroriparian Scrub natural community is a narrow, linear system that is associated with dry washes within lower bajadas and valley bottoms where intermittent, channel-constricted streamflow occurs. Vegetation composition and structure is highly variable and depends largely on the surrounding matrix community, the size of the drainage system, and the dynamic ecological processes that maintain this system. The overstory of Valley Xeroriparian Scrub is typically dominated by xeromorphic, deciduous trees including ironwood (*Olneya tesota*), blue paloverde (*Cercidium floridum*), and mesquite (*Prosopis spp.*). In some portions of the arid Lower Colorado River Valley subdivision of the Sonoran Desert, including the western portion of the Expanded Kofa Complex, saguaro is rarely found on bajadas and instead is largely restricted to Valley Xeroriparian Scrub.

Conservation Status and Regional Threats: Valley Xeroriparian Scrub is found along drainages throughout the matrix communities of the Sonoran and Mojave Deserts. Both Valley and Mountain Xeroriparian Scrub communities are extremely important as habitat, thermal protection, and movement corridors for wildlife, including mule deer and migratory birds. The composition, structure, and flow regime of many examples of Valley Xeroriparian Scrub throughout its distribution have been altered by past and current road development. Roads and other features that disrupt natural hydrologic flows can negatively impact down gradient vegetation composition and structure along the wash channel. Areas within the Expanded Kofa Complex where this type of disruption may be occurring include (1) the east side of the Eagletail Mountains where the Central Arizona Project (CAP) canal disrupts surface water flows, resulting in ironwood and paloverde death (R. Oyler, pers. comm.) and (2) the Castle Dome Plain and King Valley on YPG, where Pole Line Road cuts across wash channels and impacts vegetation on the south side of the road (V. Morrill, pers. comm.). Feral burros may also alter vegetation composition and structure of this natural community. Burros browse on trees in Xeroriparian Scrub during times of heat and drought. They seem to particularly impact paloverde trees, which are important nesting sites for birds and shelter for a host of other native species (Latta and others 1999). The Cibola-Trigo Herd Management Area overlaps with extensive areas of Valley Xeroriparian Scrub, but burro impacts on vegetation in the Expanded Kofa Complex was not analyzed in this project.

Relative Importance of the Expanded Kofa Complex: The Valley Xeroriparian Scrub systems in the planning area are particularly important in maintaining connections with two

major river systems: the Gila and the Colorado River. Washes that flow west towards the Colorado River, such as Mojave and Mule wash, deposit gravels that are important as fish spawning habitat (R. Engel and B. Knowles, pers. comm.). Valley Xeroriparian Scrub is best developed in the most arid regions of the Sonoran Desert including portions of the Expanded Kofa Complex. In this region, this natural community is the site of greatest plant species richness and abundance, and provides thermal cover that is critical for the survival of many species.

There are some unique plant assemblages within the Valley Xeroriparian Scrub natural community in the Expanded Kofa Complex that are of specific interest. For example, Indian Wash is distinct from other washes in the region in that jojoba (*Simmondsia chinensis*) occurs throughout the system, and in washes near the Colorado River both little-leaf and blue paloverdes (*Cercidium microphyllum* and *C. floridum*) co-occur and appear to be producing hybrids (K. Reichhardt, pers. comm.).

Mapping Comments: Valley Xeroriparian Scrub was mapped based on Arizona Land Resource Information System (ALRIS) 1:100,000-scale hydrography and a 30-meter DEM for areas with slopes less than five degrees and elevations less than 400 meters. The slope break is based on a model of this natural community where it occurs on the Sonoran Desert National Monument (Morrison and Snetsinger 2003). The elevation break, however, was lowered from Morrison and Snetsinger's (2003) model to be concordant with the elevation break for Creosotebush-Bursage Desert Scrub on the Expanded Kofa Complex. There may be some areas where the model for the occurrence of this natural community may be oversimplified and inaccurate, including (1) areas classified as Mountain Xeroriparian Scrub that are more characteristic of Valley Xeroriparian Scrub (at slopes greater than five degrees and elevations less than 400 meters) and (2) areas classified as Valley Xeroriparian Scrub that are more characteristic of Mountain Xeroriparian Scrub (at slopes less than five degrees and elevations greater than 400 meters). Fieldwork and additional descriptions of this natural community on the Expanded Kofa Complex could help to refine the modeling assumptions. The most refined hydrography mapping that is available for the entire planning area was used (1:100,000 scale), but it likely underestimates the extent of Xeroriparian Scrub. Higher resolution hydrography data (at least 1:24,000-scale) would be preferable to adequately map these communities.

7.5 Mountain Xeroriparian Scrub

General Description: This system is similar in composition, structure, function, and significance to the Valley Xeroriparian Scrub community, described above, but the Mountain Xeroriparian Scrub community occurs on higher gradients in the upper bajadas and mountains. In contrast to Valley Xeroriparian Scrub, this natural community is found alongside streambeds that are largely confined by bedrock such that channel migration occurs only on a geologic time scale (Morrison and Snetsinger 2003). Vegetation composition of this natural community is largely influenced by aspect and elevation.

Conservation Status and Regional Threats: Mountain Xeroriparian Scrub is found in rugged, isolated areas that are not subject to many anthropogenic threats. Conservation goals should consider representing the natural range in compositional variation of these systems that likely

correspond to differences in the surrounding matrix community, elevation, aspect, and precipitation.

Relative Importance of the Expanded Kofa Complex: The Mountain Xeroriparian Scrub in the Expanded Kofa Complex is significant for its role in maintaining the hydrological connections between the mountains and the lower Colorado and Gila Rivers.

Mapping Comments: Mountain Xeroriparian Scrub was mapped as described above for Valley Xeroriparian Scrub, except for areas with slopes above five degrees and elevations above 400 meteres (1312 feet). Potential misclassification of this natural community may occur in some areas within the Expanded Kofa Complex, as described for Valley Xeroriparian Scrub.

7.6 Braided Channel Floodplain

General Description: The Braided Channel Floodplain natural community was selected as a conservation element distinct from Valley and Mountain Xeroriparian Scrub because it differs in its form and function, vegetation composition and structure, and its disproportionate value to desert wildlife. Braided Channel Floodplains occupy low gradient to flat broad valley floodplains. This natural community is characterized by interweaving braided channels where water flows during flood events. Channels are separated by islands of vegetation that may shift in time and space and which are periodically inundated during high flows. In contrast to the predominantly channelized systems of Valley and Mountain Xeroriparian Scrub, Braided Channel Floodplain communities include off-channel areas that are periodically inundated by floods. Braided Channel Floodplains may have similarities (such as similar soils or form, as visible in DOQQs) to Valley Bottom Floodplain Complexes (Hall and others 2001), but they differ in that they are not maintained by sheet flow hydrological processes. However, there may be a gradation between these systems, making it difficult to map them accurately at a coarse scale (see the Mapping Comments section for additional information).

In addition to their width and dominant hydrological and geomorphic processes, Braided Channel Floodplains can be distinguished from Valley Xeroriparian Scrub based on differences in vegetation composition (Morrison and Snetsinger 2003, V. Morrill, pers. comm.). Braided Channel Floodplains on the Sonoran Desert National Monument have similar vegetation composition to Valley Xeroriparian Scrub but with some differences in the cover and abundance of certain species (Morrison and Snetsinger 2003). The most abundant species in the Braided Channel Floodplain natural community on the Monument is cheesebush (*Hymenoclea salsola*). Other indicator species for this natural community on the Monument include desert lavender (*Hyptis emoryi*), Mexican jumping bean (*Sebastiania bilocularis*), desert willow (*Chilopsis linearis ssp. arcuata*), sweetbush (*Bebbia juncea var. aspera*), and desert broom (*Baccharis sarothroides*) (Morrison and Snetsinger 2003). Within the Expanded Kofa Complex, the Braided Channel Floodplain natural community is found in Tyson and King Valley washes. There are some differences in species composition between the Braided Channel Floodplain and Valley Xeroriparian Scrub in the Expanded Kofa Complex, such as presence of fishhook barrel cactus (*Ferocactus wislizeni*) and bush muhly (*Muhlenbergia porteri*) in Braided Channel Floodplains rather than Le Conte's barrel cactus (*F. cylindraceus*) and big galleta (*Pleuraphis rigida*) in Valley Xeroriparian Scrub (V. Morrill, pers. comm.). The two natural communities also have

differences in shrub dominance and in grass composition (V. Morrill, pers. comm.). More information is needed to describe the full range in variation in composition and structure of this natural community and the ecological processes that maintains it, particularly as it occurs within the Expanded Kofa Complex.

Conservation Status and Regional Threats: The Braided Channel Floodplain natural community has greater species richness and abundance than the surrounding matrix communities. It provides thermal cover that is critical for the survival of many desert species and represents important foraging areas and travel corridors for wildlife including migratory birds and mule deer. This natural community is also important in maintaining connectivity between the bajadas and larger river systems, including the Gila and Colorado Rivers. Braided Channel Floodplains are located in accessible valley bottoms and bajadas where many examples in the Sonoran Desert have been degraded or lost to anthropogenic activities and developments. Roads and other features that disrupt hydrological flows within this natural community may result in altered vegetation composition and structure, as described for Valley Xeroriparian Scrub. Ironwood trees seem particularly vulnerable to disrupted surface water flows across Braided Channel Floodplains (as well as Valley Xeroriparian Scrub), where trees on the downstream side of a road receive less water and slowly die (R. Oyler, T. Green, pers. comm.). Feral burro browsing can have an adverse impact on the composition and structure of this natural community, as described in Section 7.4 on Valley Xeroriparian Scrub. The Cibola-Trigo HMA overlaps with a small portion of the Braided Channel Floodplain in Tyson Wash, but we did not evaluate potential impacts from burros in this area.

Relative Importance of the Expanded Kofa Complex: The Expanded Kofa Complex includes some of the most arid portions of the Sonoran Desert in Arizona. The large, unfragmented examples of Braided Channel Floodplain communities represent areas where vegetation is at its highest density and diversity. These areas are extremely important for wildlife. The Braided Channel Floodplain communities within the Expanded Kofa Complex are relatively intact systems with few roads or other features causing fragmentation in comparison to examples in other regions. Potential impacts to vegetation should be evaluated in areas of the Expanded Kofa Complex where impediments to flow may exist, such as impacts to vegetation in the Braided Channel Floodplain in King Valley caused by hydrological disruptions across the King Valley Road (R. Kearns, pers. comm.).

Mapping Comments: The Braided Channel Floodplain natural community was identified and mapped based on numerous sources of data including soils, hydrography, a model based on slope and elevation, DOQQs and satellite imagery, and input from land managers. A 30-meter DEM was used to identify low gradient areas with slopes less than two degrees and elevations below 400 meters (1312 feet). Soils, including Estrella (SCS 1994) and Gilman-Harqua-Glenbar (SCS 1991), were used as a guide to refine delineation or add to the mapped extent of Braided Channel Floodplains. Buffered ALRIS hydrography (1:100,000 scale) was used to delineate Braided Channel Floodplains in King Valley and Tyson Wash, by applying a 500 meter buffer (1,640 feet) to the main stems and a 250 meter buffer (820 feet) to the side channels
Braided Channel Floodplain mapping could be improved with additional analysis of DOQQs or Satellite Imagery and by restricting mapping to systems with a width of over 100 meters (Morrison and Snetsinger 2003).

It was difficult to differentiate between Braided Channel Floodplain and Valley Xeroriparian Scrub natural communities in some wash systems in the Expanded Kofa Complex. Some areas that are currently mapped as Valley Xeroriparian Scrub may include some Braided Channel Floodplain, and vice versa. For example, some large xeroriparian systems, such as Castle Dome Wash and Gould Wash, were mapped as Valley Xeroriparian Scrub because surface water flow is primarily restricted to channels. However, some braiding may occur along portions of these systems. In contrast, Tyson Wash, which is mapped as a Braided Channel Floodplain, includes stretches where flows are largely channelized (V. Morrill, pers. comm.). Mapping refinements would require further analysis with DOQQs or Satellite imagery. Other areas mapped as Braided Channel Floodplains may have similarities to the Valley Bottom Floodplain Complex natural community as it is described in the Growler Wash on the BMGR (Hall and others 2001). King Valley Wash has the same soil type (Estrella; soil class of Typic torrifluvents, fine-loamy, mixed [calcarious]) as the Valley Bottom Floodplain Complex community in the Growler Wash (SCS 1994), but they appeared to have quite different channel and vegetation patterns as seen in DOQQs, perhaps reflecting differences in the ecological and hydrological processes that maintain each system. There are some interfluvial areas in the King Valley wash where some sheet flow occurs—the ecological process that defines the Valley Bottom Floodplain Complex (Hall and others 2001). However, the areas of sheet flow in the King Valley is not as extensive as those found in the Growler Valley (R. Kearns, pers. comm.). King Valley may include a mosaic of braided channels and sheet flow floodplains or have some ecological characteristics intermediate between the two systems. More information is needed to fully describe and map the range in variation of the composition, structure, and function of Braided Channel Floodplains within the Expanded Kofa Complex.

7.7 Dune Complex

General Description: The Dune Complex natural community is a large patch system found widely scattered throughout the desert southwest, including the Sonoran Desert Ecoregion. This natural community includes a complex of sparsely or unvegetated active dune fields, stabilized dunes with more dense vegetation cover that serves to anchor sand in place, and wind-blown sand sheets that overlie other soil substrates. Surface features of Dune Complexes include sandy plains, sandy hills, and linear dunes (YPG 1997). Dunes in the southwest are somewhat isolated habitat "islands" characterized by low species similarity and high rates of endemism (Bowers 1984). Dunes are largely unvegetated (greater than 65% bare ground) and are characterized by an abundance of ephemeral plants, which are generally rare or absent from the adjacent flats and desert pavements (Warren and Laurenzi 1987). Vegetation cover on dunes is often more sparse than that on adjacent natural communities (Hall and others 2001), but in some cases vegetation is more dense on dunes, such as on dunes that are located adjacent to desert pavements (YPG 1997).

The BLM Yuma Resource Management Area includes portions of major dune systems in the Sonoran Desert including the Gran Desierto (Yuma Dunes) and Mohawk Dunes. These larger dune systems include active dunes with wind-blown sand dynamics, which support a diversity of rare, endemic plants (Bowers 1984, Warren and Laurenzi 1987, Hall and others 2001). However, dune endemics are not known from the systems found within the Expanded Kofa

Complex. Dune systems within the Expanded Kofa Complex are principally stabilized or semi-stabilized dunes with small areas of unvegetated, active dunes (Figures 7.1 and 7.2 depict a view of the habitat and vegetation on the Cibola Dunes on YPG). The mapped extent of this natural community within the Expanded Kofa Complex may also include some areas of Creosotebush-Big Galleta association.

There are three major Dune Complexes within the Expanded Kofa Complex: (1) the La Posa Dunes on the La Posa Plain in the northern portion of the Yuma Field Office on BLM land and the Gila River Indian Reservation, (2) relatively small, isolated dune patches on the western arm of Yuma Proving Ground near Cibola, hereafter referred to as the Cibola Dunes, and (3) a dune complex in the southwestern portion (Laguna Region) of the Yuma Proving Ground, hereafter referred to as the Laguna Dunes. Vegetation is dominated by big galleta grass and white bursage (Warren and Laurenzi 1987). Other characteristic species include creosotebush, ocotillo (*Fouqueria splendens*), forbs and grasses, long-leaved Mormon tea (*Ephedra trifurca*), white ratany (*Krameria grayi*), Emory dalea (*Psorothamnus emoryi*), and littleleaf ratany (*K. parvifolia*) (Warren and Laurenzi 1987, BLM 1997, YPG 1997, R. Oyler, pers. comm.).

Conservation Status and Regional Threats: Dunes account for approximately 29,000 acres (11,700 hectares) of the Expanded Kofa Complex. The dune natural communities within the Expanded Kofa Complex may be in different stages of stabilization and may have been formed or are currently maintained by different ecological processes. The Laguna and La Posa Dunes, located close to the Colorado River, may be situated on a relic beach terrace or old channel and the associated deposits left behind when the Colorado River changed its course (YPG 1997, V. Morrill, pers. comm.). In contrast, the Cibola Dunes are isolated remnants that likely represent sand deposited by wind or dust storms from the Colorado River or other sources of sandy soils (V. Morrill, pers. comm.). Some dunes of relatively small size may require outside sand inputs to maintain open, active dune areas (Hall and others 2001). The sources of sand and long-term dynamics of the Dune Complexes within the Expanded Kofa Complex are not well known. If cut off from their sand sources, dunes may become more stabilized over time resulting in changes to vegetation composition and structure, which could impact the distribution and abundance of dune-specialized fauna.

The main threat to Dune Complex natural communities in the Sonoran and Mojave Desert Ecoregions is off-road vehicle use (Hall and others 2001). Off-road vehicles eliminate vegetation by damaging shallow root systems and disturbing above-ground vegetation. Once vegetation is removed or disturbed by such activities, dunes are subject to extensive erosion (BLM 1997). Off-road vehicles and livestock may be vectors for introduction of invasive non-native plants, such as Sahara mustard (*Brassica tournefortii*). Invasive non-native plants alter vegetation composition and abundance. Invasive non-native plants can increase fine fuel loads on dunes and, under certain conditions, can increase fire frequency and intensity. Sahara mustard, in particular, can occur as dense stands and result in decreased movement of animals that are dependent on open, sparsely vegetated areas for movement and predator avoidance. Sahara mustard and Meditteranean grass (*Schismus barbatus*) are present at different levels of abundance and cover on the Dune Complexes within the Yuma Resource Management Area (Warren and Laurenzi 1987).

The La Posa Dunes are located close to Quartzsite and the La Posa Long Term Visitor Area (LTVA), an area of heavy recreational uses (BLM 1997; Figures 4.1, 6.1). Sahara mustard has been present on the La Posa Dunes for approximately ten years, and it has fueled a fire in the northern portion of the dunes (K. Reichhardt, pers. comm.). The Laguna Dunes are located on YPG on the main administrative area and the Mobility Test Area, where vehicles and other military equipment are evaluated (YPG 1997, Gutierrez-Palmenberg and Jason Associates 2001). The Cibola Dunes are more isolated than the other dune systems in the Expanded Kofa Complex. All three dunes systems on the Expanded Kofa Complex are found within the boundaries of the Cibola-Trigo Herd Management Area. The impacts of wild horse and burro grazing on these systems was not evaluated as part of this study.

Relative Importance of the Expanded Kofa Complex: The Dune Complexes within the Expanded Kofa Complex are comparatively small and stabilized dunes that, to our knowledge, lack the rare plants that are endemic to larger, active sand dune systems. However, these Dune Complexes represent a unique component of the biodiversity of the planning area that differs in its vegetation composition, structure, and function from the surrounding habitats. The Dune Complex natural community provides unique habitat for wildlife and other species. The La Posa and Laguna Dunes may be impacted by recreational and military uses, respectively. The Cibola Dunes are relatively intact and more isolated from anthropogenic disturbance. They are important because although smaller than the other systems in the planning area, they harbor a population of the Mojave fringe-toed lizard (*Uma scoparia*), a Wildlife of Special Concern in Arizona (AGFD 1996). The Mojave fringe-toed lizard was selected as a species conservation element and will be discussed in Chapter 8.

Mapping Comments: The Cibola and Laguna Dunes on YPG were mapped using Superstition-Rositas soil polygons (SCS 1991). Analysis of DOQQs or other information is needed to map the extent of the Cibola Dunes where they extend from YPG onto BLM land. The La Posa Dunes were digitized on screen using La Posa Planning Area Wildlife Habitat map (1:1,000,000; BLM 1997 p. 40) and Heritage data points for Mojave fringe-toed lizard (found on the La Posa Dunes outside of the Expanded Kofa Complex boundary), spiny sand spurge (*Stillingea spinulosa*), and scaly sand plant (*Pholisma arenarium*). The digitized polygon of the La Posa Dunes was revised based on information and hand-drawn revisions to the polygon (drawn at 1:200,000 scale) by Roger Oyler, Range Conservation Specialist at the BLM Yuma Field Office. Although the dune fields found throughout the Yuma Resource Management Area may have been formed and are likely maintained by different ecological processes, they are all currently mapped as the same natural community. More information on the similarities or differences in the composition, structure, and function of the Dune Complexes could help to refine their descriptions and their mapped distributions.

7.8 Mountain Upland

General Description: The Mountain Upland natural community is characterized by a unique assemblage of relic chaparral and woodland plants that occur at the highest elevations, north-facing slopes, and shaded canyons of some Sonoran and Mojave Desert mountains (Brown 1978). Characteristic plants may differ depending on the mountain range, but the most common associates (which are not necessarily present in all cases) include shrub live oak (*Quercus*

turbinella), one-seed juniper (*Juniperus monosperma*), and Arizona rosewood (*Vauquelinia californica*) (Brown 1978).

Within the Yuma Resource Management Area this natural community has been documented in the Kofa Mountains (Brown 1978). The GIS-modeled extent of this community (Figure 6.1) also shows smaller representations in the Castle Dome Mountains and the Eagletail Mountain Wilderness. The Eagletail Mountain Wilderness contains isolated stands of shrub live oak and juniper (BLM 1995), but Mountain Upland species are not verified to occur in the Castle Domes (R. Kearns, pers. comm.). The mapped extent of this natural community serves as a hypothesis and starting point from which to survey for small patches of this community in areas where it is not currently well-documented.

Characteristic Mountain Upland plant species that have been documented in the Kofa Mountains on north-facing slopes near Signal Peak and at lower elevations in some drainages include: shrub live oak, skunkbush (*Rhus trilobata*), Arizona rosewood, birchleaf mountain mahogany (*Cercocarpus montanus* [=*betuloides*]), and barberry (*Berberis spp*). (Brown 1978). However, aside from Brown's 1978 survey, Arizona rosewood and birchleaf mountain mahogany have not been documented in the Kofa Mountains and if they are indeed present, they are very rare (R. Kearns, pers. comm.). More common species that may be associated with the Mountain Upland natural community in the Kofa Mountains include the Kofa barberry (*Berberis harrisoniana*), crucifixion thorn (*Canotia holacantha*), and Bigelow's nolina (*Nolina bigelovii*) (R. Kearns, pers. comm.). Kofa barberry is a globally rare (G2) plant and a BLM Sensitive Species (BLM 2000) found as isolated populations on only a few mountains in the Sonoran Desert (NatureServe Explorer 2002). Crucifixion thorn (*C. holacantha*) is found in the Kofa Mountains on north-facing slopes and in the uplands (R. Kearns, pers. comm.). California fan palms (*Washingtonia filifera*) are restricted to several rugged canyons in the Kofa Mountains and are also associated with the Mountain Upland natural community. The California fan palm was selected as a species conservation element of the Expanded Kofa Complex and will be discussed in Chapter 8. Some north-facing slopes of the Mountain Upland community in the Kofa Mountains are characterized by high diversity and high vegetative cover and contain perennial grasses, desert willow, and mescat acacia (*Acacia constricta*) (K. Reichhardt, pers. comm.).

Additional fieldwork is needed to describe the composition and structure of the Mountain Upland natural community where it occurs in the Kofa Mountains and elsewhere in the Expanded Kofa Complex. Other species that may be associated with this natural community include:

- **Red barberry (*Mahonia* [=*Berberis*] *haematocarpa*).** Fairly common along drainages and canyons in the Kofa Mountains (such as Burro Canyon). It is found more extensively than Kofa barberry and may be a component of the Mountain Upland natural community however, it extends to lower elevations than shrub live oak (the species that was used to determine the lower elevation limit of the Mountain Upland community) (R. Kearns, pers. comm.).

- **Desert range almond (*Prunus fasciculata*).** Found in drainages (R. Kearns, pers. comm.)

- **Deer brier (*Ceanothus greggi*).** Occurs at higher elevations in the Kofa Mountains including on Signal Peak. This species is more common in the Tucson area (R. Kearns, pers. comm.).

- **Skunkbush sumac, (*Rhus trilobata* var. *anisophylla*).** Occurs in drainages and shady north-facing slopes. It is more rare than some other potential associates including crucifixion thorn and oak species. It is associated with jojoba along drainages (R. Kearns, pers. comm.).

- **Tobosa grass (*Pleuraphis mutica*)** and other perennial grasses on some north-facing slopes (K. Reichhardt, pers. comm.).

- **Ajo Mountain scrub oak (*Quercus ajoensis*)** has also been found in the Kofa Mountains (BLM and USFWS 1996) and may be an uncommon associate of this community.

The Mountain Upland natural community is being mapped and described for the Sand Tank and Table Top Mountains in the Sonoran Desert National Monument (Morrison and Snetsinger 2003). This work may help to develop and further refine the ecological description and mapping of this natural community as it occurs on other Sonoran Desert mountain ranges, including those within the Expanded Kofa Complex. A preliminary analysis of the Mountain Upland on the monument found that the best indicator plant for this community is crucifixion thorn (*Canotia holacantha*). Other common plants that are characteristic of this community as it occurs on the monument are: Mormon tea (*Ephedra spp.*), banana yucca (*Yucca baccata*), Parry's agave (*Agave parryi*), and perennial grasses including bush muhly (*Muhlenbergia porteri*), streambed bristle grass (*Setaria leucopila*), slim tridens (*Tridens muticus*), California crabgrass (*Digitaria californica*), and tobosa grass. A unique feature of the Mountain Upland community is the relatively high vegetative cover of perennial plants (mean cover of 60%), including extensive cover of perennial grasses (mean cover of 14%) (Morrison and Snetsinger 2003).

Conservation Status and Regional Threats: The Mountain Upland natural community has been documented on twenty two mountain ranges in the Sonoran and Mojave Deserts (Brown 1978). As we have modeled its extent, the Mountain Upland natural community covers approximately 23,800 acres (9,600 hectares) within the Expanded Kofa Complex, primarily within the Kofa Mountains. Mountain Upland communities are generally found in rugged, isolated areas that are not subject to many anthropogenic threats. The species associated with this natural community are relics from a cooler and wetter era in the desert. As the climate changed since the last ice age, these species have retreated to moist, cool refugia at the higher elevations and mountain canyons. One potential threat to this natural community is climate change, as many of the species associated with this natural community are at the limits of suitable habitat and a shift in climate may eliminate their remaining strongholds. Altered fire regimes is a potential threat to the persistence of Mountain Upland, including the occurrence in the Kofa Mountains (R. Kearns, pers. comm.).

Relative Importance of the Expanded Kofa Complex: This natural community is limited in its distribution and occurs in large to small patches on relatively few isolated mountaintops. The Kofa Mountains harbor a relatively extensive area of the Mountain Upland community, which

includes two unique and rare associated species, the California fan palm and Kofa Mountain barberry. The Expanded Kofa Complex may include other examples of this natural community that are yet undiscovered or not fully described in the Castle Dome and Eagletail Mountains.

Mapping Comments: The Mountain Upland natural community was mapped using a 30-meter DEM for areas on north facing slopes and above an elevation of 2800 feet (853 meters). This elevation break is based on the lowest elevation of shrub live oak occurrence in the Kofa Mountains (in Kofa Queen Canyon) (R. Kearns, pers. comm.). Brown (1978) reported that some characteristic Mountain Upland species occurred in some drainages in the Kofa Mountains as low as 975 meters elevation (3,199 feet)—an elevation higher than what was used to model the occurrence of this natural community. The model based on elevation and aspect was applied across the entire Yuma Planning Area and then refined where it was known to be incorrect—such as by removing a polygon for Mountain Upland in the New Water Mountains where it is not known to occur—based on input from BLM Yuma Field Office Staff (including B. Bowles, R. Morfin, R. Oyler, and K. Reichhardt). It should also be noted that Brown (1978) described relict chaparral/woodland species from the Harcuvar and Harquahala Mountains, just north of the Yuma Planning Area. However, we applied the modeling assumptions for mapping the extent of the Mountain Upland only to areas within the Yuma Planning Area. The Arizona Gap Program (1998) classified some of the higher elevation areas of the Harcuvars and Harquahalas as interior chaparral, displayed in Figure 6.1.

The mapped extent of the Mountain Upland natural community is a starting point and a hypothesis of where characteristic plant assemblages might be found. Because the model was based on the community's occurrence in the Kofa Mountains and then applied across the entire planning area, it may overestimate the extent of this natural community in some other mountain ranges. The model could be refined with a better description of the composition of these systems and distribution of their associated species and by applying the model separately based on the unique parameters for each mountain range.

7.9 Desert Tinaja/Spring

General Description: Tinajas and springs are small-patch aquatic habitats that are widely scattered in the Sonoran Desert. Tinajas are depressions in bedrock typically formed by the scouring action of boulders carried through the locale during infrequent flash floods. The duration of water retention in a tinaja depends on precipitation and the topographic position and dimensions of the tinaja (Broyles 1996). Tinajas are poorly known, biologically but are special wetland systems in the southwest. Vegetation is often sparse or absent at tinajas, but they may support local and distinctive populations of plants and animals (Minckley and Brown 1994). At higher elevations in Sonoran Desert mountains rainfall is transported underground via bedrock crevices, where it collects and flows slowly underground between rock strata. Springs and seeps form at points where canyons intersect groundwater, forcing it upwards from the underground rocks to the earth's surface where it collects in pools or flows as surface water.

