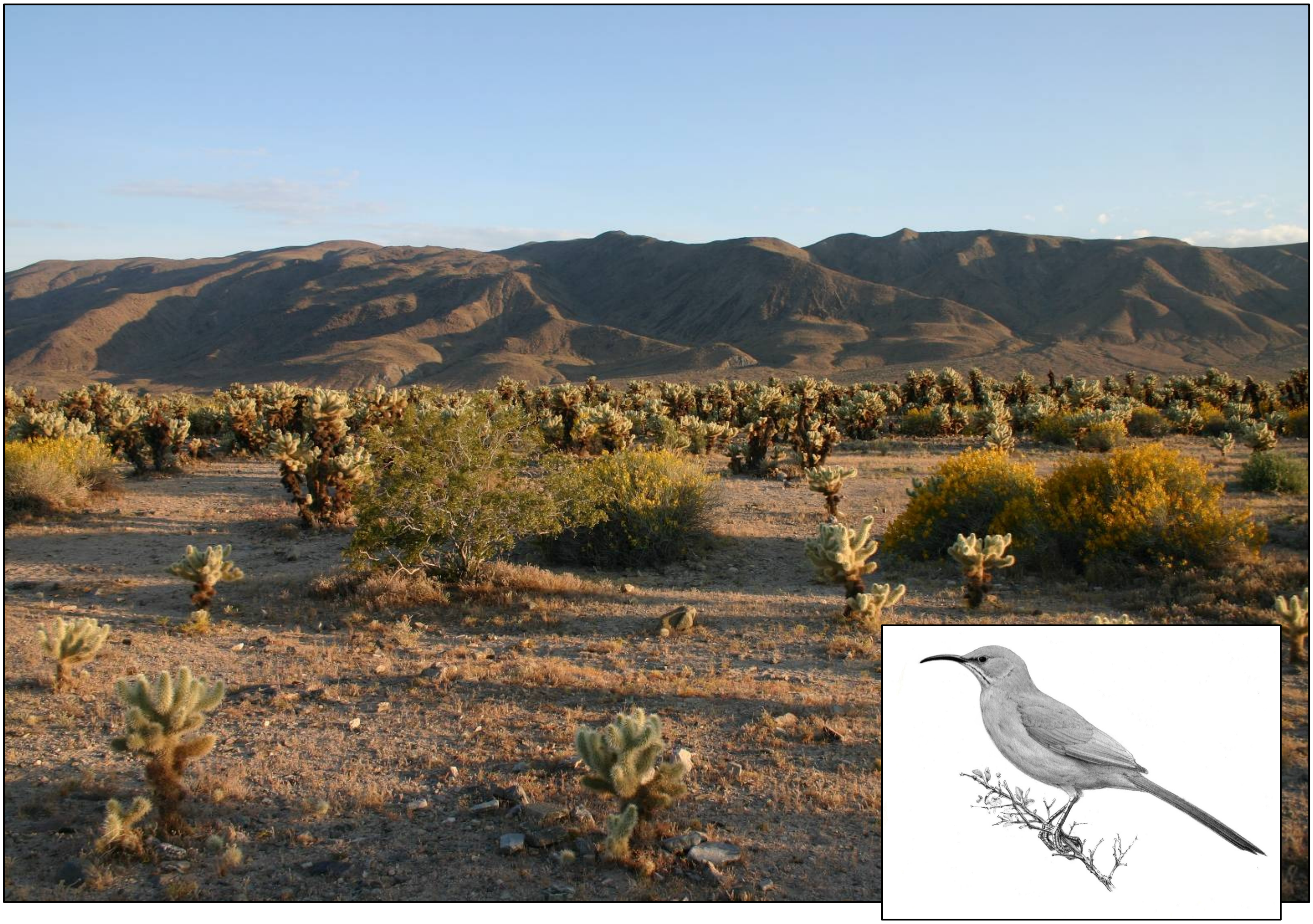
The Desert Bird Conservation Plan

A Strategy for Protecting and Managing Desert Habitats and Associated Birds in the Mojave and Colorado Deserts



A project of California Partners in Flight
and PRBO Conservation Science

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California Partners in Flight
Compañeros en Vuelo

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Version 1.0

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Conservation Plan Authors
Chris McCreedy
Melissa Pitkin
Jennie Duberstein
Kim Kreitinger
Ryan DiGaudio