Conservation Status and Regional Threats: Desert tinajas and springs are important water sources for desert wildlife. Many tinajas and springs in the Sonoran Desert are modified with features that help retain water for longer durations or make water more accessible to wildlife,

particularly large mammals such as desert bighorn sheep. The effect of water development on species abundance and distribution in the desert is not well understood. Studies of water quality and non-native bee distribution at water sources on YPG and surroundings are currently underway and will provide some insight into the consequences and effects of water development (Rosenstock and Rabe 2002). Modifications to tinajas and springs can be detrimental to non-targeted species. For example, some bats have difficulties drinking from waters that have covers placed above them (K. Hinman, pers. comm.). Alteration of the natural hydroperiod of tinajas and springs can result in altered amphibian population composition by shifting the competitive advantage to species that require longer duration surface waters, such as the Colorado River toad and Great Plains toad, (*Bufo alvarius* and *B. cognatus*) (Hall and others 2001).

Relative Importance of the Expanded Kofa Complex: The Expanded Kofa Complex is found in an arid region of the Sonoran Desert where there are limited water sources, including perennial and ephemeral springs and tinajas (Table 7.1). These water sources are critical in the life cycles of desert amphibians and aquatic invertebrates (Larsen and Olson 1997), and they provide seasonal drinking water for many other wildlife species including desert bighorn sheep, deer, bats, and many other mammals.

Mapping Comments: Springs and tinajas were mapped and characterized based on data that was provided to us by BLM, YPG, and Kofa Refuge staff. The available data likely underestimate the occurrence of natural tinajas (particularly smaller examples) within the planning area. Spring and tinaja locations were derived and spatially projected from a BLM range improvements spatial coverage (point file), YPG waters spreadsheet (including latitude/longitude data), and personal communication with BLM, YPG, and Kofa Refuge staff who identified springs and tinajas known to be missing from the other datasets. All spatial files were merged and duplicate points were removed. Attributes of some springs and tinajas, including modifications and water duration, were available in the BLM range improvement file and were updated or supplemented with detailed data for the larger tinajas and springs on the Kofa NWR (provided by S. Henry). Because attributes were not available for every spring and tinaja in the planning area, some information is lacking in Table 7.1 and in Figure 6.1, where tinajas and springs are mapped as “modified” or “unmodified or unclassified”. All data and attributes were merged into a single dataset (shapefile), which will be distributed to all partners in this project: the BLM Yuma Field Office, YPG, Kofa NWR, and AGFD. The tinaja and spring data will be useful for the agencies because it unites several different spatial datasets and attribute information into a single database, which can be revised or supplemented with additional information, as necessary.

7.10 Additional Natural Communities Considered as Conservation Elements

In addition to the natural communities described in this Chapter, several others were considered as potential conservation elements of the Expanded Kofa Complex. However, some of the necessary information to map or fully describe these communities was lacking at this time. With additional time and resources the following natural communities could be considered as conservation elements.

Rock Outcrop.—As described in the section on Paloverde-Mixed Cacti-Mixed Scrub natural community, rock outcrops provide shelter for numerous specialized species, including many Special Status Species. In some parts of the Sonoran Desert, rock outcrops are damaged by vandalism associated with recreational shooting and reptile collection. These disturbances cause permanent habitat destruction and localized impacts to rock dwelling species (Goode and others 1998). Rock outcrops have been mapped by the USGS National Land Cover Data (NLCD), but at a coarse scale that is not meaningful for this analysis. Rock outcrops are easily detected in digital orthophoto quadrants and could be mapped in the Expanded Kofa Complex at a scale appropriate for management and conservation in the future.

Desert Pavement.—Desert pavements form in the most arid parts of the Sonoran Desert, where annual rainfall is generally less than 200 mm average (8 inches). Desert pavements occur on low flat ridges separated by runnels. Desert pavement consists of a single layer of tightly packed pebbles and small stones, the surface of which is covered with a dark varnish. Extremely fine-grained soils of silt- and clay- sized particles are found beneathe the pavement surface (McAuliffe 1999). Perennial plants are often absent from these surfaces; instead the pavements support a sparse seasonal cover of ephemeral species (Turner and Brown 1994). Desert pavements on older, Pleistocene-aged alluvial fan deposits have significantly higher salt contents than other soil surfaces, which is thought to be a mechanism that prevents plants from occupying these surfaces (McAuliffe 1999). The tightly packed surfaces of desert pavement inhibit infiltration of precipitation and promote runoff, which funnels into the adjacent runnels (Turner and Brown 1994, McAuliffe 1999). These Pleistocene aged soil surfaces are extremely slow to recover from surface damage and erosion, such as those caused by road development and vehicle uses (Belnap and Warren 2002, Kade and Warren 2002). Desert pavements may play a key role in hydrologic function by transferring rainfall and surface runoff from a large area and funneling it to nearby xeroriparian channels where they support trees and other xeroriparian vegetation (Turner and Brown 1994). In conjunction with these fluvial areas, desert pavements form an integrated ecological system. Desert pavements could be mapped by their spectral characteristics from satellite imagery. Spatially-explicit land use information could identify areas where desert pavements are likely to be intact. Extensive examples of desert pavements occur on the Palomas Plain (BLM Yuma Field Office Staff, pers. comm.).

Creosotebush-Big Galleta Scrub.—The dunes mapped in the Expanded Kofa Complex are mostly semi-stabilized and are dominated by big galleta grass. The best representations of Creosotebush-Big Galleta Scrub is on sandy soils or sand sheets extending from the dunes—areas that, if present in the Expanded Kofa Complex, are likely mapped as Creosotebush-Bursage Desert Scrub. Creosotebush-Big Galleta Scrub is an important representation of the coarse filter because it has a distinct fauna associated with its characteristic sandy soils (Hall and others 2001). More information is needed to map this natural community in the Expanded Kofa Complex.

Mojave Desert Relicts.—Based on packrat midden analysis, Mojave desert vegetation flourished in southwestern Arizona at the end of the last ice age (40,000 to 20,000 years before present; YPG 1997). Species that were characteristic of this past climate remain on some north-facing slopes at higher elevations on the west arm of YPG (V. Morrill, pers. comm.). Some associated relict species may include bedstraw (*Galium stellatum*), turpentine broom

(*Thamnosma montana*), and Hall's shrubby-spurge (*Tetracoccus hallii*) (V. Morrill, pers. comm.), as well as Bigelow's nolina (*Nolina bigelovii*), and Mexican bladdersage (*Salazaria mexicana*) (YPG 1997). Additional information is needed to determine whether the Mojave relict species assemblage constitutes a unique natural community that is important for conservation and management. We also need additional information to describe the natural range in variation in composition and structure of these systems and how they could be mapped.

Mesquite Bosque.—Mesquite bosques are regionally vulnerable plant communities that are associated with xeroriparian or riparian systems. They are important habitat for many vertebrate species, including migratory birds. Extensive bosques were historically found throughout the desert southwest but many were destroyed by woodcutting, agricultural development, and hydrologic alterations (Minckley and Brown 1994). Scattered remnants of mesquite bosques occur in the Sonoran Desert, including within the Yuma Planning Area. Some bosques in the Yuma Planning Area are fairly extensive and contain large, old trees, including honey mesquite (*Prosopis glandulosa*) and screwbean mesquite, mixed with salt cedar (K. Reichhardt, pers. comm.). Presently, some mesquite bosques within the Expanded Kofa Complex may be included in areas mapped as Valley Xeroriparian Scrub or Braided Channel Floodplain natural communities. A starting point to look for and map mesquite bosques in the Yuma Planning Area would be from DOQQs. Areas to look for bosques include (1) south of the Gila River north and south of Interstate 8 near Dateland (a width of over two miles; personal observation), (2) within the Gila River Cultural ACEC, (3) scattered pockets from Wellton to Agua Caliente, and (4) along Tyson wash (V. Morrill and K. Reichhardt, pers. comm.).

Ranegras Plain/Upper Bouse Wash.—The mapped extent of this area shown in Figure 6.1 is based on Arizona Gap (1998) where it was classified as water. Soils were evaluated for their ability to refine the mapping of this area but were not included at this point in the analysis. This area is of interest to natural resource managers at the BLM Yuma Field Office, who provided us with additional information on the ecology of this area. The vegetation of this area includes extensive stands of mesquite, big galleta, salt cedar, and bush muhly (R. Oyler, pers. comm.). Vegetation occurs primarily on the outer edges of the floodplain and is clumped in places. The mapped extent of this system south of Interstate-10 may be dominated by sheet flow, which is funneled by the surrounding desert pavements. North of I-10 the system has been converted to agricultural uses and across Route 60 the system is incised and down-cut. The soils in the Upper Bouse Wash are sandy loams to clay loams and differ from the surrounding desert pavements that are gravelly and saline. The soils type of the Ranegras Plain is Estrella (soil class Typic torrifluvents, fine-loamy, mixed [calcareous] hyperthermic; SCS 1994). This is the same soil classification as the Valley Bottom Floodplain Complex (Growler Wash on the Goldwater Range; Hall and others 2001) and the Braided Channel Floodplain of the King Valley Wash. The Upper Bouse Wash has been altered in the past by spreader dikes that were constructed in 1961, 15 miles south near Coyote Peak, for the purpose of increasing forage production for livestock. Bermuda grass was planted but did not survive, but the dikes may have served to slow water flow (R. Oyler, pers. comm.). Additional information on the composition, structure, and function of the Upper Bouse Wash is required to determine if this is a distinct natural community in the Expanded Kofa Complex and if it should be included as part of the coarse filter.

Figure 7.1 Local-Scale View of Cibola Dunes on the Yuma Proving Ground
Plants in background are big galleta grass (*Pleuraphis rigida*) and white bursage (*Ambrosia dumosa*) (Photo by S.Weinstein)

Figure 7.2 Landscape view of Cibola Dunes on Yuma Proving Ground
(Photo by S. Weinstein)

Table 7.1 Tinajas and Springs in the Yuma Resource Management Area[1]

No.[2]	Name	Type	Developed or Natural (if known)	Water Duration
1	Airplane Tank	Tinaja		
2	Alamo Spring	Spring	Developed	Perennial
3	Arch Tank	Tinaja	Natural	Perennial
4	Bandy Tank	Tinaja		
5	Black Mesa Pothole	Tinaja		
6	Black Tanks	Tinaja	Developed	Ephemeral
7	Budweiser Spring	Spring	Developed	Ephemeral
8	Burnt Wagon Tank	Tinaja	Natural	Perennial
9	Chain Tank	Tinaja		Perennial
10	Charlie Died Tank	Tinaja		
11	Chuckwalla Tank	Tinaja	Developed	
12	Covered Well Spring	Spring	Developed	Perennial
13	Cripple Tank	Tinaja		
14	Dixon Spring	Spring	Developed	Ephemeral
15	Doc Carter Springs	Spring	Developed	
16	Drill Hole Tank	Tinaja	Natural	Ephemeral
17	Dripping Springs	Spring	Natural	
18	Figueroa Tank	Tinaja	Developed	Ephemeral
19	Frenchman Tank	Tinaja	Developed	Ephemeral
20	Gray Tanks	Tinaja		
21	Hanging Tank	Tinaja		
22	Hidden Valley Pothole	Tinaja		Ephemeral
23	Hidden Valley Tanks	Tinaja	Developed	
24	High Tank 2	Spring	Developed	Perennial
25	High Tank 3	Tinaja	Developed	Ephemeral
26	High Tank 6	Tinaja	Developed	Ephemeral
27	High Tank 7	Tinaja	Developed	Ephemeral
28	High Tank 8	Tinaja	Developed	Perennial
29	High Tank 9	Spring	Developed	Ephemeral
30	Hollow Rock Tank	Tinaja		
31	Holly Seep	Spring	Developed	Perennial
32	Horse Tanks	Tinaja	Developed	Perennial
33	Hummingbird Tank	Tinaja		
34	Indian Spring	Spring		
35	Indian Spring	Spring	Developed	Perennial
36	Jasper Spring	Spring	Developed	Perennial
37	Ladder Tanks	Tinaja		

[1] Sources: BLM Range waters GIS coverage, *ra_range_x*, with points added from YPG water developments, and attributes from Kofa NWR waters files.
[2] Tinajas and spring locations corresponding to these numbers are found in Figures 6.1 and 8.12.

No.[2]	Name	Type	Developed or Natural (if known)	Water Duration
38	Little Eye Tank	Tinaja		
39	Little White Tanks	Tinaja	Developed	Ephemeral
40	Mcpherson Tank	Tinaja	Developed	Ephemeral
41	Modesti Tank	Tinaja	Developed	Ephemeral
42	Mohave Tank	Tinaja	Developed	
43	Moonshine Tank	Tinaja	Developed	Ephemeral
44	Needles Eye	Tinaja		
45	Raven Tank	Tinaja	Natural	Ephemeral
46	Red Hill Tank	Tinaja	Developed	Ephemeral
47	Robin Tank	Tinaja	Natural	Ephemeral
48	Socket Tank	Tinaja	Developed	
49	Squaw Tanks	Tinaja	Developed	Ephemeral
50	Tinaja Seca	Tinaja		
51	Towhee Tank	Tinaja	Natural	Ephemeral
52	Trigo Tinajas	Tinaja		
53	Tule Springs	Tinaja		
54	Tunnel Mine Canyon Spring	Spring		Ephemeral
55	Tunnel Spring	Spring	Developed	Perennial
56	White Tanks	Tinaja		
57	Wilkerson Seep	Spring	Developed	Ephemeral
58	Willow Spring	Spring	Developed	Ephemeral
59	Yaqui Tanks	Tinaja	Developed	Ephemeral

CHAPTER 8
CONSERVATION ELEMENT STATUS: SPECIES

A total of seventeen species (five species and three species guilds) were selected as conservation elements of the Expanded Kofa Complex. Descriptions of each conservation element are provided below, including justification for why the species or guild was selected, their conservation status and regional threats, the relative importance of the Expanded Kofa Complex in the conservation of the element, and any additional information needs. Definitions of fine-filter selection criteria are presented in Table 2.1.

8.1 California Fan Palm (*Washingtonia filifera*)

Selection Criteria: *Specialized Species.*
Although the California fan palm is an associate of the Mountain Upland community in the Kofa Mountains, it may require additional management attention because the population has insufficient recruitment (R. Kearns, pers. comm.). This species may also be considered regionally vulnerable within Arizona, but populations are secure in California.

Conservation Status and Regional Threats: The California fan palm is a narrowly distributed endemic within the Sonoran Desert Ecoregion. It is native to southeastern California, southwestern Arizona, and northern Baja California where it may be uncommon but locally abundant in groves, seeps, springs, or moist canyons below 1200 meters (3937 feet) elevation with available groundwater (Hickman 1993). The fan palm has a Global Rank of G4; populations are apparently secure in California (State Rank S4), but are rare (S1) in Arizona (NatureServe Explorer 2002). California fan palms are common landscape plants that are naturalized in Florida and in Death Valley National Park, California, and are cultivated in Bolivia (NatureServe Explorer 2002).

In Arizona, naturally occurring fan palm groves are thought to exist only in several rugged canyons in the Kofa Mountains on Kofa National Wildlife Refuge (Palm Canyon, Fishtail Canyon, and Four Palms Canyon) (Figure 8.1), and on Alkali Springs near Castle Creek, southern Yavapai County (Brown and others 1976). This latter site is likely the Type Locality described in the 1870s and the seed source for nursery plants in Europe (Miller 1983). California fan palms are also abundant and productive at Palm Lake, the site of what once was a spring-fed cienega along the Hassayampa River south of Wickenberg. However, according to pollen analysis, this palm population is considered to be of recent arrival (less than 100 years), and may be encroaching upon habitat that would otherwise be occupied by cottonwood, willow, or mesquite (TNC 1998). Palm localities in the Kofa Mountains are displayed in Figure 6.1.

The California fan palm population in the Kofa Mountains does not have adequate recruitment from the seedling to juvenile stage. There are numerous adult palms and subadults to approximately three meters (ten feet) in height, and numerous seedlings are produced but very few survive to reach the sub-adult life stage (Kearns 2001). The causes of insufficient recruitment are not known. Historically, palm groves may have been maintained by Native Americans who burned them periodically (Cornett 1987), causing increased seed production (Cornett and Stewart 1986). This palm depends on adequate ground or surface water resources,

so any hydrological changes resulting in a loss of water availability could threaten the viability of the populations.

Relative Importance of the Expanded Kofa Complex: The population in the Kofa Mountains has been thought by some botanists to be unique due to its habit of "self-pruning" its petticoat of dead leaf fronds (Kearney and Peebles 1973), however many palms do in fact retain their dead leaf fronds and others have been removed by fire (Miller 1983). The Expanded Kofa Complex is significant in that it is one only two localities in Arizona where naturally occurring California fan palms are found.

8.2 Ephemeral Water-Breeding Amphibian Guild

This guild includes all four native anurans that are known to breed within the Expanded Kofa Complex: Colorado River toad (*Bufo alvarius*), Great Plains toad (*Bufo cognatus*), red spotted toad (*Bufo punctatus*), and Couch's spadefoot (*Scaphiopus couchii*)[1].

Selection Criteria: *Specialist Species*.
The species in the ephemeral water-breeding amphibian guild are suitable conservation elements because they are specialized species that rely on scarce surface waters to reproduce and complete the larval stage of development. The coarse filter alone does not capture the guild because each species uses adjacent natural communities during other parts of its life cycle. Each of the four species has certain terrestrial and aquatic habitat preferences and potential competitive interactions exist between the species depending on surface water characteristics (such as water duration). As such, the species are best managed as a guild because a focus on one species may not meet the needs of the others or could even be counterproductive. The ephemeral water-breeding amphibian guild was also selected as a conservation element of the Goldwater Range (Hall and others 2001) and the Sonoran Desert National Monument (Weinstein and others 2002). For the Goldwater Range, the only amphibian initially considered as a conservation element was the Colorado River toad because it is endemic to the Sonoran Desert and was a conservation element at the ecoregion-scale (Marshall and others 2000). The guild was subsequently expanded to include other native anurans, primarily based on input from herpetologist Dr. Philip Rosen, which was corroborated with information from the current scientific literature.

Conservation Status and Regional Threats: Amphibians are in a global decline due to numerous potential causes (USGS 2003); the status of desert anurans is not well known because long-term monitoring has not taken place. Threats to the species in the ephemeral water-breeding amphibian guild are not well documented, however vehicular traffic on highways and other paved roads can be a cause of adult mortality with significant local impacts. Competitive displacement due to interactions with other species in the guild and non-native bullfrogs (*Rana catesbeiana*) can alter population structure. Chytrid fungus has caused mortality and declines of many amphibian populations, particularly Ranid frogs (Sredl and others 2003). No population declines due to chytrid fungus have been noted in Arizona's true toads (family Bufonidae) or spadefoots (family Pelobatidae), however the fungus has been confirmed in red-spotted toads (Sredl and others 2003).

[1] We generally conform to Crother (2000) for the scientific and common nomenclature of reptiles and amphibians in this report.

Targeted surveys for the species in this guild have not been done within the Expanded Kofa Complex, but they are expected to breed in the numerous water sources found throughout the area (Figure 6.1, Table 7.1). The relative abundance of each species in the guild may depend on the characteristics of the habitat, including the type of water source (tinaja, spring, tank, reservoir, or other source) and if the source is natural or modified, the ecological attributes of the surrounding habitat, and the composition of the other anuran species present at the water source. Interspecific interactions and competitive displacement between species in the guild can potentially alter the population structure of these species. Couch's spadefoot has a brief larval stage and may outcompete other species at ephemeral water sources, but may be subject to increased predation rates at permanent pools (Woodward 1983). In contrast, the Great Plains toad and Colorado River toads have longer larval development times, so they do well in longer-lived water sources and have likely benefited from artificial water developments in the desert (Hall and others 2001).

Relative Importance of the Expanded Kofa Complex: Although the Expanded Kofa Complex is a large desert landscape with scarce water resources, the area includes a number of natural water sources—ephemeral and permanent springs and tinajas—in addition to numerous artificial sources such as tanks and catchments, which provide necessary breeding habitat for desert anurans. No formal monitoring of these desert anurans has taken place within the Yuma Planning Area, so baseline information on presence and abundance is needed. The Upper Bouse Wash in the Ranegras Plain is the site of ephemeral pools that form after rains (R. Oyler, pers. comm.). The Upper Bouse Wash is distinct from other parts of the Yuma Planning Area—with extensive areas of big galleta and mesquite—and might also be the breeding site of the species in this guild.

8.3 Mojave Fringe-Toed Lizard (*Uma scoparia*)

Selection Criteria: *Specialized Species.*
The Mojave fringe-toed lizard is restricted to areas of fine, loose, windblown sands of flats and active and semi-stabilized sand dunes in portions of the Mojave and Sonoran Deserts in California and Arizona (Stebbins 1985, NatureServe Explorer 2002). A population of Cowles fringe-toed lizards (*Uma notata rufopunctata*), a close relative of the Mojave fringe-toed lizard, is found on the Mohawk Dunes on the Goldwater Range and is geographically isolated from the rest of its population in the Gran Desierto. This species is considered regionally vulnerable and the Mohawk Dunes population is thought represent a distinct genetic unit (Hall and others 2001). Likewise, the Mojave fringe-toed lizard has a very narrow distribution and occurs in widely separated geographically isolated habitats. The taxonomy of this species is debated (NatureServe Explorer 2002) so like the Cowles fringe-toed lizard, it is possible that this species may also have unique genetic varieties.

Conservation Status and Regional Threats: The Mojave fringe-toed lizard is restricted to the Mojave Desert, California and extreme western Yuma County, Arizona (Stebbins 1985). A new occurrence and range extension for this species was found on the Cibola Dunes on Yuma Proving Ground (Palmer 1986), but subsequent fieldwork in the area did not turn up additional sightings of the lizards (V. Morrill, pers. comm.). The population of Mojave fringe-toed lizards

was confirmed in May 2003 in a field reconnaissance specifically undertaken to search for the species (undertaken by YPG biologists Randy English and Tim Green and Conservancy staff, Dale Turner and Stephanie Weinstein). Five lizards were sighted on the Cibola Dunes and a juvenile male was collected to document the record with the Heritage Program. The specimen is now located in the Herpetology Collection at the University of Arizona in Tucson. Photographs were taken of the Mojave fringe-toed lizard (Figures 8.2 and 8.3) and its habitat on the Cibola Dunes (Figures 7.1 and 7.2).

The Mojave fringe-toed lizard is also documented on the La Posa Dunes (on a portion outside the Yuma Planning Area) and on the Bouse Dunes in the BLM Lake Havasu Field Office (HDMS 2003). Suitable habitat for the lizards is found on the other dune systems within the Expanded Kofa Complex; however, Mojave fringe-toed lizards were not found in surveys on the Laguna Dunes (Palmer 1986) and the portion of the La Posa Dunes within the Yuma Planning Area has not been surveyed extensively (R. Oyler, pers. comm.).

The Mojave fringe-toed lizard is not considered threatened, with an estimated total global population in the thousands (Combined Global Rank of G3, State ranks of S2S3 in Arizona and California; NatureServe Explorer 2002). However, population trends are unknown (NatureServe Explorer 2002). The lizard is threatened along the Colorado River by conversion of habitat to agriculture and wind-drift of pesticides, and in other regions it is threatened by habitat disturbance from off-road vehicles, mining, and grazing (AGFD 1996). Infestations of invasive non-native plants such as Sahara mustard potentially degrade fringe-toed lizard habitat because they require open, sandy areas for foraging and predator avoidance ("sand-swimming"). Sahara mustard is present (and abundant in some areas) on the dune systems within the Expanded Kofa Complex. Another potential threat to the persistence of Mojave fringe-toed lizards is long-term habitat loss due to a lack of sand sources required to maintain their sparsely vegetated open dune habitat. Sand dune dynamics are not well-understood for the dunes in the Yuma Planning Area. If sand inputs are (or become) reduced or lost, dunes will become more vegetated and stabilized over time.

Relative Importance of the Expanded Kofa Complex: This species is specialized and is found in few localities within a narrow distribution. If present on the La Posa and Laguna Dunes, populations may be vulnerable to habitat disturbance due to off-road vehicle use in these areas (by recreationists on BLM land and military activities on YPG). The population on the Cibola Dunes represents an expansion of the formerly known range of the lizard (Stebbins 1985). This population is free from many of the threats impacting this species in other areas due to their isolation and restricted public access. These dunes also seem to have low cover of invasive non-native plants. This area should be protected from incompatible military activities that could affect the lizards and dune habitat.

8.4 Desert Tortoise (*Gopherus agassizii*)

Selection Criteria: *Regionally Vulnerable.*
The Mojave Desert population of desert tortoise is federal listed as Threatened. Desert tortoise populations in the Sonoran Desert have no legal federal protection, but the species is thought to

be vulnerable and declining over much of its range because of habitat loss and degradation, habitat fragmentation, and genetic contamination (AGFD 1996).

Conservation Status and Regional Threats: Desert tortoises are found in the Mojave and Sonoran Deserts in California, Nevada, Utah, and Arizona. In the Sonoran Desert tortoise habitat is primarily on the rocky slopes and bajadas of mountain ranges, principally on public lands. There are many groups and individuals that are active in desert tortoise conservation and research in Arizona. A consortium of biologists and government agencies, the Arizona Interagency Desert Tortoise Team (AIDTT), has united to conduct and coordinate research and management efforts to conserve the species and prevent habitat loss and degradation (AIDTT 1996). The Arizona Game and Fish Department classifies desert tortoise as Wildlife of Special Concern in Arizona (1996). There are numerous threats to desert tortoise populations in the Sonoran Desert. Although primarily found on bouldery slopes and bajadas, tortoise will also occasionally travel long-distances and traverse desert valleys in dispersal events. As a result, tortoises are vulnerable to habitat fragmentation that prevents movement between ranges (Edwards and others 2002, Howland and Rorabaugh 2002). Some tortoise habitat has been lost or severely degraded due to urban expansion in the Phoenix and Tucson areas. Other parts of their range have been impacted by livestock grazing, which has caused habitat degradation and competition with livestock for preferred forage (Grover and DeFalco 1995). Other threats to desert tortoise include collection of wild individuals, genetic contamination or disease due to release of pets into wild populations (Howland and Rorabaugh 2002), mortality from wildfires often spread by invasive non-native plants (Esque and others 2002), and mortality from collisions with vehicles on roads. Prolonged drought can cause population crashes (Wirt and Holm 1997) and, though tortoise have certainly confronted drought in the desert throughout their history, populations may be extremely slow to rebound not only because tortoise are extremely long-lived animals, but also because habitat fragmentation may impede recolonization from source populations.

The BLM has a disproportionate responsibility for the conservation of desert tortoise because the agency manages the majority of desert tortoise habitat across the species' entire range (BLM 1988). To address their management responsibilities, the BLM has developed a management plan for desert tortoise on public lands (BLM 1988) and a strategy for carrying out the plan in Arizona (BLM 1990). The BLM characterizes tortoise habitat on their managed lands into three categories according to the following criteria: (1) importance of the habitat to maintaining viable populations, (2) resolvability of management conflicts, (3) desert tortoise density, and (4) population status (increasing, stable or decreasing) (BLM 1988, BLM 1990). The goal of BLM is to maintain viable desert tortoise populations in Category 1 and 2 habitats and to limit population declines to the extent possible in Category 3 habitats.

The Expanded Kofa Complex has many low desert mountain ranges that provide habitat for desert tortoise (Figure 8.4). The 507,794 acres (205,498 hectares) within the Yuma Planning Area categorized as tortoise habitat by the BLM is divided almost evenly between Category 2 and 3 habitat (BLM 1990, Table 8.1). There are no areas designated as Category 1 tortoise habitat within the Yuma Planning Area. BLM only categorizes tortoise habitat on lands that they manage. A model of tortoise habitat produced by the Arizona Gap Program reveals that large portions of YPG and the Kofa Refuge also contain desert tortoise habitat and tortoise occurrence

data support the model in most mountain ranges (Figure 8.4). Because desert tortoise habitat spans the administrative boundaries of YPG, BLM, and the Kofa Refuge (Figure 8.4), tortoise would likely benefit from a coordinated management approach between these agencies.

Table 8.1 Area of Desert Tortoise Habitat in the BLM Yuma Resource Management Area (BLM 1990).

Category	Acres	Hectares	Percent
1	0	0	0
2	238,737	96,614	47
3	269,057	108,884	53
Total	507,794	205,498	100

Desert tortoise populations in the Yuma Planning Area are at low densities and are patchily distributed in appropriate habitat where their abundance and distribution is limited by sheltersite availability due to the extreme heat and aridity of this region (Averill-Murray and others 2002). Desert tortoises have been documented from YPG in the Tank Mountains, Palomas Mountains, Chocolate Mountains, and Middle Mountains based on tracks, skeletal remains, and a few live individuals (Palmer 1986). Tortoise populations may occur in other areas on YPG, but due to poor habitat quality they are likely found at low densities. Surveys for desert tortoise conducted in the Kofa Mountains (in 1979, 1989, and 1990) indicate a stable, low-density population that has its greatest potential in areas with volcanic soils that provide more abundant sheltersites (BLM and USFWS 1996).

Relative Importance of the Expanded Kofa Complex: The Expanded Kofa Complex represents an area where desert tortoise populations persist at low densities where individuals are on the edge of their physiological limits due to the high temperatures and low rainfall characteristic of the region. The region therefore may represent an area containing unique genotypes that enable individuals to adapt to life under these extreme conditions. Little is known about desert tortoise populations at this climatic extreme, so the area provides an opportunity for long-term monitoring and research. The planning area is also important because it is largely free from the impacts of cattle grazing, which is absent from YPG and Kofa NWR and is largely absent from BLM land (USFWS 1981, BLM 1997). Some tortoise habitat, however, may be impacted by wild horse and burro grazing, particularly in the western portion of the Yuma Planning Area (Figure 8.4).

8.5 Primary Excavator (Cavity) Guild

This guild is composed of the gilded flicker (*Colaptes chrysoides*), the Gila woodpecker (*Melanerpes uropygialis*), and ladder-backed woodpecker (*Picoides scalaris*).

Selection Criteria: *Keystone Species, Specialized Species.*
The Primary Excavator (Cavity) Guild was selected as a conservation element because the woodpeckers in the guild have specialized needs for nesting sites and they serve as keystone

species by creating cavities in saguaro and desert trees that are used as nest sites by numerous other cavity-nesting birds, including some neotropical migrants. The woodpeckers are best treated as a guild because each species has a preferred nest excavation site and constructs cavities that differ in their dimensions, which are in turn preferred by different secondary nesting species (Hall and others 2001). This guild was also selected as a conservation element on the Goldwater Range (Hall and others 2001) and the Sonoran Desert National Monument (Weinstein and others 2002).

Conservation Status and Regional Threats: The three woodpeckers that form the guild have Global Ranks of G5 indicating that their global populations are demonstrably secure. Saguaro cactus density declines from east to west along a precipitation gradient in the Sonoran Desert. As a result, saguaros are largely restricted to xeroriparian areas in the most arid, western regions of the Sonoran Desert, including portions of the Yuma Planning Area. As revealed by Breeding Bird surveys in Arizona, woodpecker density and abundance declines along a similar gradient (Figures 8.5-8.7). Both the Gila woodpecker and gilded flicker have been State listed Endangered in California since 1988 (CDFG 2003). Saguaros are scarce in California and as a result, the Gila woodpecker and gilded flicker are primarily found along the Colorado River, where they excavate cavities primarily in snags and mature trees in cottonwood-willow riparian forests (Hunter 1984). The gilded flicker is endemic to the Sonoran Desert Ecoregion and is designated a priority species in the Arizona Partners in Flight Bird Conservation Plan (Latta and others 1999). Both the gilded flicker and the Gila woodpecker are thought to require additional management attention and are considered Birds of Conservation Concern by the U.S. Fish and Wildlife Service (USFWS 2002). The Expanded Kofa Complex includes numerous mountain ranges and large areas of Paloverde-Mixed Cacti-Mixed Scrub on Bajadas and Rocky Slopes (Figure 6.1), where all three woodpeckers have been found in many of the Breeding Bird Atlas Survey Blocks (ABBA 2001, Figures 8.5-8.7). Woodpecker abundance is high in many of the blocks (ABBA 2001, Figures 8.5-8.7). Most of the secondary cavity-nesting species also are known to breed within the Yuma Planning Area (Table 8.2).

The main threat to the woodpeckers species is habitat loss, including urban and agricultural development, as well as any activity that negatively affects saguaro recruitment, such as livestock grazing (Abouhaidar 1992). The European starling (*Sturnus vulgaris*) is an invasive non-native, secondary cavity-nesting species that can potentially outcompete other saguaro cavity nesters for nest sites (Hunter 1984, Kerpez and Smith 1990). In the Yuma Planning Area, starlings are mostly associated with agricultural areas along the Gila and Colorado Rivers, but they have also been confirmed breeding at scattered localities within the Expanded Kofa Complex (Figures 8.8, 8.9). Starlings may be a growing threat as a competitor for nest sites with both the primary and secondary cavity-nesters, due to the growth of Yuma and increased conversion of the landscape in the desert surroundings to agriculture and residential development.

Relative Importance of the Expanded Kofa Complex: The Expanded Kofa Complex includes areas where saguaro and desert trees are found at low densities. Although the region has lower abundance of the woodpeckers in comparison to more mesic, eastern portions of the Sonoran Desert, all three species occur throughout the Expanded Kofa Complex. The woodpecker guild

is particularly important in this area to create cavities that provide habitat for other cavity-nesting species that may be on the edge of their distributions in the Sonoran Desert.
.

8.6 Le Conte's Thrasher (*Toxostoma lecontei*)

Selection Criteria: *Specialized Species, Regionally Vulnerable.*
Le Conte's thrasher was selected as a conservation element because it is an uncommon resident with a spotty distribution within the Mojave and Sonoran Deserts. It is one of the few birds that is closely associated with the sparsely vegetated, arid desert valley bottoms characteristic of the Lower Colorado River Valley Subdivision of the Sonoran Desert. Le Conte's thrasher is considered regionally vulnerable because much of its preferred habitat (Saltbush Desert Scrub) has been lost to agricultural development and the thrasher's current status in Creosotebush-Bursage Desert Scrub is not well documented. Le Conte's thrasher was selected as a conservation element of the Goldwater Range (Hall and others 2001) and the Sonoran Desert National Monument (Weinstein and others 2002, 2003).

Conservation Status and Regional Threats: Le Conte's thrasher has a Global Rank of G3, indicating that it is rather rare throughout a fairly wide range. Le Conte's thrasher is being tracked by numerous organizations and agencies that are concerned about its status. Le Conte's thrasher is a priority species in the Arizona Partners in Flight Bird Conservation Plan (Latta and others 1999) and is designated a Bird of Conservation Concern (USFWS 2002). In California, Le Conte's thrasher and its habitat are disturbed by off-road vehicle use. As a result, Le Conte's thrasher is listed as a Species of Special Concern by the California Department of Fish and Game (Remsen 1978). Le Conte's thrashers are breeding in numerous Breeding Bird Atlas survey blocks within the Expanded Kofa Complex (Figure 8.10), and are also known to breed in the northeastern portion of the Kofa Refuge (R. Kearns, pers. comm.). This species likely breeds within additional Breeding Bird Atlas survey blocks where they were not documented, given that survey methods don't easily detect Le Conte's thrasher (R. Kearns, pers. comm.).

The main threat to Le Conte's thrasher is habitat degradation and loss. Some of its former habitat, particularly saltbush along the Gila River, has been lost due to conversion to agriculture. Urban development in desert valley bottoms is a current threat in many parts of the range of Le Conte's thrasher. Habitat may also be degraded by off-road vehicle use, fires carried by invasive non-native species, and livestock grazing (Sheppard 1996). Pesticide drift could potentially affect the abundance of the thrasher's prey (primarily invertebrates), but this has not been researched. The Expanded Kofa Complex is in the vicinity of extensive agricultural areas along the Colorado and Gila Rivers in Yuma County, where pesticide applications are likely to be high.

Relative Importance of the Expanded Kofa Complex: The most important area in Arizona for this species appears to be on the Goldwater Range (Figure 8.11; Hall and others 2001). However, the Expanded Kofa Complex also includes large expanses of potential habitat as well as some Breeding Bird Blocks with confirmed breeding pairs (Figure 8.10). The Yuma Planning Area also contains some saltbush habitat along the Gila River (K. Reichhardt, pers. comm.), which may be occupied by Le Conte's thrasher.

8.7 Bat Guild

The bat guild for the Expanded Kofa Complex includes the following five species:

- Pale Townsend's big-eared bat, *Corynorhinus townsendii pallescens*
- California leaf-nosed bat, *Macrotus californicus*
- Cave myotis, *Myotis velifer*
- Pocketed free-tailed bat, *Nyctinomops femorosaccus*
- Mexican free-tailed bat, *Tadarida brasiliensis*

Selection Criteria: *Specialized Species*.
The bats selected as conservation elements for the Expanded Kofa Complex are those that (1) are found abundantly in the area or (2) are species that are regionally vulnerable and for which the Expanded Kofa Complex may represent an important part of their distribution and conservation. Bats are appropriate fine-filter conservation elements because they rely on specialized habitats for roost sites not captured by a coarse filter approach, including caves, mines, and rock crevices. Bats also require other habitats, such as washes and water sources, for foraging. Bats that roost in large colonies are particularly vulnerable to disturbance and may require special management attention that is not afforded by protecting their habitat alone. Many bats are seasonal or long-distance migrants that face different threats or have specialized habitat needs in different parts of their range.

Twenty-two of Arizona's twenty-eight bat species are found or are expected to occur within the Yuma Planning Area (Table 8.3). Each of these species was evaluated as a potential conservation element of the Expanded Kofa Complex. Some of the twenty-two species were eliminated as fine filter conservation elements, because they only are known from areas outside the Expanded Kofa Complex such as on Cabeza Prieta National Wildlife Refuge, or on the Barry M. Goldwater Range (for example, the lesser long-nosed bat and Mexican long-tongued bat). Although other species are found or expected to occur within the Expanded Kofa Complex, they were not selected as guild members because (1) they are not abundant in the Expanded Kofa Complex, (for example, species that are on the edge of their distribution in southwestern Arizona or those that are primarily associated with the Colorado River and not the core desert area of the Expanded Kofa Complex) and/or (2) because their management needs are likely fulfilled by meeting the needs of the other species that were selected as part of the guild. Table 8.3 provides occurrence and ecological information on all twenty-two bat species that are known or likely to occur in the Yuma Planning Area.

Conservation Status and Regional Threats:
Bats are the second most speciose group of mammals after rodents. Bats play important ecological roles as pollinators, seed dispersers, and in controlling insect populations. Bats also face numerous threats and are generally not valued by the public at large. Groups such as Bat Conservation International (BCI) conduct bat research throughout the world and work to help educate the public about the importance of bats and the threats that they face. In 1999, BCI brought together a coalition of government agencies, conservation groups, and the academic community together to address bat conservation issues, forming the North American Bat Conservation Partnership. Out of this partnership grew other collaborations specifically focused

on bats in western North America. The Western Bat Working Group (WBWG) facilitates communication on bat ecology and conservation between 20 U.S. States and Canadian Provinces and includes the Arizona Bat Resource Group. The Nongame Branch of the Arizona Game and Fish Department supported the development of the Arizona Bat Conservation Partnership, which is a collaboration between AGFD and many other agencies and organizations to coordinate research and bat conservation efforts in the state. This group has issued a strategic plan to guide bat conservation in the state and direct efforts on bat research, inventory and monitoring, management, and education (Hinman and Snow 2003).

The Western Bat Working Group (WBWG) offers a wealth of information on current bat research and the conservation status of bats in the western United States. The Working Group has developed a Regional Bat Species Priority Matrix, which is a system of categorizing the conservation status of bats throughout their range in western North America. The goal of the Priority Matrix is to help governments and organizations prioritize bat research, management, and conservation. The Priority Matrix ranks the status of a species within each ecoregions in which it occurs throughout its distribution in the west (WBWG 1998)

The Priority Matrix ranking scheme has three levels:

(1) **Red or High**: Species at high risk of imperilment based on available information on distribution, status, ecology, and threats
(2) **Yellow or Medium:** Species for which there is some conservation concern, particularly due to a lack information to fully evaluate the species' status and threats
(3) **Green or Low:** Species that have stable populations and that are unlikely to have status changes in the near future. Localized concerns may exist for these species, but the overall status is believed to be secure.
(WBWG 1998)

The conservation status of the six species in the bat guild, including the WBWG Priority Matrix Ranks, are discussed below. Additional information on these species and the sixteen other species of bats that were not selected as conservation elements is found in Table 8.3.

Pale Townsend's big-eared bat—This bat is ranked High by WBWG and has a Global Rank of G4. This is the most widespread of the four subspecies of *Corynorhinus townsendii* (NatureServe Explorer 2002). It is distributed across western North America from British Columbia to southern Mexico and in isolated populations in the Ozark and Appalachian Mountains (Hinman and Snow 2003). This bat is uncommon in Arizona and in the deserts of the Southwest. It summers throughout Arizona but is a local migrant known mostly from south of the Mogollon Rim and northwestern Mohave county in winter where it hibernates in cold caves, mines, and mountain uplands (Hinman and Snow 2003). It is known within the Expanded Kofa Complex from one element occurrence in Burro Canyon on the Kofa Refuge (HDMS 2003). The Pale Townsend's big-eared bat has been mist netted at tanks and is known to use mines on the Kofa Refuge (Snow 1998). This species is uncommon throughout its widespread distribution, and its presence within the planning area is significant. Maternity colonies are easily disturbed and disturbance results in abandonment (Hinman and Snow 2003). More than half of the known maternity colonies in Arizona have more than 200 bats (YPG 1997). Pale

Townsend's big-eared bats may be more common than what is currently known within the Yuma Planning Area because they are slow fliers that are able to avoid mist nets and as a result, may not be detected in survey efforts (Castner and others 1995).

California leaf-nosed bat— This bat is ranked High by WBWG and has a Global Rank of G4. It is also classified as Wildlife of Special Concern in Arizona (AGFD 1996). The California leaf-nosed bat is distributed in southern California, southern Nevada, southwestern Arizona, to southern Baja California, northern Sinaloa, and southwestern Chihuahua, Mexico (AGFD 2001). In Arizona, the California leaf-nosed bat is generally found below the Mogollon Rim at elevations below 1222 meters (4009 feet) and is a year-round resident in the Sonoran Desert (Hinman and Snow 2003). This species does not hibernate and requires warm mines or caves as roost sites. California leaf-nosed bats cannot survive exposure to temperatures below freezing for an extended period of time (AGFD 2001). California leaf-nosed bats have been found throughout the Expanded Kofa Complex on land managed by the BLM, YPG, and the USFWS at the Kofa Refuge (HDMS 2003). There are three roosts on the Kofa Refuge that have more than 250 individuals (Snow 1998) and roosting colonies are also known from YPG (Castner and others 1995). California leaf-nosed bats have been documented from BLM land in Expanded Kofa Complex in the Dome Rock Mountains near Quartzsite, at Mittry Lake, and south of YPG in the Laguna Mountains (HDMS 2003). One California leaf-nosed bat colony is found in a mine on a private inholding in the Kofa Refuge and requires immediate management attention because it is frequently disturbed by human activities in and surrounding the mine (S. Henry and R. Kearns, pers. comm.).

Cave myotis— Cave myotis is a BLM sensitive species that is ranked Medium by WBWG and has a Global Rank of G5. This species is migratory and leaves the low desert in the fall to hibernate in cold, moist mines or caves at higher elevations. During the warmer months it is known from roosting colonies in the Expanded Kofa Complex on BLM land in the Dome Rock Mountains and on YPG in the Trigo Mountains (HDMS 2003). It has also been found along the Colorado River. Cave myotis roost in caves, mines, and under bridges, often in association with other bats including California leaf-nosed bats, Brazilian free-tailed bats, and/or Yuma myotis (Hinman and Snow 2003).

Pocketed free-tailed bat— This bat is a BLM sensitive species that is ranked Medium by WBWG and has a Global Rank of G4. The Pocketed free-tailed bat is migratory to Mexico. Like other free-tailed bats, this species has a long flight path and is less maneuverable than other bats so may not readily accept bat gates. Pocketed free-tailed bats are very noisy during the day and may draw attention to their roost sites, making them particularly vulnerable to disturbance (Hinman and Snow 2003). They are known to occur on the west arm of YPG in the Laguna Mountains and near Mittry Lake (Castner and others 1995, HDMS 2003). This species was a conservation element for the Sonoran Desert Ecoregion (Marshall and others 2000) that occurred in conservation areas #12 (Kofa Complex) and #13 (Organ Pipe/Goldwater/Pinacate Complex) (Figure 3.3).

Mexican free-tailed bat— This bat is ranked Low by WBWG and has a Global Rank of G5. The Mexican free-tailed bat is widespread from southern Oregon, southwestern U.S., and the southeastern U.S., to Mexico, Central America, the Caribbean, and South America (Hinman and

Snow 2003). It is found throughout Arizona in the summer and in lesser numbers in southern Arizona in the winter (Hinman and Snow 2003). Mexican free-tailed bats are generally considered migratory. However, their migration routes are not well known and some populations may be non-migratory (K. Hinman, pers. comm.). Roosting colonies occur on private inholdings on the Kofa Refuge (King of Arizona mine) and on YPG (Castner and others 1995, Snow 1998). Although the Mexican free-tailed bat is widely distributed and populations appear to be stable where they occur, this species roosts in large colonies with up to millions of individuals so it may be difficult to detect population changes unless numbers decrease dramatically (K. Hinman, pers. comm.). Furthermore, there is some conservation concern for this species because it feeds on crop pests and may build up toxic compounds from pesticides in fat reserves accumulated prior to migration. These fat stores are metabolized all at once during migration, which makes this species particularly susceptible to the toxic effects of pesticides (K. Hinman, pers. comm.). Additionally, this species is exposed to different quantities and types of pesticides in different parts of its distribution, including pesticides used and in Mexico, Central, and South America whose use is prohibited in the United States. The Mexican free-tailed bat is also of management interest because it does not accept bat gates (K. Hinman, pers. comm.).

Relative Importance of the Expanded Kofa Complex: The Yuma Planning Area is notable for its diversity of bat species—more than three quarters of the species known to occur in Arizona. The diversity of bats in the area is perhaps due to the abundance of roost sites, including cliffs and abandoned mines, and the variety of foraging sites found within the Expanded Kofa Complex and other regions in the Yuma Planning Area. Foraging areas include springs, tinajas, extensive networks of xeroriparian scrub, including Braided Channel Floodplains, and the riparian corridors along the Colorado and Gila Rivers. The Colorado River may be a particularly important foraging and drinking area for some species, such as the free-tailed bats, that prefer expansive foraging areas because they are less maneuverable than other types of bats and may have difficulties in foraging at tinajas or springs that have been modified with roofs (Castner and others 1995). Aside from mine surveys on YPG and the Kofa Refuge, much of the Expanded Kofa Complex has not been systematically surveyed for bats. Additional roost sites and foraging for many species areas are likely to occur on BLM land in the Expanded Kofa Complex.

Desert Bighorn Sheep (*Ovis canadensis mexicana*)

Selection Criteria: *Area-dependent, Regionally Vulnerable*
Desert bighorn sheep populations have dramatically declined throughout their range. They are an area-dependent species, requiring large, unfragmented landscapes to maintain population viability. The subspecies is considered regionally vulnerable, as populations have become increasingly fragmented in the Sonoran Desert due to roads, canals, fences, and urban encroachment. As an area-dependent species, desert bighorn sheep may help establish the boundaries of the functional landscape and determine how much of the coarse filter needs to be adequately protected to maintain that landscape (Lambeck 1997)

Conservation Status and Regional Threats: Desert bighorn sheep have a Global Rank of G4, but their numbers are declining in many parts of their range as their available habitat slowly diminishes due to continued fragmentation. Bighorn sheep habitat is fragmented by roads, canals (such as the Central Arizona Project [CAP]), fences, and agricultural and urban

development. A landscape approach to bighorn sheep management is necessary in order to protect this species, as the inter-montane valleys act as corridors to gain access to other ranges for foraging and lambing (Krausman and others 1999). The Expanded Kofa Complex is important for the conservation of desert bighorn as it encompasses a functional landscape of interconnected mountain ranges and valleys. Aerial surveys in the Expanded Kofa Complex reveal an abundant, stable population of sheep in most survey areas (Table 8.4). The numerous rugged, isolated mountain ranges in the Yuma Planning Area have thus far retained their connectivity for bighorn sheep with few impediments to movement. Studies of radio-collared sheep have illuminated movement patterns, dispersal distances between mountain ranges, and have permitted calculations of desert bighorn sheep home range size. Based on what is known about bighorn sheep behavior and movement in general, the main barriers to movement in the Yuma Planning Area are probably the Colorado River to the west, Interstate 8 to the south, Interstate 10 to the north, and extensive agricultural fields east of the Eagletail Mountains to the east (B. Henry, pers. comm.). It is possible, however, that some individuals attempt (successfully or not) to cross these barriers.

Table 8.4 Population Estimates for Desert Bighorn Sheep in Selected Mountain Ranges in the BLM Yuma Resource Management Area[1]

Survey Area/ Mountain Range	1994	1995	1996	1997	1998	1999	2000	2001	2002
Castle Dome Mts	266			180			233		
Kofa Mts	545			420			579		
Trigo/Chocolate		184			196			187	
Dome Rock Mts		42			35			16	
New Waters (S of I8)				106		94			123
Plomosa (N of I8)				97		127			124
Little Horn/Tank/Palomas	92			108			108		
Eagletail Mts	53			105			207		105

Desert bighorn habitat (as modeled by Arizona Gap [1998]) and areas used for movements between mountain ranges are mapped based on information obtained in an interview with Bob Henry, a bighorn sheep specialist with the Arizona Game and Fish Department (Figure 8.12). The mapped areas of bighorn movement are based on data from radio-collared and observed sheep as well as a general knowledge of bighorn behavior and their expected movement patterns. The red and green polygons in Figure 8.12 are bighorn sheep habitat and movement corridors that sheep are known to use based on observations and data from radioed individuals. Red polygons represent areas where bighorn movement is impeded by roads or other landscape features. Orange and yellow polygons in Figure 8.12 represent areas where bighorn sheep are expected to periodically disperse between mountain ranges, based on a general knowledge of

[1] Based on aerial surveys by the Arizona Game and Fish Department (B. Henry, pers. comm.).

bighorn sheep behavior rather than discrete data. Lambing areas in the Expanded Kofa Complex include rugged, isolated areas of the New Water, Kofa, and Castle Dome Mountains (BLM and USFWS 1996).

Relative Importance of the Expanded Kofa Complex: The Expanded Kofa Complex and surroundings include the largest unfragmented landscape for desert bighorn sheep remaining in the Sonoran Desert in Arizona. Approximately half of the entire population of desert bighorn sheep in Arizona is found within the Arizona Game and Fish Department's Region IV-Yuma (B. Henry, pers. comm.). Region IV is larger than the Expanded Kofa Complex; it extends from the Colorado River north to Lake Havasu City, northeast to Wickenburg, east of Gila Bend and Ajo, and south along the U.S./Mexico border (see http://www.gf.state.az.us/h_f/hunting_units_yuma.html). The Expanded Kofa Complex may be critical to the long-term survival of this subspecies because mountain ranges on the Kofa Refuge and the BLM New Water Mountains Wilderness constitute an area with a source population of desert bighorn sheep that has been used as transplants to other Sonoran Desert ranges since 1979 (BLM and USFWS 1996).

8.9 Additional Species Considered as Conservation Elements

The thirteen species described in this section were not selected as preliminary conservation elements at this time, but required additional research and consideration to determine if they met fine filter selection criteria. We determined that some of these species do not meet the fine filter criteria based on our knowledge of the species at this time. Other species may require a more detailed review or discussion with partner agencies to evaluate suitability as conservation elements of the Expanded Kofa Complex. In this section we discuss why each of these species was considered as a potential conservation element, the reason why it was not selected at this time, and/or the outstanding information needs that would help determine if the species should be selected as a conservation element of the Expanded Kofa Complex. The thirteen species represent five higher taxa: five plants, three invertebrates, two reptiles, one bird, and two mammals.

Plants

Parish Onion (*Allium parishii*). This plant was considered a potential conservation element because it is an uncommon species (Global Rank of G3) that is restricted to the Sonoran Desert in California and Arizona. This species was a conservation element for the Sonoran Desert Ecoregion whose distribution was, in part, responsible for the delineation of the Kofa Complex Conservation Area—the only conservation area in which this species was known to occur. The network of conservation areas identified in the ecoregional assessment therefore fell short of its conservation goals to include six occurrences in conservation areas within the Arizona Upland Subdivision (Marshall and others 2000). Parish onion is found in suitable habitat on north-facing rocky slopes in the Arizona Upland Subdivision on the Kofa NWR (R. Kearns pers. comm.). It is considered rare in California, but not at risk (CNPS 2002). Parish onion is categorized as Salvage Restricted in Arizona (See Appendix D for Arizona Native Plant Law definitions), however it is not likely to be valued in the plant trade or collected from the Kofa Refuge.

California Snakewood (***Colubrina californica*).** This species is endemic to the Sonoran Desert Ecoregion and is fairly widely distributed within its range. However, it is known from very few localities in its range in southeastern California, Arizona, northern Baja and northern Sonora (Turner and others 1995). This species is a rare associate of Mountain Xeroriparian Scrub (S. Rutman, pers. comm.). California snakewood is an uncommon plant found within the Expanded Kofa Complex on the east arm of YPG and in Yuma wash (V. Morrill, pers. comm.). Although this plant is not common anywhere in its range, there is not enough known about its distribution, abundance, population status, and threats to justify selecting it as a conservation element at this time.

Longleaf Sandpaper Plant (*Petalonyx linearis*). Longleaf sandpaper plant has a narrow distribution within the Sonoran Desert. It is known from northern Baja California, northwestern Sonora, southeastern California, and southwestern Arizona (Felger 2000). Although its Global Rank is a G4, it is uncommon in Arizona and California (State Rank of S2). This species grows on lava fields (such as the Pinacate in Sonora) and exposed rocky, granitic slopes (Felger 2000). In Arizona it is known from the Laguna Mountains near the Colorado River and on the Kofa NWR in the Kofa and Polaris Mountains (HDMS 2003), and in the main wash of Kofa Queen Canyon (R. Kearns pers. comm.). Because this plant is not globally rare and no potential threats or special management needs were recognized, it was not selected as a conservation element at this time.

Crucifixion Thorn (*Castela emoryi*) (=*Holacantha emoryi*). This species is endemic to the Sonoran Desert and southern Mojave Desert (Turner and others 1995). Populations are small and are widely scattered, and the species may be declined because of low levels of reproduction, seed dispersal, seedling establishment, and poor growth (Turner and others 1995). This species was identified as a conservation element of the BMGR where it was thought to be associated with the Valley Bottom Floodplain Complex natural community (Hall and others 2000). *Castela emoryi* was also selected as a preliminary conservation element of the Sonoran Desert National Monument (Weinstein and others 2002) but was taken off the list of conservation elements for the SDNM because additional sightings by botanists suggest that this species is more common than previously thought (Weinstein and Hall 2003). This species is known from the Expanded Kofa Complex on the northeastern portion of the Kofa Refuge, along Highway 95 near milepost 80 (R. Kearns, pers. comm.), and on YPG on the La Posa and Castle Dome Plain (V. Morrill, pers. comm.). Additional information is needed on the distribution and status of this species within the Expanded Kofa Complex because it may be more vulnerable in this region than elsewhere as it is found in locations on the Yuma Proving Ground where military activities and developments tend to be located.

Wiggins Cholla (*Opuntia wigginsii*) Wiggins cholla is G3 species that is only known from scattered localities in southeastern California and adjacent Arizona (Benson 1969, Warren and Laurenzi 1987). This species was a conservation element for the Sonoran Desert Ecoregion (Marshall and others 2000), occurring in site #12 (Kofa Complex) and #27 (Chocolate Mountains). Wiggins cholla is occurs on sandy flats in accessible areas that may be prone to habitat disturbance. It was not selected as a conservation element at this time because its taxonomy is under revision (NatureServe 2002) and it is thought by some botanists to be a sterile

hybrid between the silver cholla (*Opuntia echinocarpa*) and diamond cholla (*O. ramosissima*), both which occur in the same geographic range (Warren and Laurenzi 1987).

Invertebrates

Three invertebrate taxa were considered as potential conservation elements of the Expanded Kofa Complex, but none were selected at this time. It is therefore assumed that the invertebrates within the Expanded Kofa Complex will be adequately represented by focusing on their habitat alone (the coarse filter) and do not require additional management attention.

Moth Lacewing (*Oliarces clara*). This species was considered as a potential conservation element because it is thought to be globally rare (G2G3), is classified as a Sensitive Species by the BLM (BLM 2000), and was a conservation element for the Sonoran Desert Ecoregion (Marshall and others 2000). The lacewing is endemic to the Sonoran Desert, restricted to southern California, western Arizona (Yuma county), and Baja California Sur, Mexico (NatureServe Explorer 2002, Faulkner 1990a). The genus *Oliarces* is of great biogeographical interest as the only taxon in its family (Ithonidae, Order Neuroptera) that is found outside of Australia (Faulkner 1990a). Moth lacewing larvae spend their lives underground where they are thought to feed on the roots of creosotebush. Adults emerge synchronously in spring (April-May) and congregate en masse at localized sites for nuptial flights near low elevation desert rocky slopes, canyons, and cliffs. Adults will drift and disperse with the wind and a single mated female will lay over 500 eggs on the soil surface (Faulkner 1990a, Faulkner 1990b). This species is likely to be much more abundant and widely distributed than what is currently known, possibly following the distribution of creosotebush (Faulkner 1990a). The purported rarity of this insect is likely due to the fact that it has rarely been observed during its brief period of aboveground activity at highly localized sites.

McNeill's Sootywing Skipper (*Hesperopsis gracielae*). This species was evaluated as a potential conservation element because it is a BLM Sensitive Species (BLM 2000) and is considered globally rare (Combined Global Rank of G2) with a very limited range within the Sonoran Desert (along the lower Colorado River in California and Arizona), and possibly presently imperiled (NatureServe Explorer 2002). McNeill's sootywing skipper was a former category 2 candidate for federal listing as threatened or endangered and is a species under consideration in the Lower Colorado Multi-Species Habitat Conservation Plan (Jones and Stokes 2003). Sootywing caterpillars specialize on quail bush (*Atriplex lentiformis*) (NatureServe Explorer 2002), a widely distributed shrub most abundant on saline soils, playas, and floodplains in the Sonoran and Mojave Deserts in Arizona, California, Utah, and Nevada, above the Mogollon Rim in Arizona, and along the California coast (Turner and others 1995). Little is known about the life history and ecology of the McNeill's sootywing skipper. Adult McNeill's sootywing skippers are obligatory nectar feeders and will fly up to 0.25 km away from their larval plant to nectar sources, such as honey mesquite, typically found in adjacent riparian or xeroriparian communities (Jones and Stokes 2003). Information on the minimum patch size capable of supporting a population of McNeill's sootywing skipper has not been published (Jones and Stokes 2003).