Species Account Authors
Burrowing Owl – Christine Bates, Arizona Bureau of Land Management
Costa's Hummingbird – Susan Wethington and Barbara Carlson, The Hummingbird Network
Gila Woodpecker – Chris McCreedy, PRBO Conservation Science
Ladder-backed Woodpecker – Dennis Jongsomjit and Lishka Arata, PRBO Conservation Science
Ash-throated Flycatcher – Debra Hughson, National Park Service
Common Raven – William I. Boarman, PhD. United States Geologic Survey
Verdin – Roy Churchwell, San Francisco Bay Bird Observatory
Black-tailed Gnatcatcher – Jason Tinant, California Bureau of Land Management
LeConte's Thrasher – James Weigand, California Bureau of Land Management, and Sam Fitton, Audubon Ohio
Crissal Thrasher – Justin Hite, PRBO Conservation Science
Phainopepla – Lisa Crampton, University of Nevada-Reno
Lucy's Warbler – Chris Otahal, U.S. Fish and Wildlife Service
Black-throated Sparrow – Matt Johnson, United States Geologic Survey
Scott's Oriole – Ron Gartland, California Bureau of Land Management

Species Account Range Maps
Dennis Jongsomjit
Chris McCreedy

Data Contributions
The growing list of data contributors is updated frequently and can be viewed at
http://cain.nbii.gov/prbo/calpifmap/livemaps/sitecreds.htm.

Technical Editors
Elizabeth Condon and Ryan DiGaudio

Design and Layout
Kim Kreitinger, PRBO Conservation Science

Cover Illustration
Keith Hansen (www.keithhansen.com). Illustration is from the upcoming book entitled "A Guide to the Birds of the Sierra" by Ted Beedy and David Lukas.

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Executive Summary

This Desert Bird Conservation Plan is a collaborative effort of the California Partners in Flight (CalPIF) and PRBO Conservation Science. It has been developed to guide conservation policy and action on behalf of desert habitats and wildlife. The geographic scope of this plan is the Mojave Desert in California, southern Nevada, and eastern Arizona, and the Colorado Section of the Sonoran Desert in California, eastern Arizona, northern Sonora, and Baja California Norte (Figure 1-1). The Conservation Plan focuses on data concerning focal species associated with desert habitats, but conservation recommendations, if implemented, should benefit many desert-associated species. The plan, which includes both this written document, an associated website, and a Geographic Information System (GIS) database of desert monitoring projects and focal species status is intended to provide a source of information on desert bird conservation for managers, agencies, landowners, academic institutions and non-governmental organizations.

This Conservation Plan, along with a (GIS) database of bird monitoring data obtained in desert habitats (maintained by PRBO Conservation Science and the California Avian Data Center) is the first iteration of a continuing process of updating habitat conservation recommendations based on the latest scientific data. This is not a regulatory document, nor does it represent the policies of any agency or organization.

An important extension of this Conservation Plan is the on-line GIS database of desert monitoring projects and focal species breeding status available through the California Avian Data Center at www.prbo.org/cadc/ (Ballard et al. 2003a). Contributing to and managing data in this database is accomplished through a web interface, to which access is available by request. This database is used for cataloguing new information and new analysis and for updating conservation recommendations and goals. Bird and study site data will be posted on this web site, periodically updated, and made available for use by the public. Therefore, this Conservation Plan is a "living" document.

Biological Need

The Mojave and Colorado (a sub-region of the Sonoran desert) deserts that are described in this plan contain the hottest, driest habitats in North America. As a result, Mojave and Sonoran ecosystems possess a host of endemic plants and animals, specialists that have evolved over millions of years to handle extreme environmental stresses. Due to remoteness and difficult research conditions, bird populations found in Mojave and Colorado desert habitats have poor or no trend data (Rich et al. 2004). Yet two of the top three fastest-growing metropolitan areas in the United States from 1990-2000 (Las Vegas, NV and Yuma, AZ) are found within the area covered by this plan. In the western Mojave Desert, human population has tripled over the last twenty years (Mojave Desert Ecosystem Program 2006 http://www.mojavedata.gov/westmojave/info.html). The Mojave and Colorado deserts face rapid and permanent loss of desert habitats, fierce competition for scarce water resources, and increased recreation pressures. These pressures have been found to negatively impact desert bird populations (Latta et al. 1999).

Desert riparian habitats are among the most imperiled habitats in North America. As a result, endangered species such as Southwestern Willow Flycatchers, western Yellow-billed Cuckoos, and Least Bell's Vireos that rely on desert riparian habitats have captured much of our research attention in recent years. The Mojave and Colorado deserts comprise roughly a quarter of the state of California—yet only a small fraction of this land can be classified as riparian. Mojave and Sonoran

Figure 1-1. Approximate area (dashed line) of desert regions addressed in the Desert Bird Conservation Plan, which includes the Mojave Desert (northern half of area) and the Colorado section of the Sonoran Desert (southern half of area).

desert scrubland, ephemeral riparian (also named "xeric riparian") woodland, and coniferous "sky islands" hold significant proportions of the global populations of several desert endemics.