According to Ray Stanford, Lepidoptera expert, the McNeill's sootywing skipper is apparently much more abundant and widespread than what is commonly reported. McNeill's sootywing skipper is found locally (and depending on rainfall) at low elevations along streams with quail bush, along the lower Colorado River from Needles to the Mexican border and into Baja California del Norte, the lower Bill Williams River, Gila River, and Salt River in Arizona, the Virgin River in extreme eastern Clark county, Nevada, and extreme southwestern Washington county, Utah (R. Stanford, pers. comm.). It has been recorded from Mohave, La Paz, Yuma, Maricopa, and Pinal counties in Arizona, and from San Bernardino, Riverside, and Imperial counties, California. The skipper is expected to be found along the Colorado River in Sonora and could be found at lower elevations along streams with quail bush in Pima, Gila, and Graham counties, Arizona (R. Stanford, pers. comm.). The skipper is not found along the borders of reservoirs along the Colorado River, such as Lake Havasu and Lake Mead. This species was not selected as a preliminary conservation element because it is thought to be a hardy desert butterfly with very few threats, except possibly increased habitat destruction and reservoir formation or stress caused by many consecutive drought decades (R. Stanford, pers. comm.).

Native Bee/Pollinator Guild. The Sonoran Desert is thought to be the site of the greatest bee diversity in the world, with as many as 1,000 species from at least 45 genera representing seven to eight families (S. Buchmann, pers. comm.). Sonoran Desert flora has coevolved with this suite of specialized insects, relying on these pollinators as partners in their reproduction and survival. The introduction and proliferation of European and Africanized honeybees throughout the southwest has been shown to result in competitive exclusion of native bees (Kunzmann and others 1995). Non-native bees are less efficient pollinators of many Sonoran Desert native plants and this has, in some cases, resulted in reduced seed-sets of some species (Buchmann and Nabhan 1996). We considered native bees as a potential conservation element because of the global significance of the Sonoran Desert to native bee biodiversity and the important role these insects play in pollination of native plants. However, we do not have enough information to propose this guild at present. An inventory of native bees on the Yuma Proving Ground resulted in the collection of several thousand specimens representing over 100 species, including four species of native bees that were new to science (Buchmann and others 2002). This study was not designed in way that we could identify important areas for bee biodiversity on YPG or important habitat components on which the pollinators rely (S. Buchmann, pers. comm.). Additional research is needed before being able to select native bees as a conservation element.

Reptiles

Valley Bottom Reptile Guild. This guild was selected as a conservation element of the Barry M. Goldwater Range (Hall and others 2001). Six species of snakes and lizards were defined as associates of the guild, including: the western leaf-nosed snake (*Phyllorhynchus decurtatus perkinsi*), western shovel-nosed snake (*Chionactis occipitalis*), sidewinder (*Crotalus cerastes*), desert iguana (*Dipsosaurus dorsalis*), southern desert horned lizard (*Phrynosoma platyrhinos calidiarum*), and the long-tailed brush lizard (*Urosaurus graciosus shannoni*). This guild was selected as a conservation element for the Goldwater Range because they are habitat specialists associated with the low, arid, desert valleys of the Lower Colorado River Valley Subdivision of the Sonoran Desert, and the Goldwater Range was considered to include a significant portion of the distribution of these species. The Expanded Kofa Complex includes some more mesic

habitat than the Goldwater Range and the relative significance of this area in the long-term viability of these species has not been determined. It is assumed, at this point in the analysis, that the habitat requirements of these species is met by the coarse filter, particularly the Dune Complex, Creosotebush-Bursage Desert Scrub, Braided Channel Floodplain, and Valley Xeroriparian Scrub natural communities.

Desert Night Lizard (*Xantusia vigilis*). This species was a conservation element of the Sonoran Desert Ecoregion and a species for which the Kofa Complex was delineated (Marshall and others 2000). The desert night lizard was once thought to be uncommon and with a restricted distribution in Arizona, but this is likely due to its secretive habits (Stebbins 1985). The desert night lizard was thought to be closely associated with the Mountain Upland natural community in the Kofa Mountains and with the cover provided by beargrass and California fan palm fronds, but in fact the lizard is distributed much more widely in the Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes natural community and as low as the ecotone between the Lower Colorado River Valley Subdivision and the Arizona Upland Subdivision (Paloverde-Mixed Cacti-Mixed Scrub on Bajadas natural community) (R. Kearns, pers. comm.). The desert night lizard is also likely to be found in the Castle Dome Mountains on the Kofa Refuge (R. Kearns, pers. comm.). This species does not require additional management attention as a species conservation element for the Expanded Kofa Complex and does not seem to meet the fine filter selection criteria (Table 2.1).

Birds

Western Burrowing Owl (*Athene cunicularia hypugea*)
Burrowing owl is considered a species of concern by many agencies and organizations. It is Bird of Conservation Concern in the Sonoran and Mojave Deserts (USFWS 2002), a priority species for high elevation grassland habitats (Latta and others 1999), and a BLM Sensitive Species (BLM 2000). This subspecies of burrowing owl occurs throughout western North America. Populations are declining dramatically (up to 89% of breeding groups disappearing) across its range due to habitat degradation and loss (NatureServe Explorer 2002). The primary sources of habitat degradation and loss are extermination and control of colonial burrowing mammals and conversion to urban and intensive agricultural uses (NatureServe Explorer 2002). Other threats include excessive predation by domestic dogs and cats, collisions with vehicles, pesticides, and collapse of burrows (NatureServe Explorer 2002).

Burrowing owls are generally found in or adjoining agricultural fields and canals in the southwestern portion of the Yuma Field Office (Figure 8.13). This species is also breeding in the western portion of the Eagletail Mountains, where it may be using abandoned rodent dens as burrows (BLM staff, pers. comm.). The status of burrowing owl in desert areas within the Yuma Planning Area is not well known. If there are viable breeding colonies within the Expanded Kofa Complex, this species should be added as a fine-filter conservation element because it is regionally vulnerable.

Mammals

Yuma puma (*Puma concolor browni*)

The Yuma puma was not selected as a conservation element because the taxonomy and validity of this subspecies are unresolved and there is little known about its abundance and status within the Yuma Planning Area. This subspecies is distinguished based on morphology (skull, pelage, coloration, size), however recent DNA analysis suggests that mountain lions in North America have little genetic variation (NatureServe Explorer 2002). This subspecies is thought to be confined to the lower Colorado River Valley of Arizona, California, and Mexico, and be particularly dependent on riparian habitats along the river (NatureServe Explorer 2002). The Yuma puma is rarely seen and little is known about its population status or trends. Sightings of a "big cat" at Mittry Lake are regularly reported to the BLM (R. Oyler, pers. comm.), but the identity of this species has not been determined.

Sonoran pronghorn, *Antilocapra americana sonorensis*. The Sonoran Pronghorn is listed Endangered in the United States and Mexico. The Expanded Kofa Complex is within the historic distribution of the Sonoran pronghorn and portions of the Yuma Planning Area include pronghorn habitat. This subspecies is highly imperiled and its future in the Sonoran Desert is uncertain. Portions of the Expanded Kofa Complex, including the La Posa Plain, Castle Dome Plain, and King Valley, are being evaluated by AGFD for their suitability as potential Sonoran pronghorn reintroduction sites. This species was not selected as a conservation element because all management actions will defer to the findings of the AGFD and the Endangered Species Recovery Team.

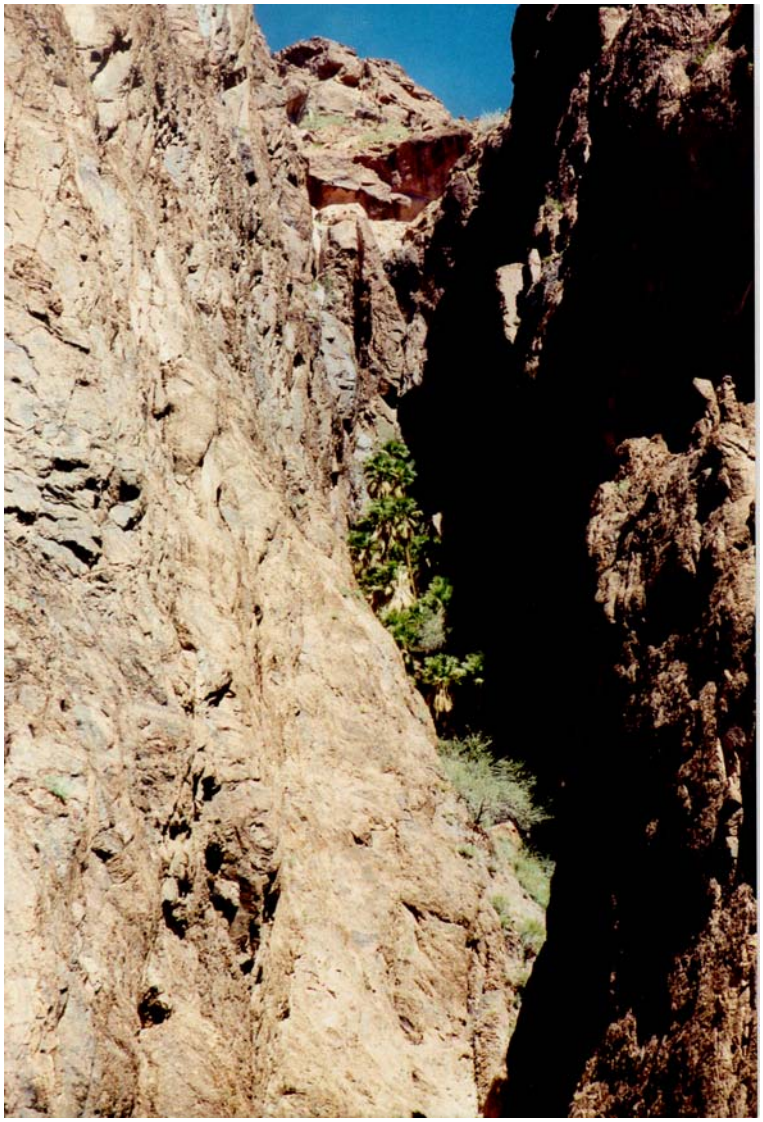
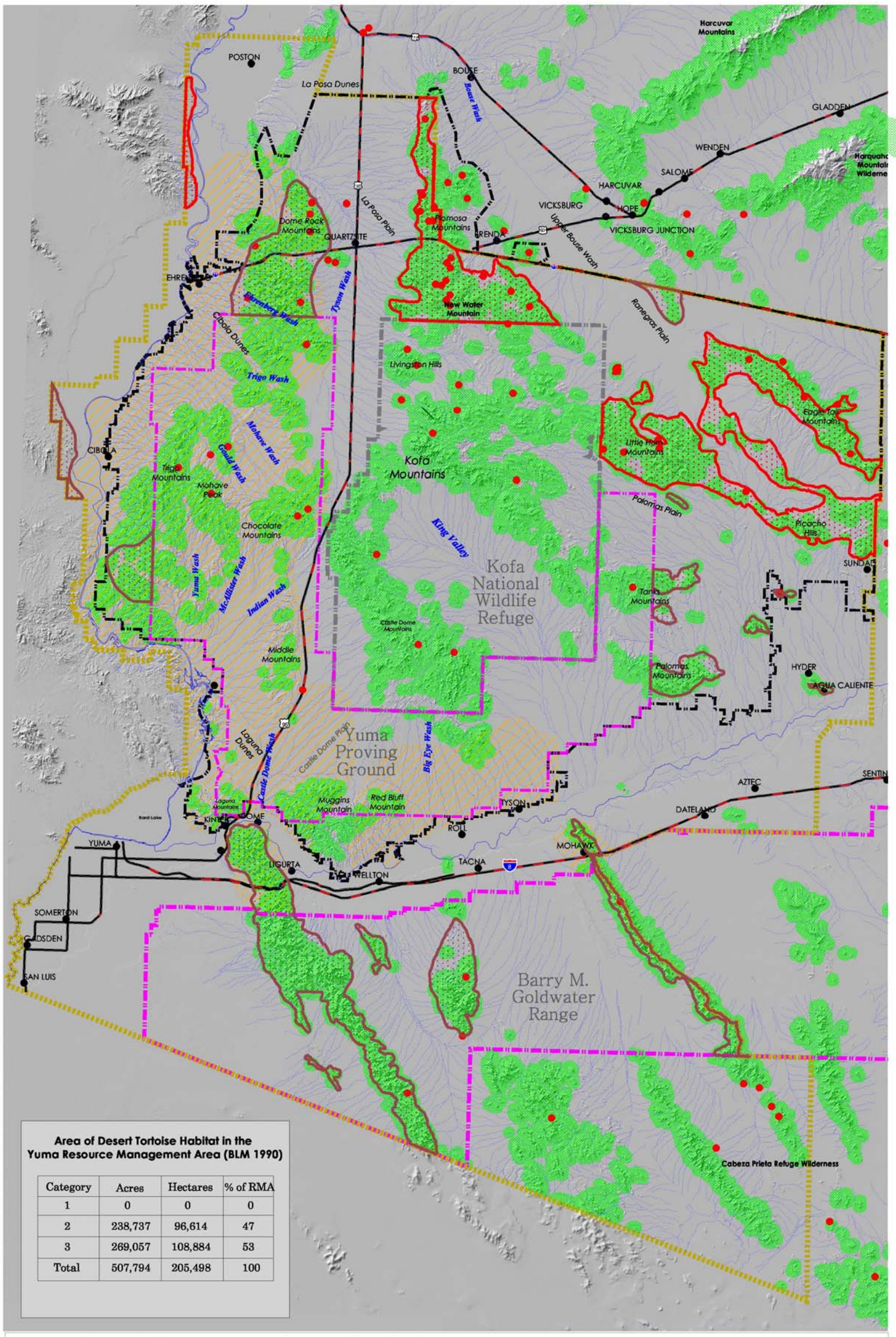


Figure 8.1 California Fan Palms (*Washingtonia filifera*) in the Kofa Mountains
(Photo by S. Weinstein 2001)

Figure 8.2 Mojave Fringe-Toed Lizard (*Uma scoparia*) Adaptations to life on dunes include a sunken lower jaw that prevents intrusion of sand particles and fringed toes that facilitate movement and "sand swimming" on loose sandy soils. (Photo by S. Weinstein 2003)

Figure 8.3 Mojave Fringe-Toed Lizard (*Uma scoparia*) on Cibola Dunes, YPG
Dorsal body color and pattern mimics the texture and color of sand (Photo by S. Weinstein 2003).



Area of Desert Tortoise Habitat in the Yuma Resource Management Area (BLM 1990)

Category	Acres	Hectares	% of RMA
1	0	0	0
2	238,737	96,614	47
3	269,057	108,884	53
Total	507,794	205,498	100

FIGURE 8.4 Desert Tortoise Habitat in the BLM Yuma Resource Management Area

SCALE 1:800,000

Tortoise Habitat (Arizona Gap Program 1998)

Desert Tortoise Habitat (BLM 1990)
- Category 2
- Category 3

Desert tortoise occurrence *(Gopherus agassizii)* Includes some "fuzzed" points (HDMS 2003)

Cibola-Trigo Wild Horse and Burro Herd Management Area

Expanded Kofa Complex Planning Area Boundary
Yuma BLM Field Office Boundary
Barry M. Goldwater Range Boundary
Yuma Proving Grounds Boundary
Kofa Refuge Boundary
Towns *(Alris, 1997)*
Roads
Rivers
Natural drainages *(Alris, 1997)*

The Nature Conservancy

Draft Map by: Anne Gondor and Stephanie Weinstein
Printed: Tucson, 02-18-04
Projection: UTM Zone 12, NAD 27

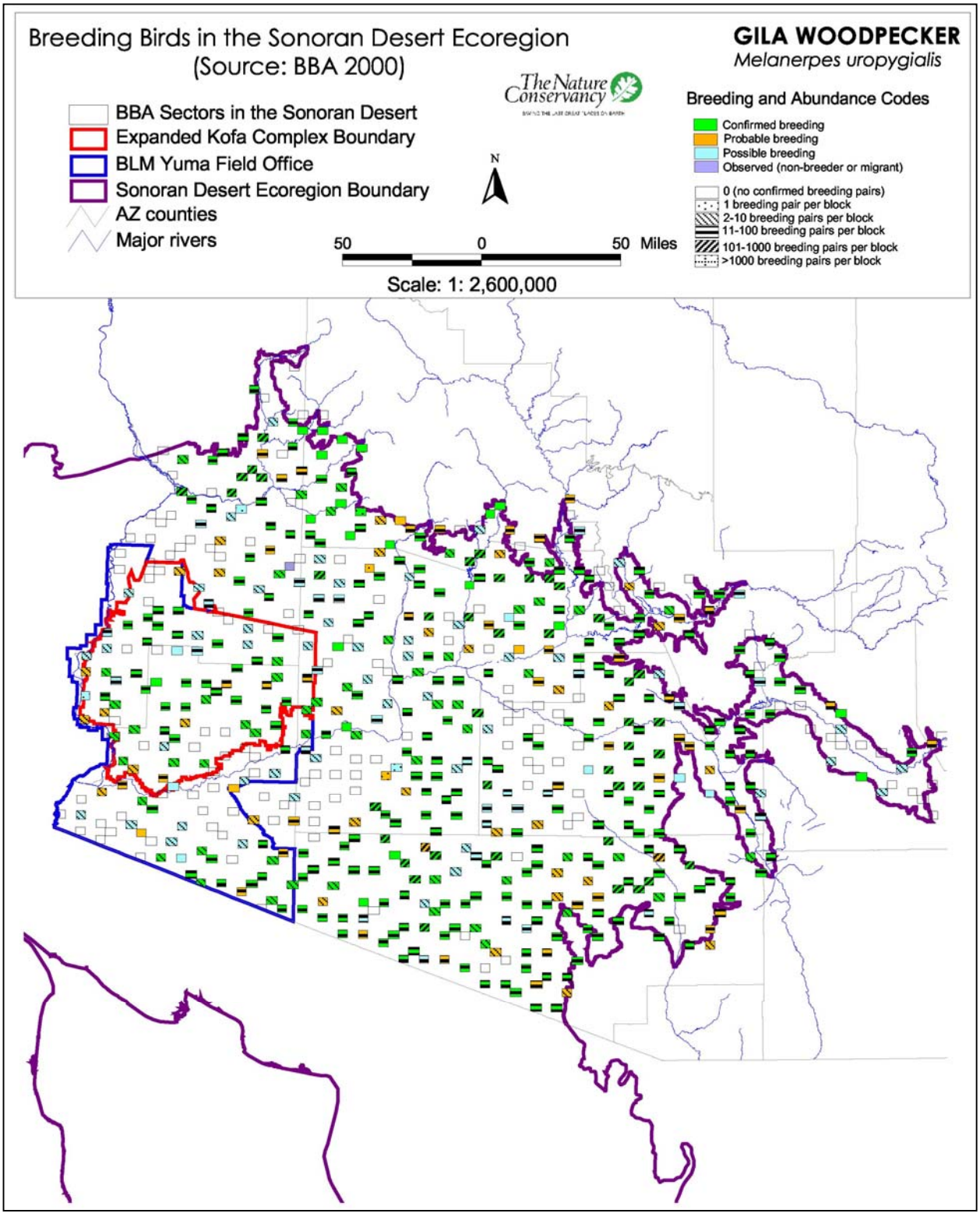


Figure 8.5 Breeding Status and Abundance of Gila Woodpecker (*Melanerpes uropygialis*) in the Sonoran Desert Ecoregion (Arizona Breeding Bird Atlas 2001).

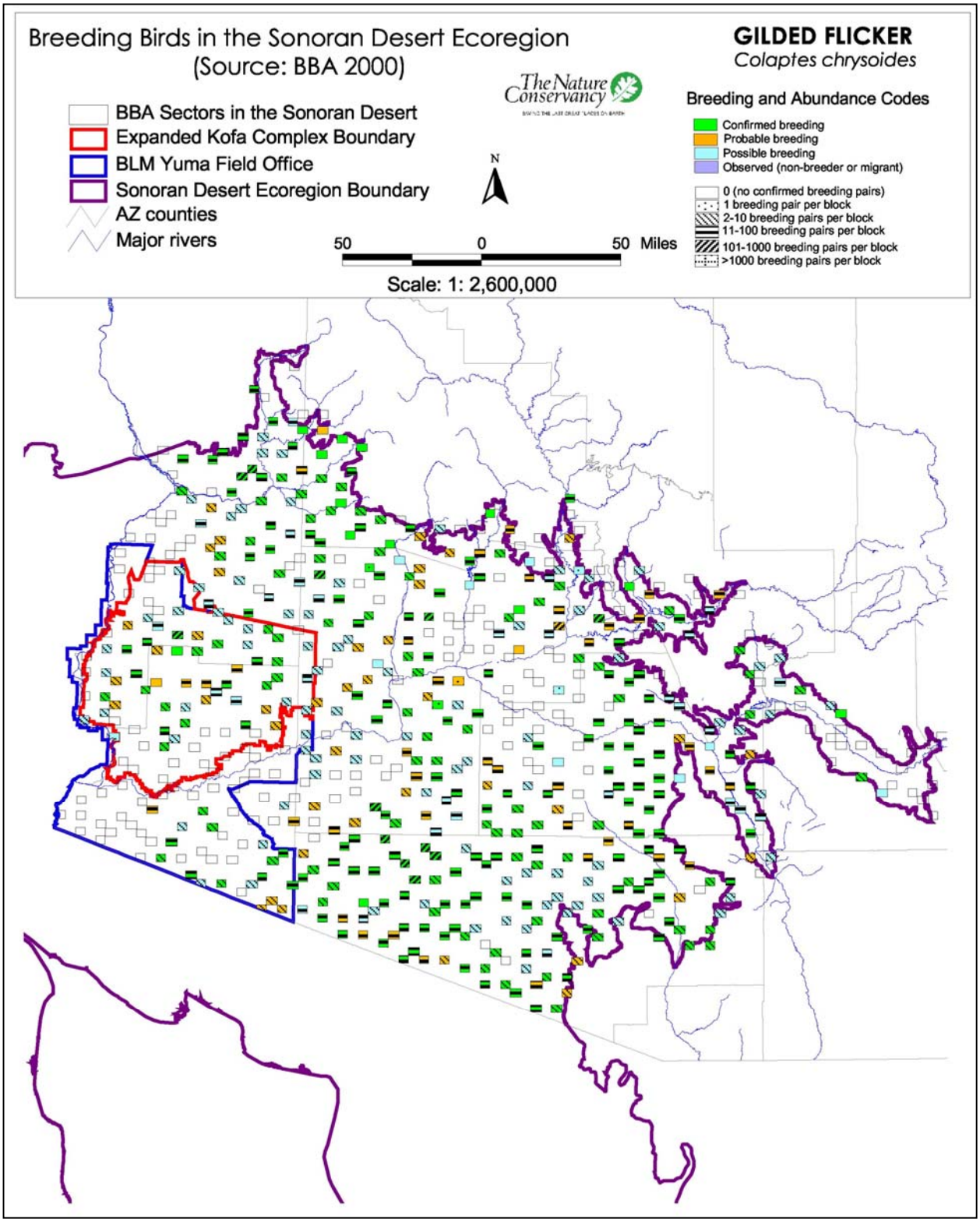


Figure 8.6 Breeding Status and Abundance of Gilded Flicker (*Colaptes chrysoides*) in the Sonoran Desert Ecoregion (Arizona Breeding Bird Atlas 2001).

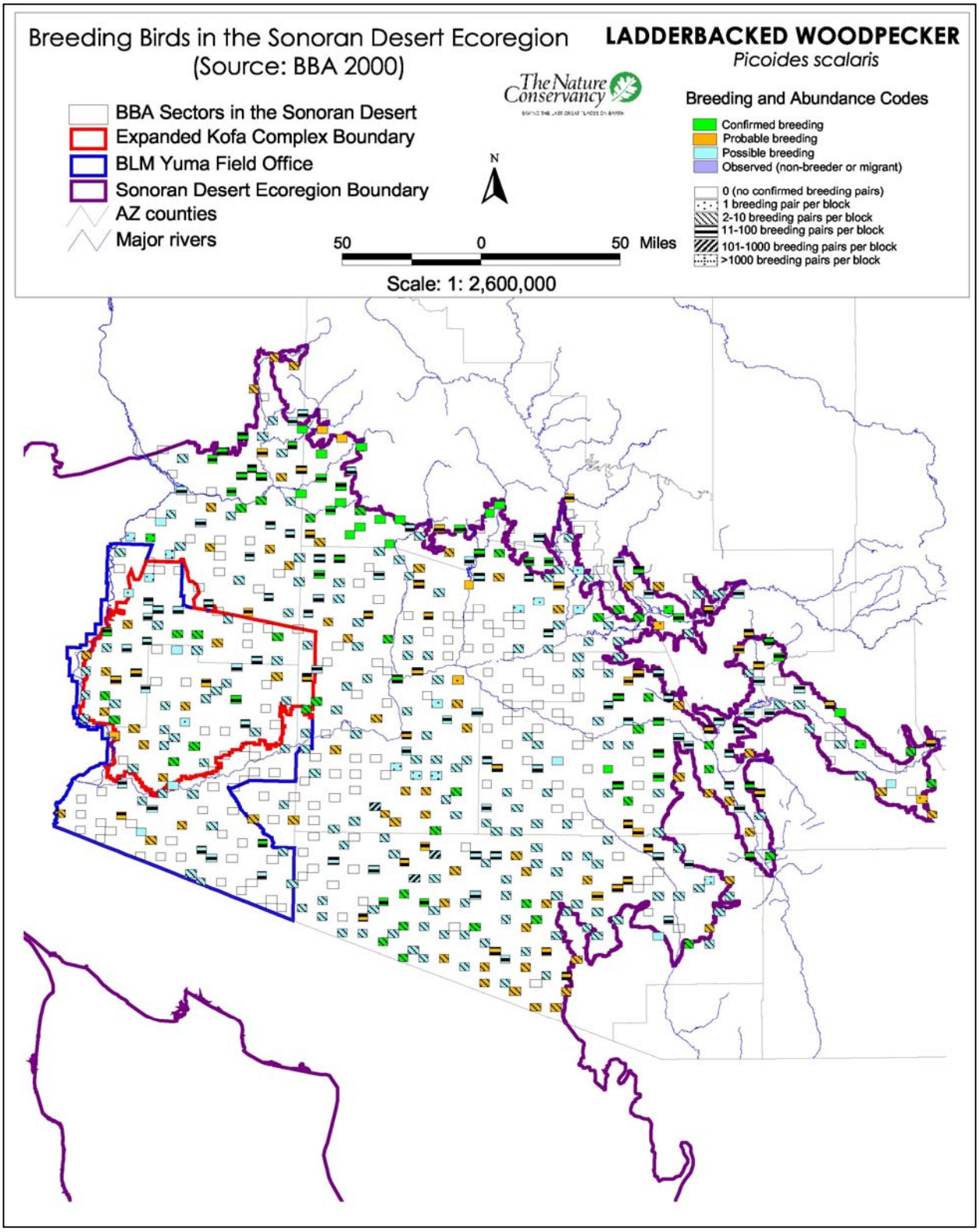


Figure 8.7 Breeding Status and Abundance of Ladderbacked Woodpecker (*Picoides scalaris*) in the Sonoran Desert Ecoregion (Arizona Breeding Bird Atlas 2001).

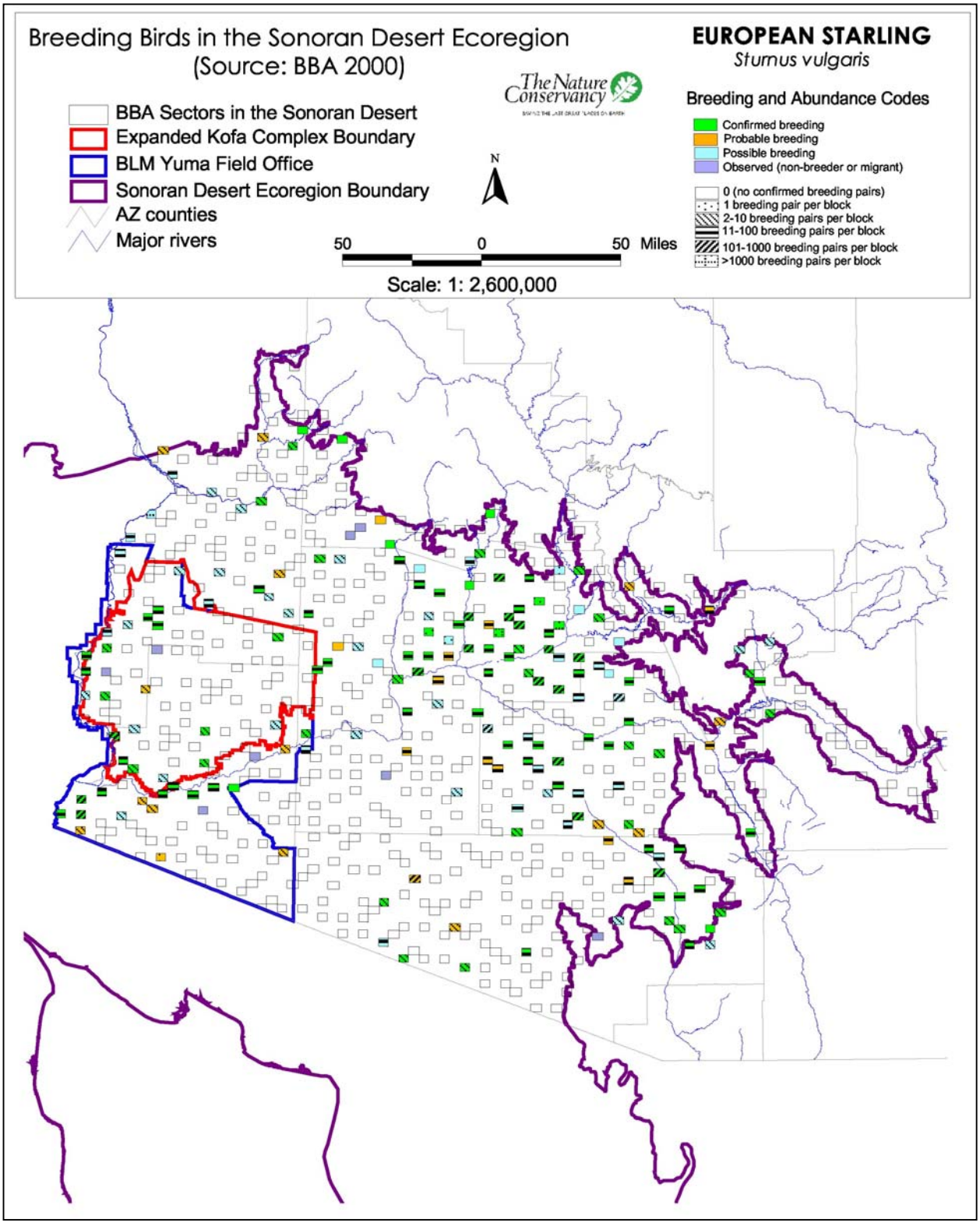


Figure 8.8 Breeding Status and Abundance of European Starling (*Sturnus vulgaris*) in the Sonoran Desert Ecoregion (Arizona Breeding Bird Atlas 2001).

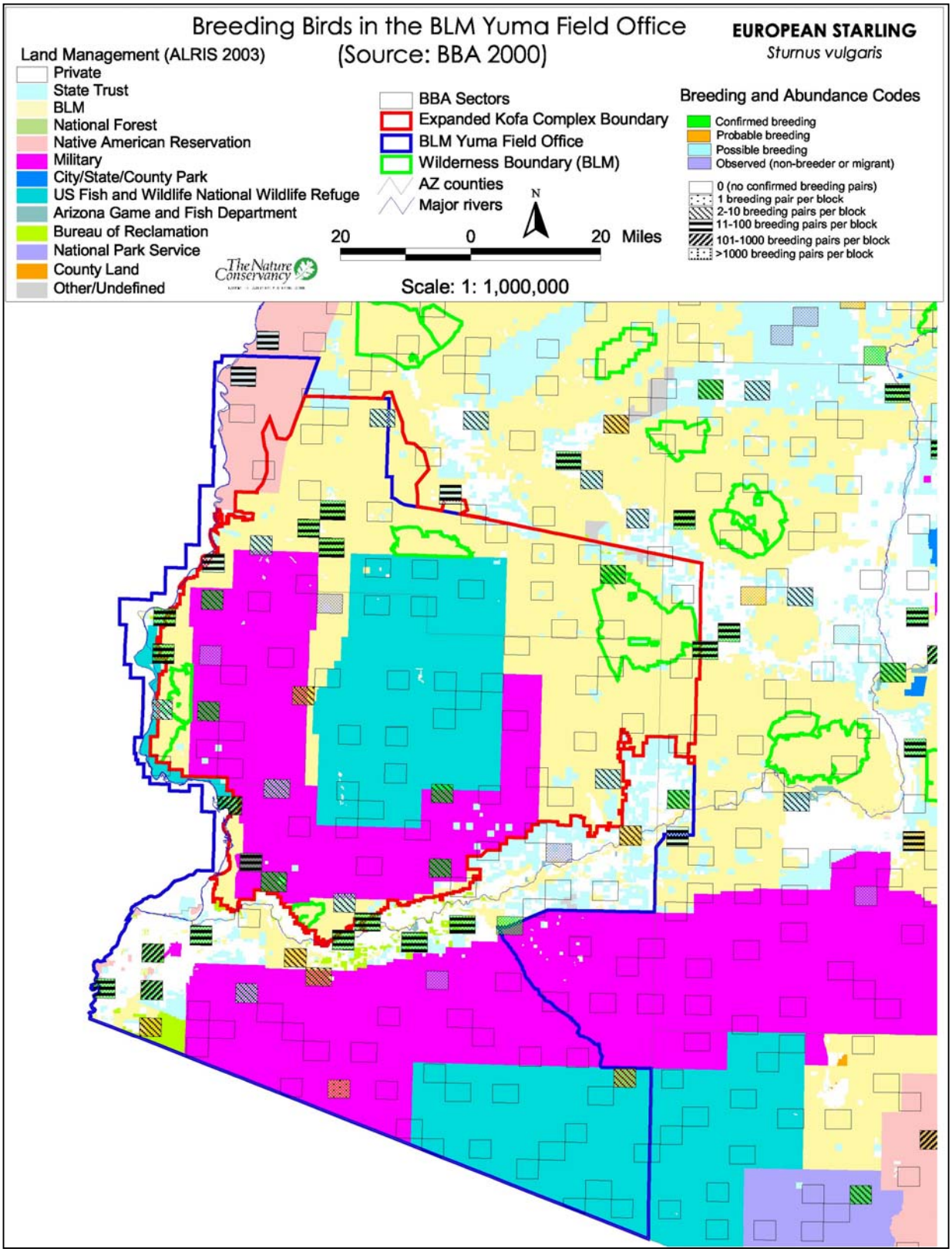


Figure 8.9 Breeding Status and Abundance of European Starling (*Sturnus vulgaris*) in the BLM Yuma Resource Management Area (Arizona Breeding Bird Atlas 2001).

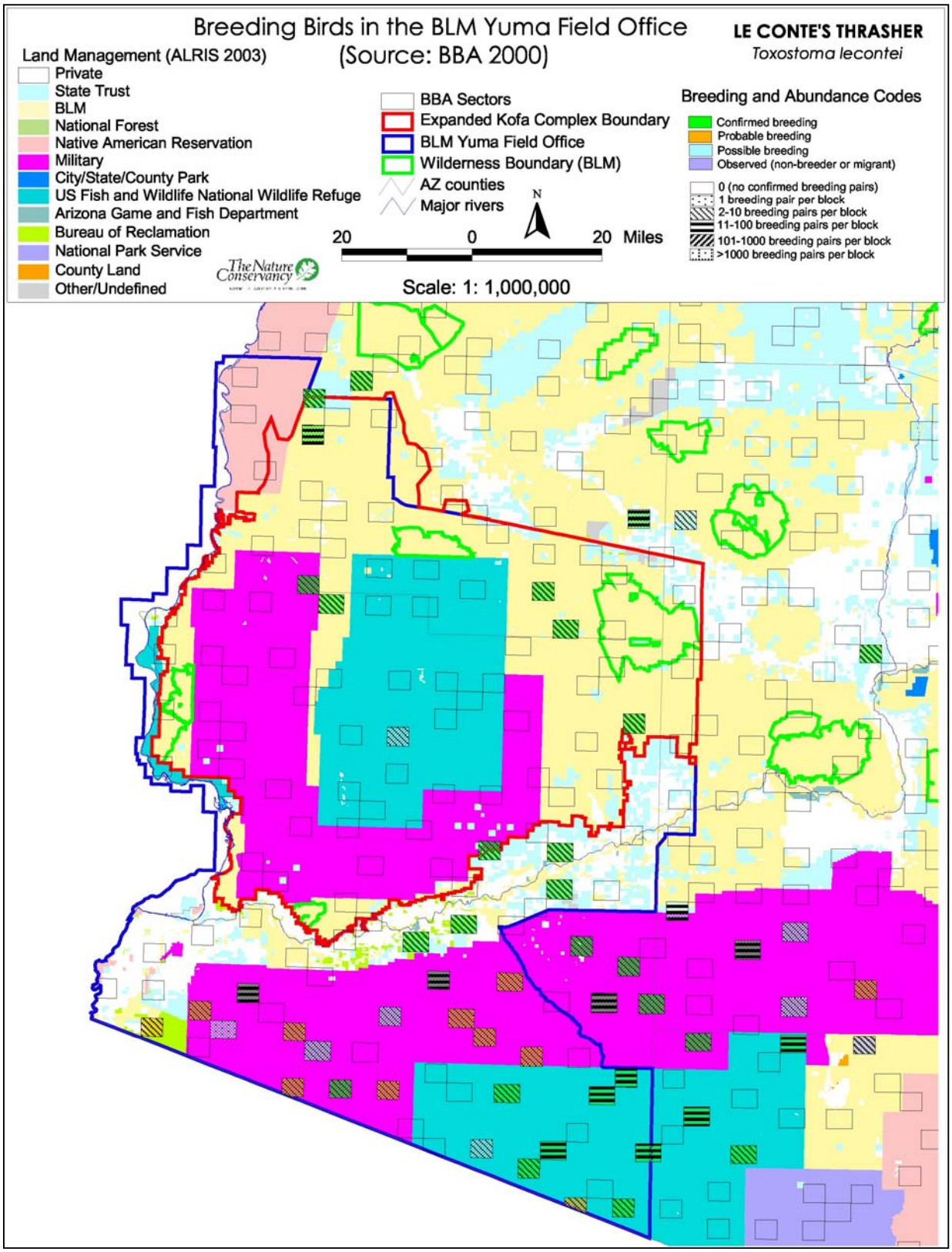


Figure 8.10 Breeding Status and Abundance of Le Conte's Thrasher (*Toxostoma lecontei*) in the BLM Yuma Resource Management Area (Arizona Breeding Bird Atlas 2001).

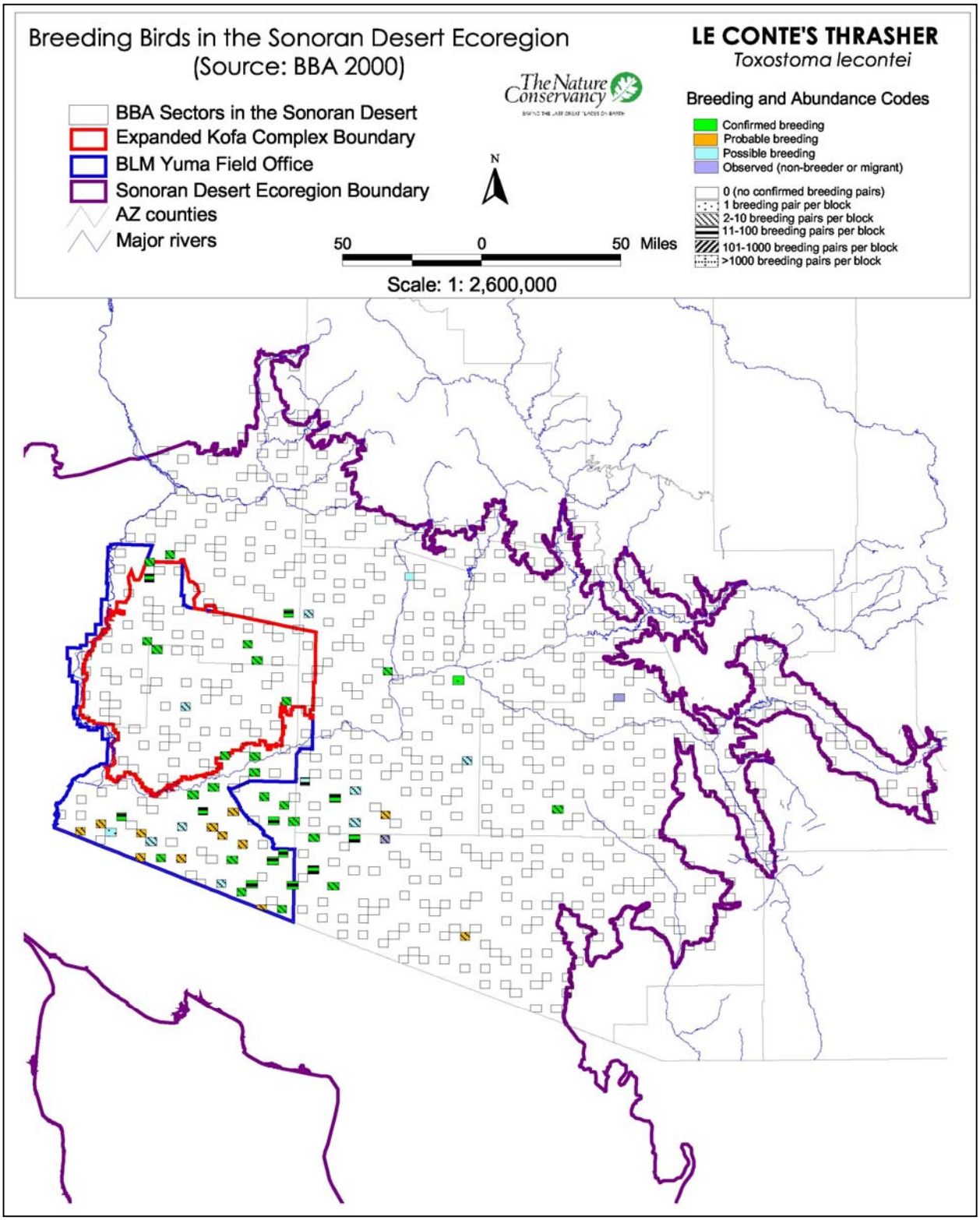


Figure 8.11 Breeding Status and Abundance of Le Conte's Thrasher (*Toxostoma lecontei*) in the Sonoran Desert Ecoregion (Arizona Breeding Bird Atlas 2001).

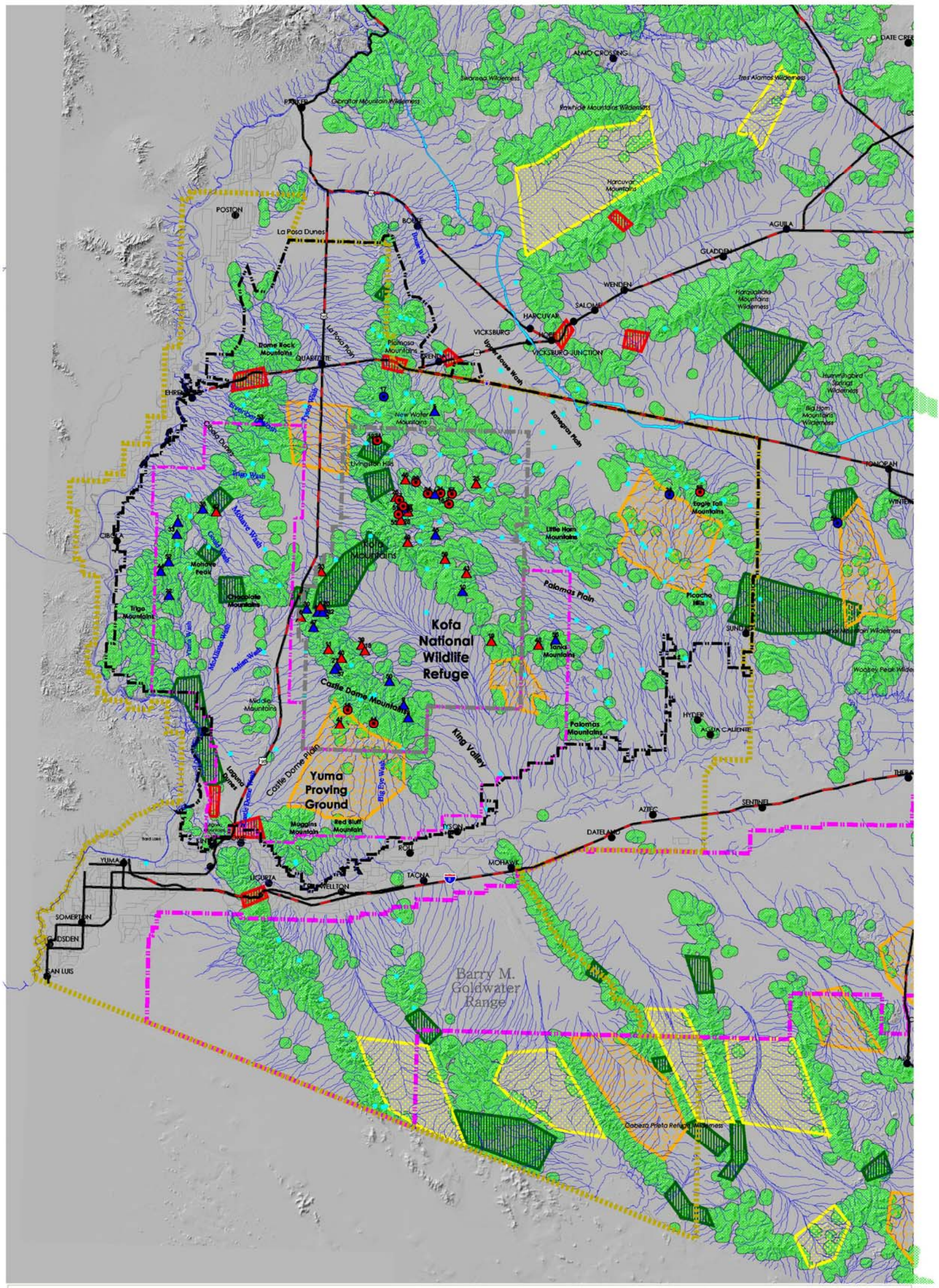


FIGURE 8.12 Desert Bighorn Sheep Habitat and Dispersal Areas in Southwestern Arizona

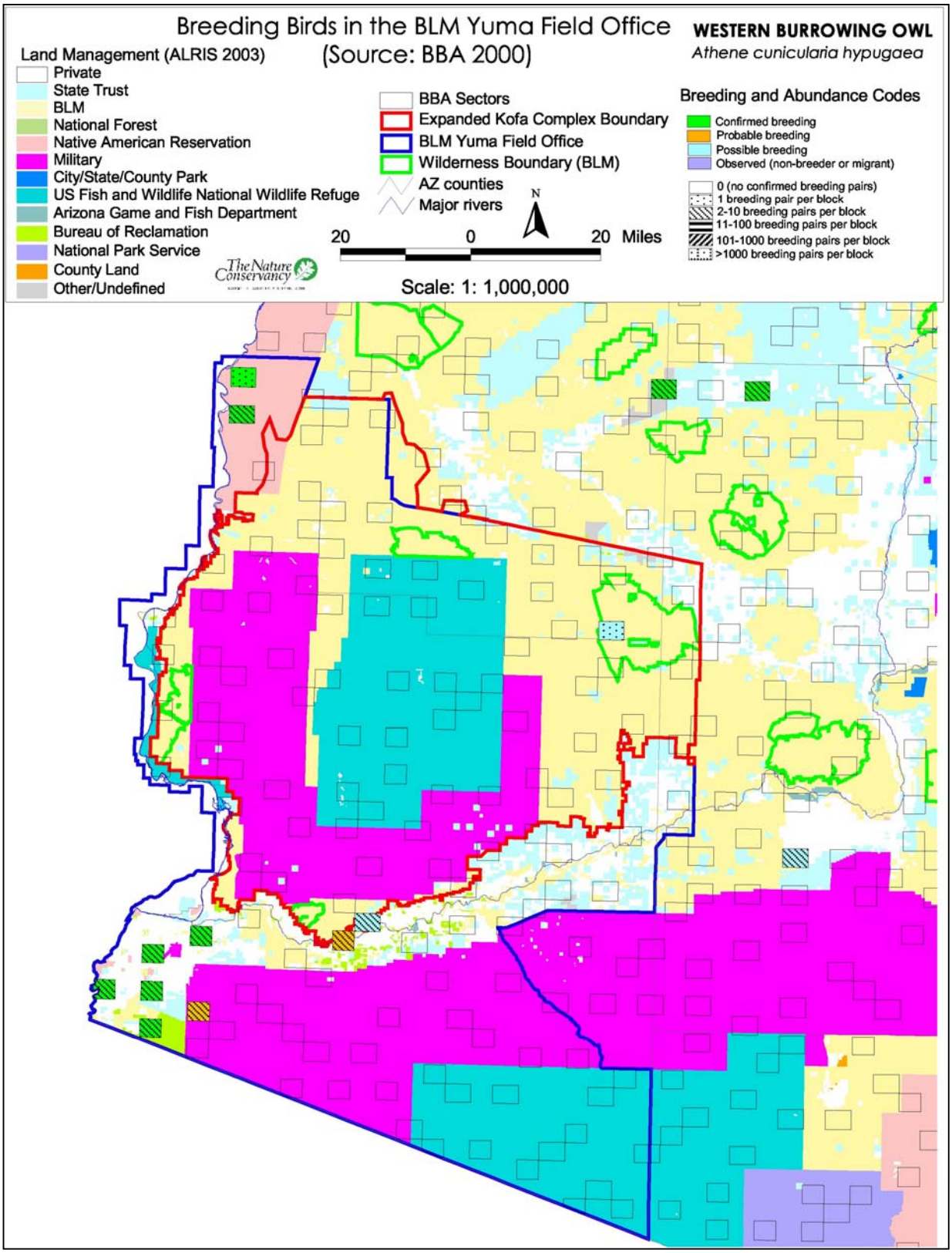


Figure 8.13 Breeding Status and Abundance of Western Burrowing Owl (*Athene cunicularia hypugaea*) in the BLM Yuma Resource Management Area
(Arizona Breeding Bird Atlas 2001).

Table 8.2 Secondary Cavity Nesters in the Sonoran Desert[1]

Common Name	Scientific Name	Habitat Associations	Status in the BLM Resource Management Area[2]
American kestrel	*Falco sparverius*	Nests in saguaro	A common, year-round resident that is found throughout the Field Office (79 BBA blocks); confirmed breeding in 9 blocks.
Ash-throated flycatcher	*Myiarchus cinerascens*	Nests in saguaro; however, frequently nests along xeroriparian washes in tree cavities constructed by ladder-backed woodpeckers	A neotropical migrant that is commonly found in the spring and summer throughout the RMA (in 134 blocks); confirmed breeding throughout the Field Office.
Brown-crested flycatcher	*Myiarchus tyrannulus*	Uses saguaros almost exclusively where it breeds in the Sonoran Desert (probably more than Ash-throated flycatchers), except where riparian habitats containing cottonwood and willow occur	A neotropical migrant that is a rare spring/summer resident in the RMA. It is confirmed breeding in one BBA block on the Kofa NWR, and observed in 10 additional blocks (with "possible" and "probable" breeding status) within the RMA.
Cactus ferruginous pygmy-owl	*Glaucidium brassilianum cactorum*	Nests in saguaro.	Federally endangered. Has not been found and is unlikely to occur within the Yuma RMA
Cactus wren	*Campylorhynchus brunneicapillus*	Often nests in cholla cactus or desert trees or shrubs, but will occasionally use cavities in saguaro.	A common year-round resident that is confirmed breeding throughout the Field Office.
Elf owl	*Micrathene whitneyi*	Nests in saguaro; hunts in xeroriparian areas and on hillsides where it eats insects.	Neotropical migrant. Found on 20 BBA blocks in the Field Office, primarily on Kofa and Cabeza Prieta NWRs. Confirmed breeding on one breeding bird block in the field office on BLM land east of Kofa NWR.
House finch	*Carpodacus mexicanus*	Nests in shrubs, on tree branches, and cavities in trees or saguaro.	A common, year-round resident that is confirmed breeding throughout the RMA
Lucy's warbler	*Vermivora luciae*	May nest along xeroriparian washes in tree cavities constructed by ladder-backed woodpeckers.	Neotropical migrant that is an uncommon spring/summer resident of the Yuma Field Office. It occurs in 53 BBA blocks in the Field Office; confirmed breeding in 13 blocks, primarily those situated near the Colorado and Gila Rivers.
Purple Martin	*Progne subis*	In the Sonoran Desert the species nests exclusively in saguaro.	Neotropical migrant. Found in one BBA block in the RMA ("probable" breeding status), on the west arm of YPG.
Western screech-owl	*Otus kennicottii*	Nests in saguaro; hunts in xeroriparian areas and on hillsides where it eats small rodents.	A year-round resident found throughout the Yuma RMA (considered common on Kofa NWR and uncommon in the RMA); confirmed breeding on 6 BBA blocks.

[1]Adapted from Hall and others (2001). Other sources of information: ABBA 2001, BLM and USFWS 1996, Birds of the Yuma Field Office Arizona brochure.
[2]A total of 137 Breeding Bird Atlas (BBA) Blocks were surveyed within the boundaries of the BLM Yuma Resource Management Area (RMA); (ABBA 2001).

Table 8.3 Bats in the Yuma Resource Management Area

Common Name	Scientific Name	Global Rank[1] (Combined)	Status[2]	WBWG Priority Status[3]	EKC[4]	Occurrence Information and Other Comments[5]
Allen's (Mexican) big-eared bat	*Idionycteris phyllotis*	G3G4 (G3)	BLM	High	No	Expected to occur within the Yuma Field Office (BLM 2000), but there are no records for this species along the Lower Colorado River south of Lake Havasu in southwestern AZ (K. Hinman, pers. comm.).
Arizona myotis	*Myotis lucifugus occultus*	G4	BLM	Medium	No	Verified within the Yuma Field Office (BLM 2000); known from four localities in California in the lower Colorado River valley but there are no records on the Arizona side (K. Hinman, pers. comm.). It is expected to be rare to uncommon on YPG (Castner and others 1995). In Arizona this species is found primarily along the Mogollon Rim (K. Hinman, pers. comm.).
Big brown bat	*Eptesicus fuscus*	G5		Low	No	This species is found throughout Arizona and is widespread across elevations and community types . It has been captured at roosts and foraging sites on YPG (Castner and others 1995), and captured in mist nets at foraging sites on the Kofa NWR (including at Black Tank and Hidden Valley Tank) (Snow 1998). This species is generally found in small colonies and will roost in caves, mines, rock crevices, saguaro cavities, and buildings . The management needs of this bat will be adequately met by focusing on other bat species (K. Hinman, pers. comm.).
Big free-tailed bat	*Nyctinomops macrotis*	G5	BLM	Medium	No	This species is verified to occur within the Yuma Field Office (BLM 2000), however localities need to be confirmed. It is expected to be rare or uncommon on the YPG (Castner and others 1995). This species is locally common and is widely distributed from northern South America to the southwestern U.S. It is found in rocky areas and riparian areas, roosting in caves or crevices in rock cliffs. It has not been found in apparently suitable habitat, possibly due to poor sampling, but is readily caught in mist nets .
California Leaf-nosed Bat	*Macrotus californicus*	G4	BLM, WSCA	High	Yes	This bat roosts in large numbers in mines and caves throughout the Yuma Field Office. There are three roosts on Kofa National Wildlife Refuge that have more than 250 individuals (Snow 1998); roosts are also found on the Yuma Proving Ground (Castner et al 1995). This bat has an usual mating system where males congregate in groups and display to females ("lekking"); mating sites are in mines, shallow caves, and under bridges and are known from the Imperial and Cibola National Wildlife Refuges (K. Hinman, pers. comm.).
California myotis	*Myotis californicus*	G5		Low	No	This species has been found in roosts on YPG (Castner and others1995), mines on Kofa NWR, and has been caught in abundance in mist nets at tanks (Snow 1998). It is found throughout western north America from Alaska to southern Mexico, from deserts to conifer woodlands (AGFD 1994). It roosts singly or in small groups in rock crevices, cliffs, mines, and caves. It often roosts in man-made features (AGFD 1994). The management needs of this species in the Expanded Kofa Complex are likely met by a focus on other species in the Bat Guild.

Table 8.3 Bats in the Yuma Resource Management Area

Common Name	Scientific Name	Global Rank[1] (Combined)	Status[2]	WBWG Priority Status[3]	EKC[4]	Occurrence Information and Other Comments[5]
Cave Myotis	*Myotis velifer*	G5	BLM	Medium	Yes	Found in the desert in the spring and summer; hibernates in wet mine tunnels above 6,000 feet in the fall. Roosts in caves, mines, bridges, often in association with California leaf-nosed bats, Brazilian free-tailed bats, and/or Yuma myotis.
Fringed myotis	*Myotis thysanodes*	G5	BLM	Medium	No	This species has been verified to occur within the Yuma Field Office (BLM 2000), however the localities need to be confirmed. There are no HDMS data points for this species within the Yuma Field Office, but HDMS only tracks roost sites or pregnant/lactating females of this species so it is possible that individual males or non-reproductive females were found within the Field Office (K. Hinman pers. comm.) This species is most commonly found in oak and pinyon woodlands and populations of this species seem stable in AZ although thay are rare elsewhere. This bat is easily disturbed by human presence.
Greater western mastiff bat	*Eumops perotis californicus*	G5		Medium	No	This species tends to forage at an elevation of several hundred to one thousand feet above large bodies of water, such as lakes and reservoirs, often many miles from roost sites. Roosts are in cliffs or crevices with a vertical drop of 10 feet or greater. Colonies may be composed of single bats to over 100 individuals. Because of its foraging habits, this bat is difficult to catch using mist nets and is best surveyed by echolocation. Individuals are known from the BMGR near Cabeza Prieta NWR and west of YPG on BLM land (HDMS 2003). This bat is expected to be uncommon or rare on YPG (Castner and others 1995), and was identified by echolocation calls near Palm Canyon (Snow 1998).
Hoary bat	*Lasiurus cinereus*	G5		Medium	No	A solitary bat that roosts in tree foliage or bark. Species in the genus *Lasiurus* are high, fast fliers so they may be found throughout the Yuma Field Office, and are expected to occur on YPG (Castner and others 1995). However, there have been no documented occurrences of this species within the Field Office (HDMS 2003); the Heritage Data Management System tracks all occurrences of this species in Arizona, not just roosting or maternity colonies (K. Hinman, pers. comm.).
Lesser Long-nosed bat	*Leptonycteris curasoae yerbabuenae*	G4T3T4 (G4)	WSCA, ESA (LE)	High	No	Within the Yuma Field Office, roosting colonies are found in the Cabeza Prieta NWR (HDMS 2003) and the BMGR (Marshall and others 2000; Hall and others 2001). This species is not known to occur or forage within the Expanded Kofa Complex.
Mexican Free-tailed bat	*Tadarida brasiliensis*	G5		Low	Yes	Roosting colonies occur within the Yuma Field Office on private land in the King of AZ mine (Snow 1998) and on YPG (Castner and others 1995); they have also been captured in mist nets at the overflow pond on YPG (Castner and others 1995).
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	G4		High	Yes	Known from mines on the Kofa NWR where it has also been caught in mist nets at tanks (HDMS 2003, Snow 1998).