Rapid human population increases in the Mojave and Colorado deserts have resulted in rapid increases in exotic, invasive species that have been shown to dramatically alter desert ecosystems. In many cases, ecosystem changes tied to exotic species have been shown to negatively impact native plant and animal diversity. African buffelgrass, red brome and Mediterranean grasses have altered fire regimes in the Plains of Sonora, and Arizona Uplands section of the Sonoran Desert, and are widespread in the Mojave and Colorado deserts (Esque and Schwalbe 2002). Saltcedar has replaced native cottonwood-willow riparian forests, as well as Fabaceous Sonoran Desert woodland vegetation in riparian transition zones and at desert springs and oases (Cleverly et al. 1997, Stromberg and Chew 2002). However, effects of exotic invasions on desert bird communities are generally unknown (Esque and Schwalbe 2002). Wild burro preferential grazing may also limit Sonoran Desert woodland regeneration in the lower Colorado River Valley (Woodward and Ohmart 1976, Hanley and Brady 1977).

Land ownership patterns in the Mojave and Colorado deserts provide a blend of opportunities and concerns that are relatively unique. The Mojave Desert has the highest proportion of public ownership of any ecoregion in North America (The Nature Conservancy 2001), with roughly 85% in federal or state ownership. In the United States, nearly 70% of the greater Sonoran Desert is in federal or state ownership (Marshall et al. 2000). South of the border, the opposite pattern holds: nearly 80% of Mexico's portion of the Sonoran Desert is in private or communal status under the *Ejido* system (Marshall et al. 2000).

Bird species of the southwestern United States tend to have smaller populations and smaller breeding ranges (Figure 1-2), rendering these species more vulnerable to ecological stresses (Rich et al. 2004). Thus land management decisions of American state and federal agencies (such as the Bureau of Land Management, Department of Defense, National Park Service, and Arizona Game and Fish Department) will have a large impact on global populations of Mojave and Colorado Desert breeding bird species. Conversely, recent changes in the Mexican Constitution allow for the sale and transfer of communal *ejido* lands, placing the conservation of Colorado Desert habitats into the hands of many. In light of increasing threats and under-studied desert bird populations in a matrix of land ownership challenges, it is important to assemble our current knowledge into a cohesive plan that will address the needs of the birds of the Mojave and Colorado deserts.

Growing interest and rapid implementation of large-scale alternative energy infrastructures in the desert further highlights the need for a Desert Bird Conservation Plan. The resources contained in this plan will also be extremely useful to help inform the planning and siting of wind and solar farms such that clean renewable energy may be developed while minimizing the impacts to desert bird populations and their sensitive habitats.

Mission and Objectives

The mission of Partners in Flight (PIF) is to stop the decline of, and maintain or increase, healthy populations of landbirds in North America. This mission translates into identification of habitat conservation and management priorities for bird species at risk in California. By developing the Desert Bird Conservation Plan, CalPIF seeks to promote conservation and restoration of these habitats to support long-term viability and recovery of both native bird populations and other native species. The goals of the Desert Bird Conservation Plan are to:

- Emphasize what is needed to conserve both populations of species, and species assemblages, which are defined here as groups of naturally co-occurring bird species.

- Synthesize and summarize current scientific knowledge of the requirements of birds in desert habitats.
- Provide recommendations for habitat protection, restoration, management, monitoring, and policy to ensure the long-term persistence of birds and other wildlife dependent on desert ecosystems.
- Support and inform efforts to increase the overall acreage and effectiveness of desert habitat conservation efforts in California by funding and promoting on-the-ground conservation projects.