Table 8.3 Bats in the Yuma Resource Management Area

Common Name	Scientific Name	Global Rank[1] (Combined)	Status[2]	WBWG Priority Status[3]	EKC[4]	Occurrence Information and Other Comments[5]
Pallid bat	*Antrozous pallidus*	G5		Low	No	This bat is has been mist netted at tanks on the Kofa NWR (Snow 1998) and at ponds on YPG (Castner and others 1995). It has been found on YPG near the Colorado River and in the Kofa and Castle Dome Mountains (HDMS 2003). Colonies are medium-sized (usually 10-30 individuals; occasionally up to approximately 100; K. Hinman, pers. comm.) and pallid bats often roost with other bat species in caves, mines, buildings, bridges, rock crevices, and tree cavities. The management needs of this bat will be adequately met by focusing on other bat species (K. Hinman, pers. comm.).
Pocketed Free-tailed Bat	*Nyctinomops femorosaccus*	G4	BLM	Medium	Yes	Mist netted on YPG (Castner and others 1995); found at Mittry Lake and in the Laguna Mountains (HDMS 2003). Also known from the Kofa Complex (Conservation Site #12) and the Goldwater/Organ Pipe/Pinacate Complex (Conservation Site #13; Marshall and others 2000)
Small-footed myotis	*Myotis ciliolabrum*	G5	BLM	Medium	No	Verified to occur within the Yuma Field Office (BLM 2000), however the localities need to be confirmed. There are no records for roosts, pregnant females, or maternity colonies in southwestern Arizona (K. Hinman, pers. comm.). It is possibly that non-reproductive females, or non-roosting individuals were found in this area (these types of occurrences are not tracked by HDMS). This species is found throughout the rest of AZ (K Hinman, pers. comm.).
Southern yellow bat	*Lasiurus ega*	G5	WSCA		No	This species was possibly caught in a mist net on YPG (Castner and others 1995), but according to NatureServe Explorer (2002), this bat occurs only in Texas. There is likely some taxonomic confusion within the literature regarding the distribution and status of this species because *Lasiurus xanthinus* used to be considered a subspecies of *L. ega* (K. Hinman, pers. comm.). This species roosts in palms and tree foliage.
Spotted bat	*Euderma maculatum*	G4	BLM, WSCA, USFS, MEX	Medium	No	A widespread, uncommon species that has poorly known distribution and natural history. It roosts in cliff crevices and within the Yuma Field Office it has been found on private land near the Gila River (HDMS 2003) and was collected near Yuma. It is expected to be rare or uncommon on YPG (Castner and others 1995). The spotted bat was not chosen as a conservation element at this time because it has not been found within the Expanded Kofa Complex and little is known on the ecology, abundance, and distribution of this species within the planning area. If spotted bat roost sites or maternal colonies are found within the Expanded Kofa Complex, this species should be added as a conservation element as a member of the bat guild.
Western pipistrelle	*Pipistrellus hesperus*	G5		Low	No	This species is widespread throughout Arizona, is common in residential areas, is a fairly solitary, roost generalist (uses caves, mines, crevices, and rocky cliffs) (K. Hinman pers. comm.). Western pipistrelles were the most abundant species captured in mist nets at tanks throughout Kofa NWR and YPG (Snow 1998, Castner and others 1995).

Table 8.3 Bats in the Yuma Resource Management Area

Common Name	Scientific Name	Global Rank[1] (Combined)	Status[2]	WBWG Priority Status[3]	EKC[4]	Occurrence Information and Other Comments[5]
Western red bat	*Lasiurus blossevillii*	G5	WSCA	High	No	This bat is closely associated with desert riparian areas, particularly those with cottonwoods. Roosts are in tree foliage, under bark, and in saguaro cavities. This species is expected to occur on YPG (Castner and others 1995), but there are currently no occurrences documented within the Yuma Field Office (HDMS 2003).
Western yellow bat	*Lasiurus xanthinus*	G5	WSCA	High	No	This species roosts solitarily in tree vegetation, including California fan palm fronds. It may roost in palms in residential or urban areas and can fly fairly far to foraging sites (K. Hinman, pers. comm.). It has been found at a foraging site on the Castle Dome Plain on YPG (HDMS 2003) and may be expanding its range in the southwestern U.S. Loss of roosting habitat (including trimming dead palm fronds) is a threat.
Yuma Myotis	*Myotis yumaensis*	G5		Low	No	This species has been caught in mist nets on YPG (Castner and others 1995) and is expected to occur on Kofa NWR (Snow 1998). It forages over open water and roosts in colonies near foraging sites in caves, mines, buildings, cliffs, under bridges, or in abandoned cliff swallow nests. Foraging areas and colonies are documented near YPG on the Imperial NWR (HDMS 2003). One colony co-occurs with cave myotis and California leaf-nosed bats (HDMS 2003). This species was not selected as a conservation element for the Expanded Kofa Complex because the primary foraging and roosting sites are most likely to be found along the Colorado River.

[1]Definitions of Global and Combined Global Ranks are found in Appendix C.
[2] **Status Legend:** BLM: BLM Sensitive Species, ESA: under federal protection in the U.S., MEX: under federal protection in Mexico, USFS: USFS Sensitive Species, WSCA: Wildlife of Special Concern in Arizona. Management status codes and definitions are found in Appendix D.
[3]Western Bat Working Group Regional Priority Matrix (1998). Defined in Section 8.7 of this report.
[4]Was the species selected as a preliminary conservation element of the Expanded Kofa Complex (EKC)?
[5]Much of the information provided in this column is from Hinman and Snow (2003), unless stated otherwise.

CHAPTER 9
BIODIVERSITY VALUES BEYOND THE EXPANDED KOFA COMPLEX

In this report we have provided information on a large, functional landscape within the BLM Yuma Field Office—the Expanded Kofa Complex. Although we did not include areas outside the Expanded Kofa Complex in the development of the coarse and fine filter, some of these areas play a significant role in biodiversity conservation. Important areas that were excluded from the analysis include the Colorado and Gila River corridors and the areas south of Interstate 8, including the land on the Goldwater Range and Cabeza Prieta National Wildlife Refuge.

9.1 The Yuma Dunes, Goldwater Range, and Cabeza Prieta National Wildlife Refuge

The area south of Interstate 8 is a large landscape that retains much of its ecological integrity. Conservation elements were identified, mapped, and categorized for this portion of the Yuma Planning Area in a separate effort by Hall and others (2001), and served as one starting point for developing the biodiversity management framework for the Expanded Kofa Complex. The biodiversity values of the Goldwater Range and Cabeza Prieta Refuge are discussed in great detail in Hall and others (2001) and this information is not repeated here. However, numerous Special Status species that occur within the Yuma Planning Area on the Goldwater Range and Cabeza Prieta Refuge are listed in Table 6.4. A portion of the Gran Desierto Dunes (the Yuma Dunes) is found outside the Goldwater Range in the southwestern corner of the Yuma Planning Area, primarily on BLM and Bureau of Reclamation land. This dune system provides important habitat for dune specialists, including sand food (*Pholisma sonorae*), a globally rare (G2) BLM sensitive species, and the flat-tailed horned lizard (*Phrynosoma mcallii*), a vulnerable (G3) species that is designated Wildlife of Special Concern in Arizona (AGFD 1996, HDMS 2003).

9.2 The Colorado River

The Colorado and Gila Rivers are also important areas for biodiversity conservation within the Yuma Planning Area. We did not include the river systems in our analysis of the Expanded Kofa Complex because they are highly controlled systems that retain little of their former ecological conditions, including the natural ecological processes (such as flooding) that maintained them historically. However, portions of the Colorado and Gila Rivers within the Yuma Planning Area retain remnant native habitat and areas that are important for native biodiversity, discussed below. More detailed analyses are being developed by the Multi-Species Conservation Program for the Lower Colorado River, which is tasked with the challenge of developing an ecosystem approach to biodiversity conservation within these systems (Jones and Stokes 2003).

The Colorado River has been greatly transformed since the late 1800s when it was a dynamic, free-flowing river with backwater marshes and extensive riparian woodlands. Since this time, the Lower Colorado River has been dammed and diverted, resulting in hydrological and ecological changes; its woodlands and floodplains have been converted to agricultural and urban uses, and the composition of riparian and aquatic habitats have been greatly altered by the introduction of non-native invasive species. The BLM manages a significant proportion of the land along the Colorado River in the planning area. A large part of this area has high visitation (over 60,000 annually) and is managed for recreational uses (BLM 1994). Today, the majority

of the riparian vegetation is dominated by salt cedar—only 5% (10,000 acres) of the riparian vegetation mapped along the Colorado River is native cottonwood-willow (*Populus fremontii-Salix gooddingii*) and honey mesquite (*Prosopis glandulosa* var. *torreyana*) (BOR 1997). However, these and other remnant natural habitat along the Colorado River remain valuable to native biodiversity.

The Yuma Planning Area includes the portion of the Colorado River that extends from south of the Headgate Rock Dam to the Mexico border (Figure 6.1; some portions of the river are mapped in Figures 9.1 and 9.2). Land cover has been classified in the Lower Colorado River based on plant community composition and structure (see Appendix E for definitions based on Anderson and Ohmart [1984]) and has been mapped at a 1:24,000 scale (BOR 1997). The Yuma Planning Area includes almost 44% of the mapped riparian vegetation along the Colorado River (over 88,000 acres) and the majority of the mapped extent of honey mesquite woodland (Table 9.1). The Yuma Planning Area also includes the majority (almost 90%) of the agricultural land along the river (Table 9.1). Close to 3,000 acres of cottonwood-willow riparian forest remains in the Yuma Planning Area, however, this area is composed of hundreds of small patches, the majority of which are less than 20 acres in size (Table 9.1, Figures 9.1 and 9.2). Cottonwood-willow woodland is particularly important habitat for some birds, and the loss of much of its historic extent is thought to be the cause of the decline of numerous birds that were once common throughout the area, including the Sonoran yellow warbler, vermillion flycatcher, and summer tanager, which are in danger of being extirpated on the California side of the river (Hunter 1984). Cavity-nesting birds also rely on mature cottonwood-willow woodland for nest sites. Gila woodpeckers and Gilded flickers are in decline along the Colorado River in California due to habitat loss and competition with European starlings, which are very abundant in nearby parks and agricultural fields (Hunter 1984). Both of these woodpeckers are listed Endangered by the California Department of Fish and Game (2003).

The Colorado River and its riparian vegetation provide habitat for numerous native plants and animals, including many species that are otherwise rare in Arizona (Table 6.4 includes Special Status species found along the Colorado River). Endangered species found on the Lower Colorado River include the Yuma clapper rail (*Rallus longirostris yumanensis*), southwestern willow flycatcher (*Empidonax trailii extimus*), bonytail chub (*Gila elegans*), humpback chub (*Gila cypha*), and the razorback sucker (*Xyrauchen texanus*). Arizona Heritage data for the planning area includes twenty-seven species that are found along the Colorado River, fifteen of which are found nowhere else within the planning area, and two that are found elsewhere only on the Gila River (Table 9.2).

The Lower Colorado River includes important breeding habitat for migratory birds. The Cibola and Imperial Wildlife Refuges, both found within the Yuma Planning Area, were established for this very reason and protect over 35,000 acres. The stretch of the Colorado River from the Imperial Dam to the northern boundary of the Imperial Refuge is the last unchannelized section of the river before it enters Mexico. Floods are controlled by dam releases, which constrain the natural ecological processes that would have maintained the riparian systems in the past. Nonetheless, this section of the river has numerous backwater lakes and wetlands and lacks agricultural development. Areas above Laguna Dam contain most of the marshes within the planning area, including Mittry Lake, which is habitat for California black and Yuma clapper

rails. Based on the BOR vegetation mapping of the Lower Colorado River (1997), one of the largest, contiguous stands of mature cottonwood- willow forest (110 acres, Structure Type 1) is found below the confluence with the Gila River and is surrounded by cottonwood-willow forest in other age classes (with a total of over 660 acres of cottonwood-willow). The Limitrophe section from the Morelos Dam to the Mexico border is also an area of significant biological importance. Although much of its surface water flows are from agricultural irrigation tail waters, this area includes some large stands of mature cottonwood-willow and provides habitat for native wildlife including striped mullet (*Mugil cephalus*), beaver (*Castor canadensis*), and migratory birds (J. Young, pers. comm.).

We conducted an analysis of the overlap between species occurrence (HDMS element occurrence) and riparian vegetation community and structure using GIS. The analysis did not reveal any pattern of species preference, possibly because some species localities are polygons created by buffering points and do not correspond to their preferred habitat at such a fine scale (as mapped by BOR 1997). More detailed information on Colorado River vegetation types and their associated species is analyzed in a Multi-Species Conservation Program Habitat Management Plan for the Lower Colorado River (Jones and Stokes 2003). The conservation needs of thirty species are being considered in this plan, with the goal of building regional partnerships to protect native fish, wildlife, and their habitat while considering future water and power development needs.

9.3 The Gila River

For approximately 50 miles above its confluence with the Colorado River, the lower Gila has stretches with perennial surface flows. Although these surface flows are not "natural" —they are from agricultural returns from the Wellton-Mohawk irrigation district, this area nonetheless has biological significance and restoration potential. This stretch of the lower Gila was recognized for its biological diversity—including a breeding area for southwestern willow flycatchers—in the Sonoran Desert Ecoregion assessment, although it was not included in a conservation area (Marshall and others 2000). Although much of the vegetation along the lower Gila is non-native salt cedar, young stands of cottonwood-willow are also scattered in the area (Table 9.3), as well as remnant mesquite bosque and wetlands (J. Rorabaugh, pers. comm.). The lower Gila River and its surrounding vegetation provides habitat for native riparian and marsh birds, one native species of fish (striped mullet), and numerous native amphibians, including Woodhouse's toad (*Bufo woodhousii*), the Great Plains toad, Colorado River toad, and the red-spotted toad. Tributary washes into the Gila also support Couch's spadefoot. Non-native bullfrogs and Rio Grande leopard frogs (*Rana berlandieri*) also occur in this area (J. Rorabaugh, pers. comm.).

Other portions of the Gila River within the planning area have valuable habitat. Aside from the BOR vegetation map for the lower Gila River (1997), the majority of the vegetation mapped along the Gila River displayed in Figure 9.2 was produced by Marshall and others (2000) and was based primarily on Arizona Gap Vegetation (1998), which was mapped for the state at a relatively coarse scale. A more refined vegetation map for this area would help to identify areas where rare and regionally vulnerable natural communities persist, such as mesquite bosque and saltbush desert scrub. Saltbush Desert Scrub has largely been lost throughout the Sonoran Desert due to agricultural development and it provided important breeding habitat for Le Conte's

thrasher. The extent of mesquite bosques has also been greatly reduced throughout much of the Sonoran Desert. Some remnant patches along the floodplain terraces remain within the planning area but are not currently mapped, such as one found north of Dateland.

Tacna Marsh, also known as Quigley Pond, is an oxbow of the Gila River located approximately two miles north of Tacna. The marsh is approximately 100 acres (40 hectares) and is a Wildlife Area managed by the Arizona Game and Fish Department. The cattail marsh is habitat for the Western least bittern and Yuma clapper rail (Marshall and others 2000, HDMS 2003), as well as numerous other wetland birds such as ducks, herons, egrets, sora, marsh wren, and yellow-headed blackbird.

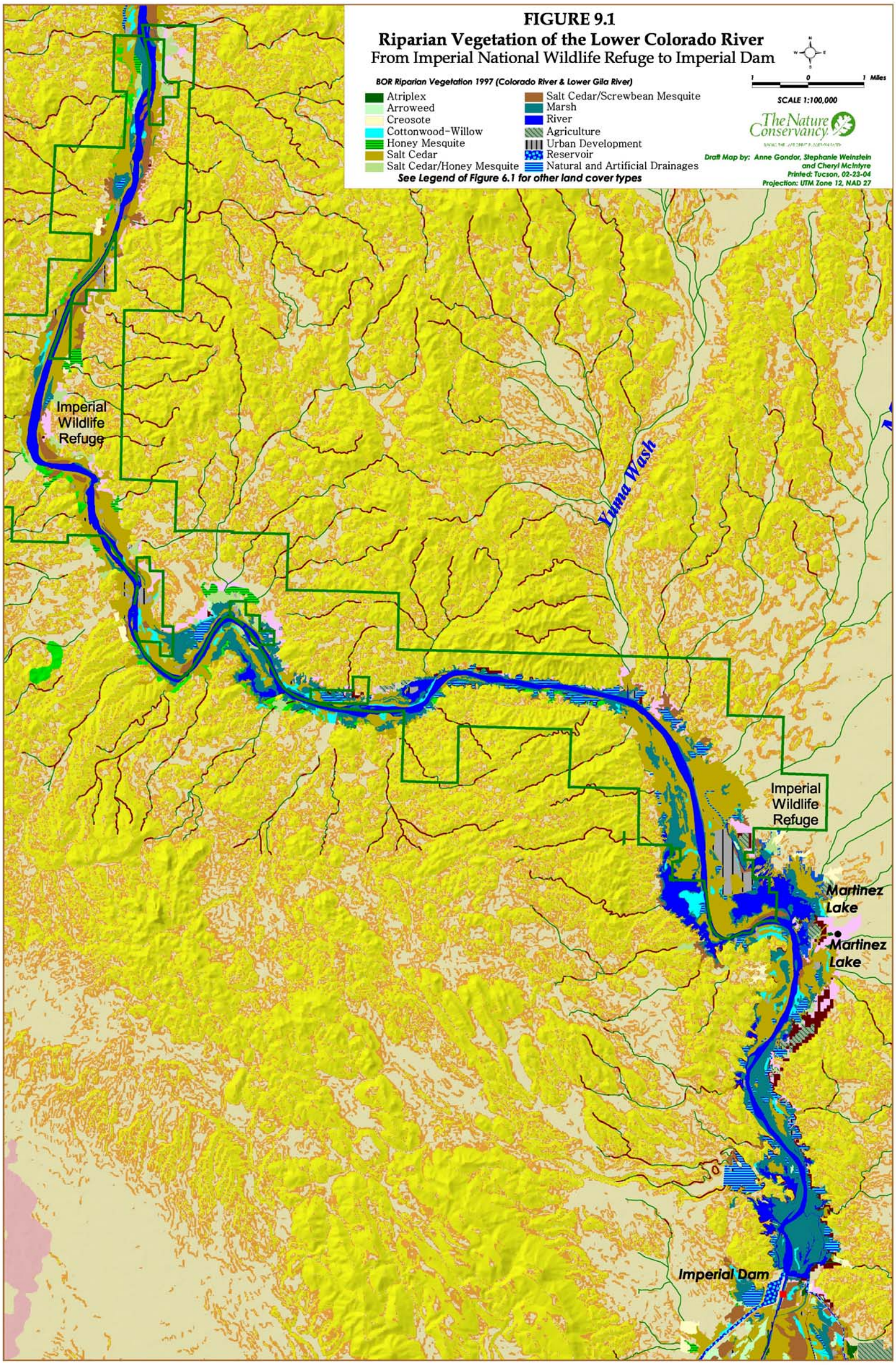


FIGURE 9.1
Riparian Vegetation of the Lower Colorado River
From Imperial National Wildlife Refuge to Imperial Dam
BOR Riparian Vegetation 1997 (Colorado River & Lower Gila River)
Atriplex
Arroweed
Creosote
Cottonwood-Willow
Honey Mesquite
Salt Cedar
Salt Cedar/Honey Mesquite
Salt Cedar/Screwbean Mesquite
Marsh
River
Agriculture
Urban Development
Reservoir
Natural and Artificial Drainages
See Legend of Figure 6.1 for other land cover types
1 0 1 Miles
SCALE 1:100,000
The Nature Conservancy
Draft Map by: Anne Gondor, Stephanie Weinstein and Cheryl McIntyre
Printed: Tucson, 02-23-04
Projection: UTM Zone 12, NAD 27
Imperial Wildlife Refuge
Yuma Wash
Imperial Wildlife Refuge
Martinez Lake
Martinez Lake
Imperial Dam

FIGURE 9.2
Riparian Vegetation on the Lower Colorado and Lower Gila Rivers

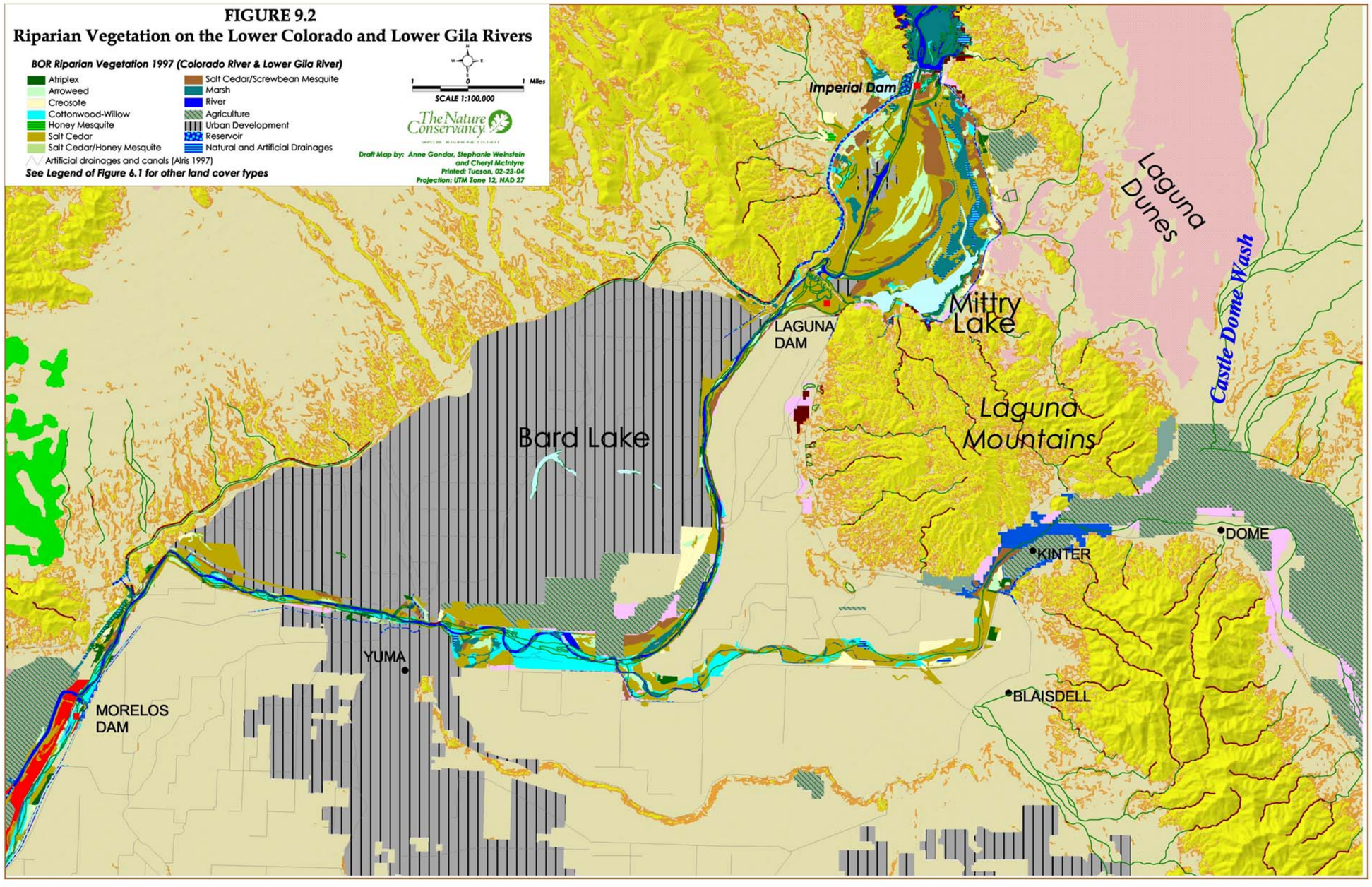


Table 9.1 Area of Riparian Vegetation Community and Structure Types on the Lower Colorado River in the BLM Yuma Resource Management Area
(BOR 1997, based on Anderson and Ohmart 1984)

Community and Structure[1]	Yuma RMA (acres)	Total Area (acres)	# of Polygons	% within the Yuma RMA
AG	1,461.83	1,631.67	3	89.6%
ATX	657.53	883.41	69	74.4%
AW	3,306.95	4,630.77	215	71.4%
CR	905.43	1,294.54	44	69.9%
CW-I	250.60	986.16	26	25.4%
CW-II	129.82	222.27	9	58.4%
CW-III	1,197.69	2,932.75	132	40.8%
CW-IV	1,040.58	1,939.24	133	53.7%
CW-V	160.80	396.81	34	40.5%
CW-VI	189.89	319.39	27	59.5%
TOTAL CW	2,969.39	6,796.62	361	43.7%
HM-III	394.23	440.30	16	89.5%
HM-IV	1,987.81	2,159.18	85	92.1%
HM-V	362.94	584.37	23	62.1%
HM-VI	81.81	81.92	4	99.9%
TOTAL HM	2,826.79	3,265.78	128	86.6%
MA-1	2,030.12	4,461.27	177	45.5%
MA-2	269.86	483.60	43	55.8%
MA-3	1,956.25	2,517.38	233	77.7%
MA-4	1,136.12	2,370.31	107	47.9%
MA-5	162.30	641.03	29	25.3%
MA-6	557.41	716.60	96	77.8%
MA-7	261.68	788.40	87	33.2%
TOTAL MA	6,373.74	11,978.59	772	53.2%
OW	1,716.08	9,437.89	131	18.2%
RIV	11,398.64	63,472.55	11	18.0%
SC-I	36.47	36.52	5	99.9%
SC-II	23.63	346.69	5	6.8%
SC-III	572.13	4,450.56	35	12.9%
SC-IV	22,633.00	35,545.61	592	63.7%
SC-V	9,620.94	18,041.45	340	53.3%
SC-VI	5,815.70	8,713.76	260	66.7%
TOTAL SC	38,701.87	67,134.59	1,237	57.6%
SH-III	92.35	243.49	13	37.9%
SH-IV	6,683.46	8,732.56	142	76.5%
SH-V	2,662.63	5,143.71	55	51.8%
SH-VI	369.80	1,039.29	16	35.6%
TOTAL SH	9,808.24	15,159.05	226	64.7%
SM-III	28.76	436.62	4	6.6%
SM-IV	4,081.59	7,218.11	211	56.5%
SM-V	1,437.41	2,828.08	89	50.8%
SM-VI	479.45	1,275.42	26	37.6%
TOTAL SM	6,027.22	11,758.24	330	51.3%
SOW	416.25	454.07	37	91.7%
UD	1,452.35	3,274.68	112	44.4%
GRAND TOTAL	**88,022.31**	**201,172.44**	**3,676**	**43.8%**

[1]See Appendix E for riparian vegetation community and structure type codes.

Table 9.2 Species Tracked by the Arizona Heritage Data Management System that are Associated with the Colorado River in the Yuma Resource Management Area

All species except those in bold occur only along the Colorado River in the Yuma Planning Area. Species in bold are found along both the Colorado River and the Gila River in the Yuma Planning Area (HDMS 2003).

COMMON NAME	SCIENTIFIC NAME
Black-necked stilt	*Himantopus mexicanus*
Bonytail	*Gila elegans*
California black rail	*Laterallus jamaicensis coturniculus*
Cattle egret	*Bulbucus ibis*
Great blue heron	*Ardea herodias*
Great egret	*Ardea alba*
Needles knotweed	*Polygonum fusiforme*
Razorback sucker	*Xyrauchen texanus*
Southwestern willow flycatcher	***Empidonax traillii extimus***
Spiny pocket mouse	*Chaetodipus spinatus*
Upright burrhead	*Echinodorus berteroi*
Western least bittern	*Ixobrychus exilis hesperis*
Western yellow-billed cuckoo	***Coccyzus americanus occidentalis***
White-faced ibis	*Plegatus chihi*
Yuma clapper rail	*Rallus longirostris yumanensis*
Yuma hispid cotton rat	*Sigmodon hispidus eremicus*
Yuma myotis	*Myotis yumanensis*

Table 9.3 Area of Riparian Vegetation Community and Structure Types on the Lower Gila River (BOR 1997 and Anderson and Ohmart 1984).[1]

Community and Structure[1]	Lower Gila River (acres)	Number of polygons	Percentage of Total
AG	0	0	0
ATX	67.25	4	3.4%
AW	84.11	10	4.3%
CR	213.60	9	10.8%
CW-I	34.04	5	1.7%
CW-II	0	0	0
CW-III	69.60	12	3.5%
CW-IV	86.90	17	4.4%
CW-V	43.39	5	2.2%
CW-VI	57.22	2	2.9%
TOTAL CW	291.15	41	14.7
TOTAL HM	0	0	0
MA-1	0	0	0
MA-2	0	0	0
MA-3	20.45	11	1.0%
MA-4	0	0	0
MA-5	0	0	0
MA-6	1.11	1	0.1%
MA-7	62.69	16	3.2%
TOTAL MA	84.24	28	4.3
OW	25.14	3	1.3%
RIV	80.34	1	4.1%
SC-I	29.84	2	1.5%
SC-II	0	0	0
SC-III	11.63	3	0.6%
SC-IV	259.84	24	13.2%
SC-V	151.80	14	7.7%
SC-VI	533.74	36	27.0%
TOTAL SC	986.84	79	50.0
TOTAL SH	0	0	0
SM-III	0	0	0
SM-IV	111.92	11	5.7%
SM-V	1.83	1	0.1%
SM-VI	0	0	0
TOTAL SM	113.75	12	5.8
SOW	28.29	6	1.4%
UD	0	0	0
GRAND TOTAL	**1,974.72**	**193**	**100.0%**

[1] See Appendix E for riparian vegetation community and structure type codes.

CHAPTER 10
COORDINATED MANAGEMENT OPPORTUNTIES

One goal of the analysis presented in this report was to identify coordinated management opportunities within the Yuma Planning Area, particularly between the resource managers in the Expanded Kofa Complex: the Arizona Game and Fish Department, BLM Yuma Field Office, Yuma Proving Ground, and U.S. Fish and Wildlife Service at Kofa National Wildlife Refuge. Coordinated ecosystem management can be a challenging enterprise. Different missions constrain and guide natural resource management on different land management units and a tendency exists to demarcate boundaries with roads and fences. However, biodiversity does not fit neatly within administratively or politically defined boundaries and roads and fences can inhibit any number of ecological processes. Federal agencies within the Yuma Planning Area are poised to meet—and in many cases are already meeting—the challenges of coordinated ecosystem management. In our discussions with agency staff, we found that agencies in the region currently cooperate to resolve many natural resource issues and a strong collaborative environment already is in place.

Agency staff mentioned numerous areas in which they are working cooperatively on natural resource management issues. Some notable coordinated efforts are listed below, with the primary participating agencies noted in parentheses.

- **Bighorn sheep management (AGFD, BLM, YPG, and USFWS).** The agencies involved in bighorn management depends on the specific area of interest. For example, AGFD, BLM, and the Kofa Refuge collaborate on bighorn issues in the Kofa and New Water Mountains, whereas AGFD and YPG are working together to resolve impediments to bighorn movement in the Laguna Mountains.

- **Wild horse and burro management (AGFD, BLM, YPG, and USFWS).** The BLM and YPG work together to conduct wild horse and burro surveys, measure utilization on key plant species, and remove animals in excess of the appropriate management level (AML) (K Reichhardt, pers. comm.). The BLM Yuma Field Office is currently coordinating efforts with an interdisciplinary team represented by staff from the USFWS, YPG, and AGFD to develop a cooperative management plan for lands and resources contained within the Cibola-Trigo Wild Horse and Burro Herd Management Area. The Draft Herd Management Area Plan is expected to be released this year as part of the Trigo-Imperial Wilderness Management Plan (R. Oyler, pers. comm.).

- **Sonoran pronghorn management (AGFD, BLM, YPG, and Kofa NWR).** The AGFD Research Branch is evaluating three areas for potential pronghorn reintroduction including the La Posa Plain, Castle Dome Plain, and King Valley. Each of these areas has multiple land managers, including YPG, BLM, and/or USFWS (at Kofa NWR). Because Sonoran pronghorn is a nomadic species that requires large unfragmented areas to maintain viable populations, successful management of a recovery population will require coordination of all agencies in the region.

- **Recreation management (AGFD, BLM, and USFWS).** The Colorado River provides numerous recreational opportunities to many residents and tourists. The AGFD, BLM, and USFWS at Imperial and Cibola Refuges coordinate recreation activities on BLM land and at the National Wildlife Refuges along the Colorado River. The agencies also work with state and county law enforcement, as necessary.

- **Resource management planning (AGFD, BLM, YPG, and USFWS).** Federal land managers have developed (or are in the process of developing) coordinated management plans, including the Kofa and New Water Mountain Wilderness Management Plan (BLM and USFWS 1996) and the Trigo-Imperial Wilderness Management Plan (in progress by BLM and USFWS). Staff from all four agencies are on the planning teams for other planning efforts, such as YPG's Integrated Natural Resource Management Plan.

- **Invasive non-native species management (AGFD, BLM, USFWS, and YPG).** Representatives from all four agencies are involved in invasive species management coordinated in the King of Arizona Weed Management Area. The BLM and USFWS are members of the Lower Colorado Giant Salvinia Task Force, a task force consisting of 13 agencies to manage giant salvinia (*Salvinia molesta*) along the Colorado River.

- **Multi-Species Conservation Program (MSCP) for the Colorado River** (**AGFD, BLM, USFWS**). Representatives from the AGFD, BLM, and USFWS are participants in the MSCP. The MSCP is a regional partnership that aims to protect sensitive species and habitats along the lower Colorado River.

- **Wildlife waters research (AGFD, YPG, and Kofa NWR).** The effects of water development on native and non-native wildlife in the desert Southwest is a topic of great controversy and debate. The AGFD is conducting scientific research on the effects of water development in an attempt to resolve some pressing questions, including the effects of water development on water quality and wildlife disease, water use by native wildlife (bats, bighorn sheep, coyote, and migratory birds), and water use by native and non-native pollinators. This research is being conducted at waters on YPG and the Kofa Refuge (Rosenstock and others 2002).

In addition to the examples listed above, potential coordinated management opportunities can be determined by considering where the conservation elements described in this report are distributed across land managed by different agencies. For example, management of the Mountain Upland natural community and the California fan palm population is the responsibility of the Kofa Refuge and can be accomplished without cooperation from other land managers. In contrast, the hydrologic functionality of Valley Xeroriparian Scrub and Braided Channel Floodplain natural communities will only be maintained or restored by coordinated management between agencies. Additionally, some species elements, such as bighorn sheep, routinely cross administrative boundaries to meet their life-cycle needs.

In short, the information on the conservation elements of the Expanded Kofa Complex provided in this report can serve to guide and encourage future cooperative efforts between federal land managers by providing land managers: (1) regional- and landscape-scale contexts that highlight

the relative significance of their individual land management unit and the complex's biological resources, (2) a focal set of community- and species-level conservation elements that are meant to represent all of the biodiversity of the complex for planning and management purposes, and (3) an initial understanding of the supporting ecological processes, primary threats, and information gaps that must be addressed to define and manage the Expanded Kofa Complex as a functional conservation area. It is only by continuing the spirit of collaboration that already exists between agencies in the Yuma Planning Area that the functional landscape of the Expanded Kofa Complex and its biodiversity will be conserved.

CHAPTER 11
DATA NEEDS AND NEXT STEPS

This report presents detailed information on the biodiversity of a functional Sonoran Desert landscape—the Expanded Kofa Complex. Although much of the Expanded Kofa Complex is protected from certain types of activities and anthropogenic uses, the area is not a nature preserve. A functional landscape can be maintained and still allow for a multitude of human uses and meet the missions of each agency that manages land within the Expanded Kofa Complex.

The major questions that have not been addressed in this report are "how much is enough?" and "what areas are needed—and in what condition?"—that is, how much and what parts of the landscape are needed to maintain the composition, structure, and function of the natural communities and to sustain the needs of resident and migratory species? The boundary of the Expanded Kofa Complex represents an initial attempt to delineate a functional conservation area in the Yuma Planning Area, and the selected conservation elements (and related distribution and occurrence information) provide a starting point to identify some important components of Sonoran Desert biodiversity, including where they occur and their ecological requirements. To determine "how much is enough" and "what areas are needed", it would be necessary to address some data limitations and conduct additional analyses.

11.1 Natural Community Mapping

The natural community map presented in this report is preliminary and is based primarily on GIS modeling and analysis of remotely sensed imagery for select areas. As mentioned in Chapter 7, additional natural communities, such as Desert Pavement and Creosotebush-Big Galleta Scrub, may be appropriate conservation elements but a lack of information hindered our ability to map their occurrence at this time. It is essential that appropriate coarse filter conservation elements are selected and mapped in order to evaluate "how much is enough" and "what areas are needed" to maintain the biodiversity of the region. The boundaries and descriptions of the natural communities of the Expanded Kofa Complex could be refined with more extensive analysis of remotely sensed imagery (including aerial photos, DOQQs, and satellite imagery) and with field assessments. Land Condition Trend Analysis (LCTA) data for YPG could be useful to verify or "ground truth" natural community mapping at plot locations.

Because vegetation cover in parts of the Expanded Kofa Complex is extremely sparse, soil maps are valuable sources of data that can be used to help delineate the boundaries of some natural communities. Soils were used to identify the Dune Complex and Braided Channel Floodplain natural communities and could be used to help delineate other natural communities, such as Desert Pavement. However, fine-scale soil maps only exist for YPG, making it difficult to map natural communities that extend across political boundaries.

11.2 Historic and Existing Land Uses

Spatially-explicit land use information is necessary to identify where the best opportunities are for biodiversity conservation and where conflicts with other land uses would be minimized.

Although some spatial data on land use was available for this analysis, such as Wilderness and recreation sites, more complete information is needed in spatial format from the BLM, Kofa Refuge, and YPG to identify areas of current or past ground disturbance. A more detailed road spatial layer could be used as an indicator for potentially disturbed areas. Information on roads and land uses would be particularly useful to map areas of Desert Pavement that are more likely to be intact and therefore more likely to transfer surface water to adjoining runnels and function as an integrated system with adjacent Valley Xeroriparian Scrub natural communities.

Field assessments, such as those conducted on the Sonoran Desert National Monument (Morrison and Snetsinger 2003), are relatively expensive and time consuming but could provide the most detailed information on the natural range of variation of natural communities and their condition, including the presence of invasive non-native species and other potential disturbance vectors such as unsustainable livestock or wild horse and burro grazing. Partner agencies in the Yuma Planning Area have data that would be useful for evaluating natural community condition, but an assessment of these data was beyond the scope of our analysis. Other useful investigations include analysis of land cover change using remote sensing, which could provide valuable information on disturbance history or recovery from past activities, and hydrologic modeling based on watershed boundaries to help determine the potential impacts from military or other activities on off-site areas, such as the Colorado and Gila Rivers. This latter topic is of particular interest to YPG and they have begun to research this subject.

11.3 Ecological Requirements of Species

The ecological requirements of species conservation elements can be used to refine the boundary of the functional conservation area (Lambeck 1997). The movements and impediments to movement of desert bighorn sheep (Figure 8.12) is one source of information that may help to refine the boundary of the Expanded Kofa Complex and provide information on the areas that are needed to maintain movement corridors and population viability. The habitat needs of other species may also help determine how much of a natural community is required or the spatial configuration and landscape context of natural communities that are needed to maintain a population. For example, some bats may require a certain type of roost site within a specific distance to preferred foraging areas. This report did not attempt to do a complete ecological characterization of every species conservation element. A next step to refine the boundary of the Expanded Kofa Complex and determine “how much is enough” and “what areas are needed” would be to research each species conservation element and the natural range in variation of their composition, structure, landscape context, and management needs within the Expanded Kofa Complex.

CHAPTER 12
LITERATURE CITED

[ABBA] Arizona Breeding Bird Atlas. 2001. Unpublished data (collected 1993 through 2000). Arizona Game and Fish Department, Nongame Branch, Phoenix, Arizona.

Abouhaidar, F. 1992. Influence of livestock grazing on saguaro seedling establishment. Pages 57-59 in Proceedings of the Symposium on Research in Saguaro National Monument, 23-24 January 1991. C.P. Stone and E.S. Bellantoni (editors). Southwest Parks and Monuments Association, Globe, Arizona.

[AGFD] Arizona Game and Fish Department. 1994. *Myotis californicus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona. 3pp.

[AGFD] Arizona Game and Fish Department. 1996. Wildlife of Special Concern in Arizona. March16, 1996 in prep. Arizona Game and Fish Department Publication. Phoenix, Arizona. 32pp.

[AGFD] Arizona Game and Fish Department. 2001. *Macrotis californicus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

[AIDTT] Arizona Interagency Desert Tortoise Team. 1996. Management Plan for the Sonoran Desert Population of the Desert Tortoise in Arizona. December 1996. 55pp.

Anderson, B.W. and R.D. Ohmart. 1984. Vegetation Community Type Maps, Lower Colorado River. U.S. Bureau of Reclamation, Boulder City, NV. 59 pp.

Arizona Department of Commerce, Quartzsite Chamber of Commerce, and Town of Quartzsite. 2001. Quartzsite Community Profile. Available online at http://www.ci.quartzsite.az.us/community_profile.htm (Accessed July 2003).

Arizona Gap Program. 1998. Arizona Gap Map. U.S. Geological Survey, Cooperative Park Studies Unit, Arizona Gap Program, University of Arizona, Tucson.

Averill-Murray, R.C., A.P. Woodman, and J.M. Howland. 2002. Population ecology of the Sonoran Desert Tortoise in Arizona. Pages 109-134 in The Sonoran Desert Tortoise: Natural History, Biology, and Conservation. T. R. Van Devender (editor). University of Arizona Press and The Arizona-Sonora Desert Museum. Tucson, AZ.

Begon, M., J.L. Harper, and C.R. Townsend. 1990. Ecology: Individuals, Populations, and Communities. 2nd edition. Blackwell Scientific Publications, Cambridge, Massachusetts.

Belnap, J. and D.J. Eldridge. 2001. Disturance and recovery of biological soil crusts. Pages 363-384 in Biological Soil Crusts: Structure, Function, and Management. Belnap, J., and O.L. Lange (editors). Springer-Verlag, Heidelberg, Germany.

Belnap, J., and O.L. Lange (editors). 2001. Bological Soil Crusts: Structure, Function, and Management. Springer-Verlag, Heidelberg, Germany.

Belnap, J. and S.D. Warren. 2002. Patton's tracks in the Mojave Desert, USA. Arid Land Research and Management 16:245-258.

Benson, L. 1969. The cacti of Arizona. University of Arizona Press, Tucson.

[BLM] U.S. Bureau of Land Management. 1988. Desert Tortoise Habitat Management on the Public Lands: A Rangewide Plan. November, 1988. Washington, D.C.

[BLM] U.S. Bureau of Land Management. 1990. Strategy for Desert Tortoise Habitat Management on Public Lands in Arizona. October, 1990.

[BLM] U.S. Bureau of Land Management. 1995. Eagletail Mountains Wilderness Management Plan, Environmental Assessment, and Decision Record. E.A.-AZ-055-94-80. Yuma Resource Area, Arizona.

[BLM] U.S. Bureau of Land Management. 1997. La Posa Interdisciplinary Management Plan. Yuma Field Office. EA-AZ-055-96-051.

[BLM] U.S. Bureau of Land Management. 2000. Arizona BLM Sensitive Species List (October, 2000). United States Department of the Interior, Bureau of Land Management, Arizona State Office. Available online at http://www.blm.gov/nhp/efoia/az/2000IMs/AZIM2000-018.htm.

[BLM and CDFG] U.S. Bureau of Land Management (California Desert District) and California Department of Fish and Game (Inland, Deserts, and Eastern Sierra Region). 2002. Proposed Northern and Eastern Colorado Desert Coordinated Management Plan and Final Environmental Impact Statement. Available online at http://www.ca.blm.gov/news/pdfs/neco2002 .

[BLM and USFWS] U.S. Bureau of Land Management and U.S. Fish and Wildlife Service. 1996. Kofa National Wildlife Refuge and Wilderness and New Water Mountains Wilderness Interagency Management Plan, Environmental Assessment, and Decision Record. EA-AZ-055-95-105.

[BOR] U.S. Bureau of Reclamation. 1997. Digital mapping of the vegetation community and structure types on the Colorado River. (GIS database).

Bowers, J. E. 1984. Plant geography of southwestern sand dunes. Desert Plants 6(1): 31-42, 51-54.

Brown, D.E. 1978. The vegetation and occurrence of chaparral and woodland flora on isolated mountains within the Sonoran and Mojave Deserts in Arizona. Journal of the Arizona-Nevada Academy of Science. 13: 7-12.

Brown, D.E., N.B. Carmony, C.H. Lowe, and R.M. Turner. 1976. A second locality for native California fan palms (*Washingtonia filifera*) in Arizona. Journal of the Arizona Academy of Science 11: 37-41.

Brown, D.E. and C.H. Lowe. 1980. Biotic Communities of the Southwest (map at scale 1:1,000,000). U.S.D.A. Forest Service General Technical Report RM-78.

Brown, D.E. and C.H. Lowe. 1994. Biotic Communities of the Southwest. A supplementary map to D.E. Brown (editor), Biotic Communities: Southwestern United States and Northwestern Mexico. University of Utah Press, Salt Lake City. Originally published in 1980 as General Technical Report RM-78 by the Rocky Mountain Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture.

Broyles, B. 1996. Surface water resources for prehistoric peoples in western Papagueria of the North American Southwest. Journal of Arid Environments 33:483-495.

Buchmann, S.L. 2000. Bees. Pages 341-344 in A Natural History of the Sonoran Desert. Phillips, S.J. and P. Wentworth Comus (editors). Arizona-Sonora Desert Museum Press, Tucson, AZ. 628 pp.

Buchmann, S., A. Donovan, M. Rabe, and R.L. Minckley. 2002. Monitoring native bee and other pollinator diversity on the Yuma Proving Grounds and Kofa Wildlife Refuge in southwest Arizona. Meeting Resource Management Information Needs: Fourth Conference on Research and Resource Management in the Southwestern Deserts, Extended Abstracts. W.L. Halvorson and B.S. Gebow (editors). USGS Sonoran Desert Field Station, University of Arizona, Tucson.

Buchmann, S.L. and G.P. Nabhan. 1996. The Forgotten Pollinators. Island Press/Shearwater Books, Washington, D.C.

Búrquez, A., A. Martínez-Yrízar R.S. Felger, and D. Yetman. 1999. Vegetation and Habitat Diversity at the Southern Edge of the Sonoran Desert. Pages 36-67 in Ecology of Sonoran Desert Plants and Plant Communities. R.H. Robichaux (editor). University of Arizona Press, Tucson.

Caro, T.M., and G. O'Doherty. 1999. On the use of surrogate species in conservation biology. Conservation Biology 13:805–814.

Castner, S.V., T.K. Snow, and D.C. Noel. 1995. Bat Inventory of the U.S. Army Yuma Proving Ground, Arizona: 1995. Nongame and Endangered Wildlife Program Technical Report 90. Arizona Game and Fish Department, Phoenix, Arizona.

[CDFG] California Department of Fish and Game. 2003. California's Plants and Animals: Threated and Endangered Birds, List and Species Accounts. Habitat Conservation Planning Branch, California Department of Fish and Game Available online at http://www.dfg.ca.gov/chpb/specis/t_e_spp/tebirda.shtml last revised May 5, 2003. (Accessed June 2003).

Center for Ecological Management of Military Lands. 1995. Vascular Plant List of Yuma Proving Grounds La Paz and Yuma Counties, Arizona. June 8, 1995. Center for Ecological Management of Military Lands. Department of Forest Sciences Colorado State University, Fort Collins, Colorado.

[CNPS] California Native Plant Society 2002. Inventory of Rare and Endangered Plants. Version 6.1, November 2002. http://www.CalFlora.org. (Accessed June 2003).

Cornett, J.W. 1987. Indians and the desert fan palm. Masterkey: Anthropology of the Americas, Southwest Museaum 60(4): 12-17.

Cornett, J.W. and J.M. Stewart. 1986. Palm burning and increased spadix production. The Southwestern Naturalist 31(4): 552-553.

Council on Environmental Quality. 1993. Incorporating Biodiversity Considerations into Environmental Impact Analysis Under the National Environmental Policy Act. Council on Environmental Quality, Executive Office of the President, Washington, D.C.

Crother, B.I. 2000. Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in our Understanding. Society for the Study of Amphibians and Reptiles, Herpetological Circular Number 29. 82 pp.

Ecological Society of America. 1995. The Scientific Basis for Ecosystem Management. Ad hoc Committee on Ecosystem Management, Ecological Society of America, Washington, D.C.

Edwards, T., D.E. Swann, and C.R. Schwalbe. 2002. Assessment of landscape change on desert tortoise populations using genetic analyses. Meeting Resource Management Information Needs: Fourth Conference on Research and Resource Management in the Southwestern Deserts, Extended Abstracts. W.L. Halvorson and B.S. Gebow (editors). USGS Sonoran Desert Field Station, University of Arizona, Tucson.

Esque, T.C., A. Búrquez M., C.R. Schwalbe, T. R. Van Devender, P. J. Anning, and M. J. Nijhuis. Fire Ecology of the Sonoran Desert Tortoise. Pages 312-333 in The Sonoran Desert Tortoise: Natural History, Biology, and Conservation. T.R. Van Devender (editor). University of Arizona Press and The Arizona-Sonora Desert Museum. Tucson, AZ.

Felger, R.S. 2000. Flora of the Gran Desierto and Rio Colorado of northwestern Mexico. University of Arizona Press, Tucson.

Franklin, J.F. 1993. Preserving biodiversity: species, ecosystems, or landscapes. Ecological Applications 3:202-205.

Goldberg, D.E. and R.M. Turner. 1986. Vegetation change and plant demography in permanent plots in the Sonoran Desert. Ecology. 67(3): 695-712.

Goode, M.J., J.M. Howland, and M.J. Sredl. 1995. Effects of Microhabitat Destruction on Reptile Abundance in Sonoran Desert Rock Outcrops. Nongame and Endangered Wildlife Program Heritage Report. Arizona Game and Fish Department, Phoenix, Arizona. 22 pp.

Goode, M.J., D.E. Swann, C.R. Schwalbe, and R.W. Mannan. 1998. The Effects of Microhabitat Destruction on Reptile Abundance. Nongame and Endangered Wildlife Program Heritage Report. Arizona Game and Fish Department, Phoenix, Arizona.

Grover, M.C., DeFalco, L.A., and Intermountain Research Station 1995. Desert tortoise (*Gopherus agassizii*) Status-of-knowledge Outline with References. General technical report INT 316. U.S. Dept. of Agriculture Forest Service, Intermountain Research Station, Ogden, Utah 134 pp.

Groves, C.R., D.B. Jensen, L.L.Valutis, K.H. Redford, M.L. Shaffer, J.M. Scott, J.V. Baumgartner, J.V. Higgins, M.W. Beck and M.G. Anderson. 2002. Planning for biodiversity: putting conservation science into practice. BioScience 52:499–512.

Groves, C., C.L. Valutis, D. Vosick, B. Neely, K. Wheaton, J. Touval, and B. Runnels. 2000. Designing a Geography of Hope: A Practitioner's Handbook for Ecoregional Conservation Planning. The Nature Conservancy, Arlington, Virginia.

Gutierrez-Palmenberg and Jason Associates. 2001. Yuma Proving Ground Final Range Wide Environmental Impact Statement. Command Technology Directorate CSTE-DTC-YP-CD-ES. Yuma, AZ.

Hall, J.A., P. Comer, A. Gondor, R. Marshall, and S. Weinstein. 2001. Conservation Elements of and a Biodiversity Management Framework for the Barry M. Goldwater Range, Arizona. The Nature Conservancy of Arizona, Tucson. 199 + ix p. + 15 unpaginated figures.

[HDMS] Heritage Data Management System. 2003 Arizona Game and Fish Department Heritage Data Management System. Element occurrences for the Yuma Field Office and surroundings. (GIS database).

Hickman, J.C. (editor). 1993. The Jepson Manual: Higher plants of California. University of California Press, Berkeley, California. 1400 pp.

Hinman, K.E. and T.K. Snow (editors). 2003. Arizona Bat Conservation Strategic Plan. Nongame and Endangered Wildlife Program Technical Report 213. Arizona Game and Fish Department, Phoenix, Arizona.

Howland, J.M. and J.C. Rorabaugh. 2002. Conservation and protection of the desert tortoise in Arizona. Pages 334-354 in T.R. VanDevender (editor). The Sonoran Desert Tortoise: Natural History, Biology, and Conservation. University of Arizona Press and The Arizona-Sonora Desert Museum, Tucson.

Hunter, M.L., G.L. Jacobson, Jr., and T. Webb, III. 1988. Paleoecology and the coarse-filter approach to maintaining biological diversity. Conservation Biology 2: 375–385.

Hunter, W.C. 1984. Status of nine bird species of special concern along the Colorado River. Report No. 84-2, State of California Department of Fish and Game, Nongame Wildlife Investigations, Wildlife Management Branch Administration, December 1984. Available online at http://www.dfg.ca.gov/hcpb/info/bm_pdfrpts/84_09.pdf

[ITIS] Integrated Taxonomic Information System. 2002. Integrated Taxonomic Information System online database, http://www.itis.usda.gov. (Accessed June 2003).

Jones and Stokes. 2003. Lower Colorado River Multi-Species Conservation Program Habitat Conservation Plan. May 22, 2003 Preliminary Draft. Prepared for Steering Committee. SAIC/Jones and Stokes. Sacramento, CA. Available online at http://www.lcrmscp.org/files.html

Kade, A. and S.D. Warren. 2002. Soil and plant recovery after military disturbance. Arid Land Research and Management 16:231-243.

Kearney, T.H., R.H. Peebles, and Collaborators. 1973. *Arizona Flora*. 2nd Edition with Supplement by J.T. Howell, E. McClintock, and Collaborators. University of California Press, Berkeley.

Kearns, R. 2001. *Washingtonia filifera* Survey. Unpublished data gathered on October 10, 2001 by Kofa NWR biologist Ron Kearns and SCEP student, Moon.

Kerpez, T.A. and N.S. Smith. 1990. Competition between European starlings and native woodpeckers for nest cavities in saguaros. Auk. 107: 367-375.

Krausman, P.R., A.V. Sandoval, and R.C. Etchberger. 1999. Natural history of desert bighorn sheep. Pages 139–191 in Mountain Sheep of North America. R. Valdez and P.R. Krausman (editors). University of Arizona Press, Tucson, Arizona.

Kunzmann, M.R., S.L. Buchmann, J.F. Edwards, S.C. Thoenes, and E.H. Erickson. 1995. Africanized bees in North America. Pages 448-451 in Our Living Resources: A Report to the Nation on the Distribution, Abundance, and Health of U.S. Plants, Animals, and Ecosystems. E.T. LaRoe, G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac (editors). U.S. Department of the Interior, National Biological Service, Washington, D.C. Available online at http://biology.usgs.gov/s+t/index.htm

Lambeck, R.J. 1997. Focal species: a multi-species umbrella for nature conservation. Conservation Biology 11(4): 849-856.

Landres, P.B., J. Verner, and J.W. Thomas. 1988. Ecological uses of vertebrate indicator species: a critique. Conservation Biology 2(4): 316-328.

Larsen, E. and C. Olson. 1997. Aquatic Coleoptera and Hemiptera of Organ Pipe Cactus National Monument, Arizona. Entomological News 108(1): 34–42.

Latta, M.J., C.J. Beardmore and T.E. Corman. 1999. Arizona Partners in Flight Bird Conservation Plan. Technical Report 142, Arizona Game and Fish Department Nongame and Endangered Wildlife Program. Phoenix, Arizona.

Marshall, R.M., S. Anderson, M. Batcher, P. Comer, S. Cornelius, R. Cox, A. Gondor, D. Gori, J. Humke, R. Paredes Aguilar, I.E. Parra, S. Schwartz. 2000. An Ecological Analysis of Conservation Priorities in the Sonoran Desert Ecoregion. Prepared by The Nature Conservancy Arizona Chapter, Sonoran Institute, and Instituto del Medio Ambiente y el Desarollo Sustentable del Estado de Sonora with support from the Department of Defense Legacy Program and agency and institutional partners.

McAuliffe, J.R. 1999. Landscape complexity and ecological diversity. Pages 68–114 in R.H. Robichaux (editor), Ecology of Sonoran Desert Plants and Plant Communities. University of Arizona Press, Tucson, Arizona.

Meffe, G.K. and C.R. Carroll. 1994. Principles of Conservation Biology. Sinauer Associates, Sunderland, Massachusettes.

Miller, V. J. 1983. Arizona's Own Palm: *Washingtonia filifera*. Desert Plants 5(3): 99-104.

Minckley, W.L. and D.E. Brown. 1994. Wetlands. Pages 223-287 in Biotic Communities: Southwestern United States and Northwestern Mexico. D. E. Brown (editor). University of Utah Press, Salt Lake City, Utah.

Morrison, P.H. and S.D. Snetsinger. 2003. Natural Communities of the Sonoran Desert National Monument and Sand Tank Mountains. Pacific Biodiversity Institute. Unpublished report to The Nature Conservancy in Arizona.

Nabhan, G.P. and A.R. Holdsworth. 1999. State of the Desert Biome: Uniqueness, Biodiversity, Threats and Adequacy of Protection in the Sonoran Bioregion. 2nd edition. Sponsored by the Wildlands Project. Arizona-Sonora Desert Museum, Tucson, Arizona.

NatureServe Explorer. 2002. NatureServe Explorer: An online encyclopedia of life (web application). 2002. Version 1.6. Arlington, Virginia, USA: NatureServe. Available online at http://www.natureserve.org/explorer. (Accessed June 2003).

Noss, R.F. 1990. Indicators for monitoring biodiversity: a hierarchical approach. Conservation Biology 4: 355–364.

Noss, R.F., and A.Y. Cooperrider. 1994. Saving Nature's Legacy: Protecting and Restoring Biodiversity. Island Press, Washington, D.C.

Olsen, D.M. and E. Dinerstein. 1998. The Global 200: A Representation approach to conserving the Earth's most biologically valuable ecoregions. Conservation Biology 12: 502-515.

Omernick, J.M., and R.G. Bailey. 1997. Distinguishing between watersheds and ecoregions. Journal of the American Water Resources Association 33: 935–949.

Palmer, B. 1986. Special Status Species Summary Report. Arizona Game and Fish Department. Special Services Division. U.S. Army Proving Grounds, Yuma, Arizona. 52 pp.

Phillips, S.J. and P. Wentworth Comus. 2000. A Natural History of the Sonoran Desert. Arizona-Sonora Desert Museum Press, Tucson, AZ. 628 pp.

Poiani, K.A., J.V. Baumgartner, S.C. Buttrick, S.L. Green, E. Hopkins, G.D. Ivey, K.P. Seaton, and R.D. Sutter. 1998. A scale-independent, site conservation planning framework in The Nature Conservancy. Landscape and Urban Planning 43: 143–156.

Poiani, K.A., B.D. Richter, M.G. Anderson, and H.E. Richter. 2000. Biodiversity conservation at multiple scales: functional sites, landscapes, and networks. BioScience 50: 133–146.

Remsen, J.V. Jr. 1978. Bird Species of Special Concern in California, LeConte's Thrasher. Habitat Conservation Planning Branch, California Department of Fish and Game. Available online at: http://www.dfg.ca.gov/hcpb/cgi-bin/read_one.asp?specy=birs&idNum=88. (Accessed June 2003).

Rosenstock, S.S. and M.J. Rabe. 2002. Ecological effects of wildlife water developments in the Sonoran Desert: preliminary results. Meeting Resource Management Information Needs: Fourth Conference on Research and Resource Management in the Southwestern Deserts, Extended Abstracts. W.L. Halvorson and B.S. Gebow (editors). USGS Sonoran Desert Field Station, University of Arizona, Tucson, Arizona.

Scarborough, R. 2000. The geologic origin of the Sonoran Desert. Pages 71-85 in Phillips and Wentworth Comus (editors), A Natural History of the Sonoran Desert. Arizona-Sonora Desert Museum, Tucson. Arozpma.

Science Advisory Board. 1991. Evaluation of the Ecoregion Concept. Report of the Ecoregions Subcommittee of the Ecological Processes and Effects Committee. EPA-SAB-EPEC-91–003. U.S. Environmental Protection Agency, Washington, D.C.

Scott, J.M. and B. Csuti. 1997. Noah worked two jobs. Conservation Biology 11:1255–1257.

[SCS] U.S. Department of Agriculture Soil Conservation Service. 1991. The Soil Survey of the U.S. Army Yuma Proving Ground, Arizona—parts of La Paz and Yuma Counties. U.S. Department of Agriculture, Soil Conservation Service.

[SCS] U.S. Department of Agriculture Soil Conservation Service. 1994. State Soil Geographic (STATSGO) database for Arizona. U.S. Department of Agriculture, Soil Conservation Service. Fort Worth, Texas.

Sheppard, J.M. 1996. Le Conte's thrasher (*Toxostoma lecontei*). No. 230 in A. Poole and F. Gill (editors), The Birds of North America. The Academy of Natural Sciences, Philadelphia, Pennsylvania and The American Ornithologists' Union, Washington, D.C.

Shreve, F. 1951. Vegetation of the Sonoran Desert. Carnegie Institution of Washington Publication no. 591. Washington, D.C.

Snow, T. K. 1998. Bat Inventory of the Kofa National Wildlife Refuge. Nongame and Endangered Wildlife Program Technical Report 134. Arizona Game and Fish Department, Phoenix, Arizona.

Sredl, M.J. 2003. Understanding and Mitigating Effects of Chytrid Fungus to Amphibian Populations in Arizona. Nongame and Endangered Wildlife Program Technical Report 208. Arizona Game and Fish Department, Phoenix, Arizona.

Stebbins, R.C. 1985. A Field Guide to Western Reptiles and Amphibians. 2nd edition. Houghton Mifflin Company, Boston.

[TNC] The Nature Conservancy. 1998. Site Conservation Plan for the Hassayampa River Preserve and Wickenburg Sonoran Desert Corridor. The Nature Conservancy Field Office, Tucson, Arizona. November 30, 1998.

[TNC] The Nature Conservancy 2000. The Five-S Framework for Site Conservation: A Practitioner's Handbook for Site Conservation Planning and Measuring Conservation Success. 2nd edition. The Nature Conservancy, Arlington, Virginia. June 2000.

Turner, R.M. and D.E. Brown. 1994. Tropical-subtropical desertlands. Pages 180-222 in Biotic Communities: Southwestern United States and Northwestern Mexico. D. Brown (editor). University of Utah Press, Salt Lake City, Utah.

Turner, R.M., J.E. Bowers, and T.L. Burgess. 1995. Sonoran Desert Plants: An Ecological Atlas. University of Arizona Press, Tucson.

U.S. Census Bureau. 2000. Census 2000 as analyzed by Social Science Data Analysis Network. Available online at http://www.censusscope.org (Accessed July 2003).

U.S. Department of Commerce. 2002. Bureau of Economic Analysis, Regional Economic Information System. REIS CD-ROM.

[USFWS] U.S. Fish and Wildlife Service. 2002. Birds of Conservation Concern 2002. U.S. Fish and Wildlife Service Division of Migratory Bird Management. Arlington, VA.

[USFWS] U.S. Fish and Wildlife Service.1981: Proposal to Eliminate Cattle Grazing and Wild Burro Populations on Kofa National Wildlife Refuge Yuma County Arizona. Final Environmental Impact Statement. USFWS. Albuquerque, New Mexico.

[USGS] U.S. Geological Survey. 2003. Amphibian Research and Monitoring Initiative, Patuxent Wildlife Research Center. Available online at http://www.mp2-pwrc.usgs.gov/armiatlas/ last updated February 2003. Accessed June 2003.

Warren, P.L., and A.W. Laurenzi. 1987. Rare Plant Survey of the Yuma District. The Arizona Nature Conservancy. Final Report P.O. No. AZ-950-PH6-0540. Submitted to the U.S. Bureau of Land Management, Yuma District Office. July 1987.

[WBWG] Western Bat Working Group 1998. Regional Bat Species Priority Matrix. Available online at http://www.batworkinggroups.org/SpMatrix.html (Accessed June 2003).

Webb, R.H. 2002. Recovery of severely compacted soils in the Mojave Desert, California, USA. Arid Land Research and Management. 16: 291-305.

Webb, R.H. and H.G. Wilshire (editors). 1983. Environmental Effects of Off-Road Vehicles: Impacts and Management in Arid Regions. Springer Verlag, New York.

Weinstein, S., A. Gondor, and J.A. Hall. 2002. Conservation Elements of the Sonoran Desert National Monument: A Preliminary Analysis. The Nature Conservancy of Arizona, Tucson, Arizona. 42 pp.

Weinstein, S. and J.A. Hall. 2003. Assessment and Incorporation of Biodiversity Values into the Bureau of Land Management's Planning and Management on the Sonoran Desert National Monument: Progress Report. The Nature Conservancy of Arizona, Tucson, Arizona. 37pp.

Wirt, E.B. and P.A. Holm.1997. Climatic Effects on Survival and Reproduction of the Desert Tortoise (Gopherus agassizii) in the Maricopa Mountains, Arizona. Report to Arizona Game and Fish Department, Phoenix, Arizona.

Woodward, B.D. 1982. Predator-prey interactions and breeding-pond use of temporary-pond species in a desert anuran community. Ecology 64: 1549–1555.

[YPG] U.S. Army Yuma Proving Ground. 1997. Integrated Natural Resources Management Plan. Yuma, Arizona.

APPENDIX A

SONORAN DESERT ECOREGION CONSERVATION AREAS AND CONSERVATION ELEMENTS WITHIN THE YUMA RESOURCE MANAGEMENT AREA

(Marshall and others 2000)

Taxon	Scientific Name	Common Name	Conservation Areas								Global Rank[1]	ESA Status[2] and BLM Sensitive Species, Oct. 2000 ("BLM")	element of BMGR or SDNM[3]
			Tacna Marsh (9)	Kofa Complex (12)	Pinacate/Organ Pipe/ Goldwater Complex (13)	Chocolate Mountains (27)	McCoy Mountains (29)	Riverside Mountains (30)	Colorado River/Río Hardy (38)	Yuma Proving Ground Dunes (75)			
Inverte-brate	*Eremarionta immaculata*	White desertsnail						X			G1		
	Oliarces clara	Cheese-weed owlfly							X		G2	SC, BLM	
	Micrarionta rowelli mccoiana	California mccoy snail					X				G1		
	Tryonia quitobaquitae	Quitobaquito tryonia			X						G1	SC	
Fish	*Elops affinis*	Pacific Tenpounder							X		G5		
	Catostomus latipinnis	Flannelmouth Sucker							X		G3	SC	
	Cyprinodon macularius	Desert Pupfish			X	X					G1	LE	
	Cyprinodon macularius eremus	Quitobaquito Desert Pupfish			X						G1	LE	
	Gila elegans	Bonytail							X		G1	LE	
	Gila robusta	Roundtail Chub							X		G3	SC	
	Plagopterus argentissimus	Woundfin							X		G1	LE	
	Ptychocheilus lucius	Colorado Squawfish							X		G1	LE (CA-LE/X	
	Xyrauchen texanus	Razorback Sucker							X		G1	LE	
Amphi-bian	*Bufo retiformis*	Sonoran green toad			X						G3	SN (R)	SDNM
Reptile	*Charina trivirgata gracia*	Desert Rosy Boa		X	X	X	X				G3	SC, BLM	
	Charina trivirgata trivirgata	Mexican Rosy Boa			X						G3	SC	
	Chionactis palarostris organica	Organ Pipe Shovelnose Snake			X						G3		
	Cnemidophorus burti xanthonotus	Redback Whiptail			X						G2	SC	
	Gopherus agassizii	Desert Tortoise		X	X	X	X				G4	CA(LT)	BMGR, SDNM
	Kinosternon sonoriense longifemorale	Sonoyta Mud Turtle			X						G1	C	
	Phrynosoma mcallii	Flat-tailed Horned Lizard			X						G3	SC	BMGR
	Phyllorhynchus browni lucidus	Maricopa Leafnose Snake			X						G2		
	Uma notata rufopunctata	Cowles Fringe-toed Lizard			X						G2	SC, BLM	BMGR
	Uma scoparia	Mojave Fringe-toed Lizard					X			X	G3		
	Xantusia vigilis	Desert Night Lizard		X		X					G5	SN(T)	
Bird	*Athene cunicularia*	Burrowing Owl							X		G4	SC, BLM	
	Coccyzus americanus occidentalis	Western Yellow-billed Cuckoo							X		G3	PE	

Taxon	Scientific Name	Common Name	Conservation Areas								Global Rank[1]	ESA Status[2] and BLM Sensitive Species	element of BMGR or SDNM[3]
			9	12	13	27	29	30	38	75			
Bird	*Colaptes chrysoides*	Gilded Flicker			X				X		G5		BMGR, SDNM
	Empidonax traillii extimus[4]	Southwestern Willow Flycatcher[4]							X		G2	LE	
	Falco mexicanus	Prairie Falcon				X	X	X			G5		
	Glaucidium brasilianum cactorum	Cactus Ferruginous Pygmy-owl			X						G3	LE	SDNM
	Haliaeetus leucocephalus	Bald Eagle							X		G4		
	Ixobrychus exilis hesperis	Western Least Bittern	X						X		GU		
	Laterallus jamaicensis coturniculus	California Black Rail							X		G1		
	Micrathene whitneyi	Elf Owl							X		G5		
	Migratory Bird Concentration Area	Migratory Bird Concentration Area				X					GU		
	Pipilo aberti	Abert's Towhee	X						X		G3		
	Rallus longirostris yumanensis	Yuma Clapper Rail	X			X			X		G3	LE	
	Toxostoma lecontei	Le Conte's Thrasher				X					G3		BMGR, SDNM
Mammal	*Antilocapra americana sonoriensis*	Sonoran Pronghorn			X						G1	LE	BMGR
	Choeronycteris mexicana	Mexican Long-tongued Bat			X						G4	SC, BLM	
	Eumops underwoodi	Underwood's Mastiff Bat			X						G4	SC, BLM	
	Leptonycteris curasoae yerbabuenae	Lesser Long-nosed bat			X						G4	LE	BMGR, SDNM
	Macrotus californicus	California Leaf-nosed Bat		X	X	X	X	X	X		G4	SC, BLM	BMGR, SDNM
	Myotis velifer	Cave Myotis		X	X	X		X	X		G5	BLM	BMGR, SDNM
	Nyctinomops femorosaccus	Pocketed Free-tailed Bat		X	X						G4	BLM	
	Ovis canadensis mexicana	Desert Bighorn Sheep		X	X						G4		BMGR, SDNM
	Ovis canadensis nelsoni	Desert Bighorn Sheep				X	X				G4		
	Peromyscus merriami	Mesquite Mouse			X						G5		
	Peromyscus eremicus papagensis	Pinacate Cactus Mouse			X						G2	C	
	Peromyscus crinitus delgadilli	Delgadillo's Canyon Mouse			X						GU		
	Perognathus intermedius pinacate	Rock Pocket Mouse			X								
	Sigmodon hispidus eremicus	Yuma Cotton Rat							X		G3	SC	
Plant	*Acalypha californica*	California copperleaf			X						G3		
	Agave schottii var treleasei	Trelease Agave			X						G1	SC	
	Allium parishii	Parish Onion		X							G3		
	Argythamnia californica	California Ditaxis				X					G2		
	Astragalus insularis var harwoodii	Harwood Milkvetch				X					G3		BMGR[5]
	Astragalus magdalenae var peirsonii	Peirson's Milkvetch			X						G2	PE, CA(LT)	BMGR[5]
	Atamisquea emarginata	Desert Tree Caper			X						G4		
	Berberis harrisoniana	Kofa Barberry		X	X						G2	BLM	
	Capsicum annuum var aviculare	Chiltepin			X						G4		
	Carnegiea gigantea	Saguaro Cactus				X			X		G5		
	Castela emoryi	Crucifixion Thorn				X	X				G4		BMGR, SDNM

Taxon	Scientific Name	Common Name	Conservation Areas								Global Rank[1]	ESA Status[2] and BLM Sensitive Species	element of BMGR or SDNM[3]
			9	12	13	27	29	30	38	75			
Plant	*Croton wigginsii*	Dune Croton			X						G2		BMGR[5]
	Cryptantha ganderi	Gander's Cryptantha			X						G2	SC	BMGR[5]
	Drymaria viscosa	Sticky drymary			X						G3		
	Echinomastus erectocentrus var acunensis	Acuña Cactus			X						G1	C	SDNM
	Eriogonum deserticola	Desert Wild-buckwheat			X						G3		BMGR[5]
	Eryngium nasturtiifolium	Hierba Del Sapo			X						G5		
	Escobaria vivipara	Spinystar				X	X		X		G5		
	Eucnide rupestris	Rock Stingbush			X						G3		
	Euphorbia platysperma	Flatseed Spurge			X						G3	SC	BMGR[5]
	Helianthus niveus	Dune Sunflower			X						G4		BMGR
	Helianthus niveus ssp. tephrodes	Algodones Dunes Sunflower			X						G2	SC, CA(LE)	
	Justicia candicans	Hierba Azul			X						G4		
	Machaeranthera arida	Arid Tansy-aster			X						G3		
	Muhlenbergia gooddingii	Goodding's muhly			X						G3		
	Opuntia munzii	Munz Cholla				X					G1		
	Opuntia wigginsii	Wiggin's Cholla		X		X					G3		
	Palafoxia arida var gigantea	Giant Spanish Needle			X				X		G3	SC	
	Perityle ajoensis	Ajo Rock Daisy			X						G1		
	Petalonyx linearis	Longleaf Sandpaper Plant			X						G4		
	Pholisma sonorae	Sand Food			X						G3	SC, BLM	BMGR[5]
	Rhus kearneyi	Kearney Sumac			X						G4	BLM	BMGR[6]
	Salvia greatae	Orocopia Sage				X					G2	SC	
	Senecio pinacatensis				X						G1		
	Stegnosperma halimifolium	Amole			X						GU		
	Stephanomeria schottii	Schott's Wire-lettuce			X						G2	BLM	BMGR[5]
	Suaeda puertopenascoa				X						GU		
	Triteleiopsis palmeri	Blue Sand Lily			X						G4	BLM	BMGR[5]
	Washingtonia filifera	California Fan Palm		X		X					G2		
	Yucca whipplei	Whippley's Yucca			X						G4		
Com-munity	*Abronia villosa-mixed shrub*	Desert sand-verbena interior dune			X						G1		
	Allenrolfea occidentalis	Pickleweed shrubland			X						G3		
	Batis maritima	Glasswort-saltwort flats			X						G5		
	Cercidium floridum	Blue palo verde mixed desert scrub				X					G3		
	Cercidium floridum-Olneya tesota	Blue palo verde-ironwood-smoke tree woodland			X						G3		
	Distichlis spicata	Coastal saltgrass			X						G5		
	Ecological gradient	Ecological gradient		X	X		X						
	Larrea tridentata (group)	Creosotebush-bursage (group)			X	X					GU		BMGR, SDNM[7]
	Parkinsonia-Carnegia-Opuntia (group)	Palo verde-mixed cacti (group)			X	X	X				GU		BMGR, SDNM[7]
	Perennial/Intermittent Stream	Perennial/Intermittent Stream				X					GU		
	Phragmites sp.	Interior giant reed marsh							X		GU		

Taxon	Scientific Name	Common Name	Conservation Areas								Global Rank[1]	ESA Status[2] and BLM Sensitive Species	element of BMGR or SDNM[3]
			9	12	13	27	29	30	38	75			
Com-munity	*Playa lake*	Intermittently flooded playa lake bed			X						GU		BMGR[7]
	Populus fremonti-Salix gooddingii[8]	Fremont cottonwood-Goodding's black willow riparian woodland [8]							X		G2		
	Prosopis (sp. glandulosa, velutina)	Mesquite woodland			X	X			X		G3		SDNM[7]
	Prosopis velutina-mixed short tree	Mesquite-mixed short tree woodland				X					GU		
	Salicornia sp.	Glasswort sand flats			X						GU		
	Salix gooddingii-Fraxinus velutina	Goodding's black willow-velvet ash woodland							X		G2		
	Typha domingensis	Interior cattail marsh				X			X		G5		
	Typha-Phragmites-Scirpus (group)	Interior riparian marsh (group)							X		GU		
	Washingtonia filifera association	California fan palm oasis		X	X	X					G2		
	Washingtonia filifera-Brahea armata	California fan palm-blue palm oasis		X	X						GU		

[1] This column shows Combined Global Ranks. See Appendix C for definitions.
[2] See Appendix D for Management Status definitions.
[3] Selected as a conservation element of the Barry M. Goldwater Range (BMGR; Hall and others 2001) or of the Sonoran Desert National Monument (SDNM; Weinstein and others 2002).
[4] This species (Southwestern Willow Flycatcher) also occurs within the planning area at special element site #235.
[5] These plants were included as conservation elements within the Dune natural community on the BMGR.
[6] This plant was included as a conservation element within the Elephant tree-limberbush natural community on the BMGR.
[7] These communities were selected as conservation elements and defined at the scale of the BMGR or SDNM. They are not necessarily the same as those defined at the scale of the Sonoran Desert Ecoregion.
[8] This community (Fremont cottonwood-Goodding's black willow riparian woodland) also occurs within the planning area at special element site #264.

APPENDIX B

AGENCY STAFF AND ACADEMIC OR INDEPENDENT SCIENTISTS CONSULTED

(Including those cited in report text as personal communications)

Name	Affiliation
Bowles, Barbara	Bureau of Land Management
Brock, Jim	Independent scientist
Buchmann, Steve	The Bee Works
Engel, Russell	Arizona Game and Fish Department
English, Randy	Yuma Proving Ground
Green, Jennifer	Bureau of Land Management
Green, Tim	Yuma Proving Ground
Henry, Susanna	Kofa National Wildlife Refuge
Henry, Bob	Arizona Game and Fish Department
Hinman, Katy	Arizona Game and Fish Department
Kearns, Ron	Kofa National Wildlife Refuge
Knowles, Bill	Arizona Game and Fish Department
Lashlee, David	Yuma Proving Ground
Morfin, Ron	Bureau of Land Management
Morrill, Valerie	Yuma Proving Ground
Olson, Carl	University of Arizona
Oyler, Roger	Bureau of Land Management
Ramos, Juan	Bureau of Reclamation
Reichhardt, Karen	Bureau of Land Management
Repass, David	Bureau of Land Management
Rorabaugh Jim	U.S. Fish and Wildlife Service
Rosen, Philip	University of Arizona
Rutman, Sue	Organ Pipe Cactus National Monument
Stanford, Ray	Independent scientist
Varney, Ray	Kofa National Wildlife Refuge
Wong, Fred	Bureau of Land Management
Young, Jeff	Bureau of Land Management

APPENDIX C

NATURAL HERITAGE PROGRAM GLOBAL RANKING DEFINITIONS

Global and State Ranks

Grank Global Rank**:** Priority Ranking (1 to 5) based on the number of occurrences throughout the entire range of the element.

Srank State Rank: Priority Ranking (1 to 5) based on the number of occurrences of an element within a state.

Global Rank	State Rank	Definition
G1	S1	Very Rare: 1 to 5 occurrences or very few individuals or acres
G2	S2	Rare: 6 to 20 occurrences or few individuals or acres
G3	S3	Uncommon or Restricted: 21 to 100 occurrences, rather rare throughout a fairly wide range, or fairly common in a rather restricted range.
—	S3S4	Fairly Common: 51 to 100 occurrences and found over a rather wide range within the State.
G4	S4	Apparently Secure: more than 100 occurrences, though it could be quite rare in some parts of its range.
G5	S5	Demonstrably Secure: more than 100 occurrences.
GU	—	Unranked.
G#Q		Taxonomic Question: taxonomic status is questionable; numeric rank may change with taxonomy.
G#T#		Subspecies: numeric designations based on same criteria as those for global ranks
G#?		Uncertain: insufficient information to give a definitive ranking. Confidence of numeric rank is plus or minus one rank

Adapted from Arizona Game and Fish Department, Heritage Data Management System, 1/12/94 revision.

Combined Global Ranks

Combined global ranks were determined from the following global rank designations:

G1 = G1, G1Q, G1T1, G4T1, G3T1Q, G5T1Q, G4G5T1, G5T1 (G_T1Qs need case by case review), G1G2
G2 = G2, G2?, G3T2, G1G3, G2G3, G3T2, G3G4T2, G2G4T1T2Q, G4T1T2, G4T2, G4?T2?, G5T2, G5T1T2, G5T1T2Q (again, G_T2Qs need case by case review)
G3 = G3, G3?, G3Q, G3?Q, G2G3Q, G2G4, G2G4T?, G3G4T3, G3G4, G3QT2T3, G3T3Q, G4T2T3, G4T3, G4T3?, G4?T3, G4?T3, G5T2T3, G5T3, G5T3?, G5T2T3Q
G4 = G4, G4?, G?, G4T4, G3G5, G4T3T4, G5T4, G5T3T4, G4G5T3T4, G4G5T4, G4G5
G5 = G5, G5?, G5T, G5T?

APPENDIX D

MANAGEMENT STATUS DEFINITIONS

Arizona Game And Fish Department (AGFD)
Heritage Data Management System (HDMS)
Revised 7/24/00, AGFD HDMS

FEDERAL STATUS

ESA **Endangered Species Act** (1973 as amended)
US Department of Interior, Fish and Wildlife Service (http://arizonaes.fws.gov)

Listed

LE Listed Endangered: imminent jeopardy of extinction.
LT Listed Threatened: imminent jeopardy of becoming Endangered.
XN Experimental Nonessential population.

Proposed for Listing

PE Proposed Endangered.
PT Proposed Threatened.

Candidate (Notice of Review: 1999)

C Candidate. Species for which USFWS has sufficient information on biological vulnerability and threats to support proposals to list as Endangered or Threatened under ESA. However, proposed rules have not yet been issued because such actions are precluded at present by other listing activity.

BLM **US Bureau of Land Management** (2000)
US Department of Interior, Bureau of Land Management, Arizona State Office (http://azwww.az.blm.gov)

S Sensitive: those taxa occurring on BLM Field Office Lands in Arizona that are considered sensitive by the Arizona State Office.
P Population: only those populations of Banded Gila monster (*Heloderma suspectum cinctum*) that occur north and west of the Colorado River, are considered sensitive by the Arizona State Office.

USFS **US Forest Service** (1999)
US Department of Agriculture, Forest Service, Region 3 (http://www.fs.fed.us/r3/)

S Sensitive: those taxa occurring on National Forests in Arizona that are considered sensitive by the Regional Forester.

ARIZONA STATE STATUS

NPL **Arizona Native Plant Law** (1993)
Revised Statutes Title 3, Chapter 7
Arizona Department of Agriculture
http://agriculture.state.az.us/PSD/nativeplants.htm

- **HS** **Highly Safeguarded:** No collection allowed
  Species of native plants and parts of plants, including the seeds and fruit, whose prospects for survival in Arizona are in jeopardy or which are in danger of extinction.
- **SR** **Salvage Restricted:** Collection only with permit
  Species of native plants that are that are not included in the highly safeguarded category but are subject to damage by theft or vandalism.
- **ER** **Export Restricted:** Transport out of State prohibited
- **SA** **Salvage Assessed**: permits required to remove live trees.
  Species of native plants that are not included in either the highly safeguarded or salvage restricted category but have a sufficient value if salvaged to support the cost of salvage
- **HR** **Harvest Restricted:** Permits required to move plant by-products
  Species of native plants that are not included in the highly safeguarded category but are subject to excessive harvesting or overcutting because of their intrinsic value.

WSCA **Wildlife of Special Concern in Arizona** (March 16, 1996 in prep)
Arizona Game and Fish Department (http://www.azgfd.com)
Wildlife of Special Concern in Arizona. Species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines, as described by the Arizona Game and Fish Department's listing of Wildlife of Special Concern in Arizona (AGFD 1996).

MEXICAN STATUS

MEX **Mexican Federal Endangered Species List** (May 16, 1994)
Secretaría de Desarollo Social, NORMA Oficial Mexicana NOM-059-ECOL-1994

The Mexican Federal Endangered Species List contains taxa with status from the entire Mexican Republic and waters under its jurisdiction. MEX designations for only those taxa occurring in Arizona and also in Mexico.

- **P** En Peligro de Extinción (Determined Endangered in Mexico): in danger of extinction.
- **A** Amenazada (Determined Threatened in Mexico): could become endangered if factors causing habitat deterioration or population decline continue.
- **R** Rara (Determined Rare in Mexico): populations viable but naturally scarce or restricted to an area of reduced distribution or very specific habitats.
- **Pr** Sujeta a Protección Especial (Determined Subject to Special Protection in Mexico): utilization limited due to reduced populations, restricted distribution, or to favor recovery and conservation of the taxon or associated taxa.

APPENDIX E

DESCRIPTION OF RIPARIAN VEGETATION COMMUNITY AND STRUCTURE TYPES

(Anderson and Ohmart 1984)

Vegetation Community Criteria

Code	Community	Descriptions
CW	Cottonwood-Willow	*Salix gooddingii* and *Populus fremontii* (the latter in extremely low densities) constituting at least 10% of total trees.
SC	Salt cedar	*Tamarix chinensis* constituting 80-100% of total trees.
SH	Salt cedar-Honey mesquite	*Prosopis glandulosa* constituting at least 10% of total trees; rarely found to constituting greater than 40% of total trees.
SM	Salt cedar-Screwbean mesquite	*Prosopis pubescens* constituting at least 20% of total trees.
HM	Honey Mesquite	*Prosopis glandulosa* constituting 90-100% of total trees.
AW	Arrowweed	*Tessaria sericea* constituting 90-100% of total vegetation in area.
ATX	Atriplex	*Atriplex lentiformis*, *A. canescens* and/or *A. polycarpa* constituting 90-100% of total vegetation in area.
MA	Marsh	Predominately cattail/bulrush *(Typha/Scrirpus)* and carrizo *(Phragmites).*
CR	Creosote	*Larrea Divaricata* constituting 90-100% of total vegetation in area.

Structure Type Criteria

Code	Description
I	45% of stand in overstory (>15 ft); 30% in intermediate story (2-15 ft); 10% in understory (<2 ft).
II	60% of stand in overstory (>15 ft); 30% in intermediate story (2-15 ft); 10% in understory (<2 ft).
III	25% of stand in overstory (>15 ft); 50% in intermediate story (2-15 ft); 25% in understory (<2 ft).
IV	15% of stand in overstory (>15 ft); 45% in intermediate story (2-15 ft); 40% in understory (<2 ft).
V	5% of stand in overstory (>15 ft); 35% in intermediate story (2-15 ft); 60% in understory (<2 ft).
VI	<5% of stand in overstory (>15 ft); 20% in intermediate story; >75% of stand in understory (<2 ft).

Marsh Type Criteria

Code	Description
1	Nearly 100% cattail/bulbrush, small amounts of *Phragmites* and open water.
2	Nearly 75% cattail/bulbrush, many trees and grasses interspersed.
3	About 25-50% cattail/bulbrush, some *Phragmites*, open water; some trees and grass.
4	About 35-50% cattail/bulbrush, many trees and grasses interspersed.
5	About 50-75% cattail/bulbrush, few trees and grasses interspersed.
6	Nearly 100% *Phragmites*, little open water.
7	Open marsh (75% water), adjacent to sparse marsh vegetation; includes sandbars and mudflats when Colorado River is low.