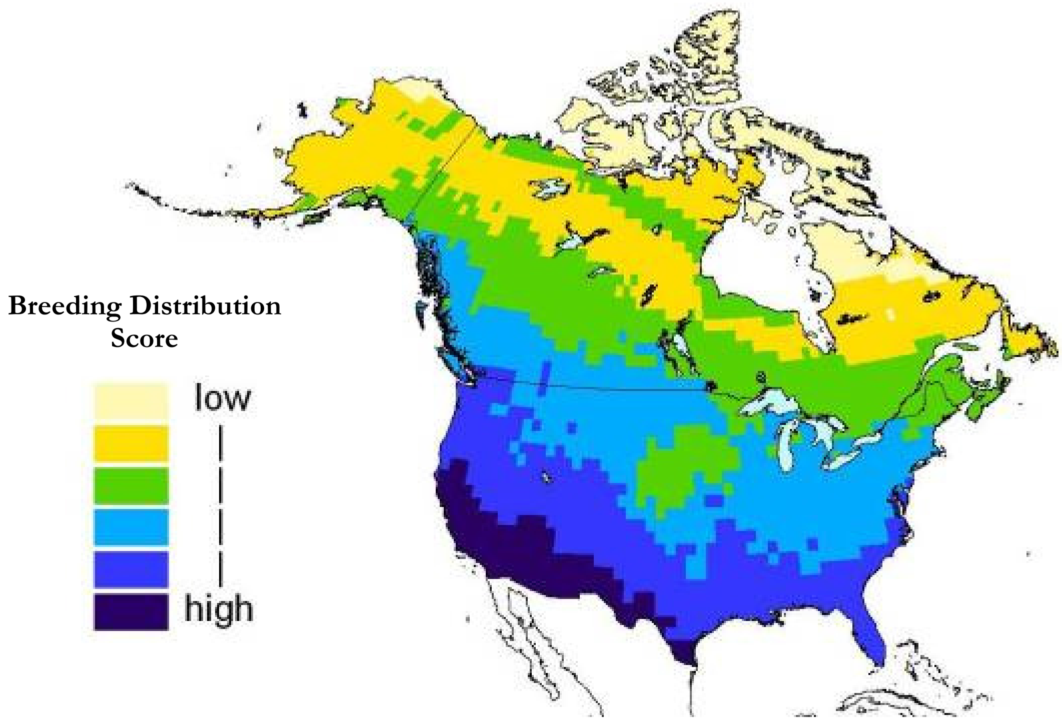

Figure 1-2. Average vulnerability among species occurring in each lat-long block during the breeding season, based on Breeding Distribution (BD) scores for 448 landbird species. Smallest range size = highest vulnerability (high BD score); largest range size = lowest vulnerability (low BD score) (Rich et al. 2004).

The subject of land management and land use, whether on private or public lands, can be contentious. CalPIF supports the need for land managers and landowners to have flexibility to develop systems that accommodate their needs while seeking to achieve the desired habitat characteristics that will maximize benefits to wildlife. CalPIF supports and will seek to maximize the benefits of new and ongoing efforts to ensure a critical level of desert habitat is protected, monitored, and properly managed for future generations of Californians and wildlife.

Findings and Recommendations

This Conservation Plan has been developed collaboratively by many of the leading bird researchers in California, Nevada, Arizona, and Mexico through a process designed to:

- Capture the conservation needs for the complete range of desert habitat types throughout the state.
- Develop biological conservation objectives using current data on desert-associated focal species.

At more than 25 monitoring sites throughout California, researchers have been collecting data on desert songbirds and are contributing to the CalPIF songbird monitoring database (http://cain.nbii.gov/prbo/calpifmap/index.html). Some of these data have contributed to the focal species accounts and recommendations presented in this plan. This document emphasizes a suite of 15 bird species chosen because of their conservation interest and as focal species representative of desert habitats.

Chapter 1. Introduction

Deserts comprise a large portion of the western United States. Each of the four major North American deserts (Great Basin, Mojave, Sonoran, and Chihuahuan) possesses a unique spectrum of climates and physiography that present hurdles and ultimately, opportunities for their representative flora and fauna. The Mojave Desert ecoregion alone contains 230 special status plant species, the majority of them endemics (The Nature Conservancy 2001). The Sonoran Desert was designated one of 200 world ecosystems to deserve special conservation attention due to its high diversity and number of endemics (Olson and Dinerstein 1998).

Desert aridity plays an integral part in plant and animal life – including human life - in this region. Stereotypes of the Mojave and Sonoran Deserts conjure images of sparse vistas emanating coils of heat into the atmosphere, cracked and desiccated soils, thorny plants and poisonous snakes. Yet the deserts of the southwestern United States and northwestern Mexico support an incredible diversity of flora and fauna found nowhere else in the world. The Mojave and Sonoran Deserts contain well-developed radiations of quail (family Odontophoriadae), doves (family Columbidae), owls (family Strigidae), hummingbirds (family Trochilidae), woodpeckers (family Picidae), gnatcatchers (family Sylviidae), and thrashers (family Mimidae), as well as the only North American occurrence of family Remizidae (Verdin) and the only occurrence of family Ptilogonatidae (Phainopepla) in the United States.

Our wide array of desert-adapted avian species is well known, but natural histories, demography and population trends for these species are often poorly understood (Sauer et al. 2005, Rich et al. 2004, Laudenslayer et al. 1992, Ehrlich et al. 1988). The Partners In Flight North American Landbird Conservation Plan (Rich et al. 2004) states that the population trends for the majority of PIF Watch List species for shrubland and woodland within the Southwest Avifaunal Biome remain unknown. One of the National PIF Landbird Conservation Plan's primary recommendations for the Southwest is straightforward and simple, and it highlights our paucity of knowledge regarding our desert birds: *"Conduct monitoring in the following southwestern habitats: thorn forest, coniferous forests, woodlands, Sonoran and Mojave Desert shrublands, and riparian."*

Photo by Ian Tait

Gila Woodpecker, a desert focal species

Birds are important targets of conservation planning not only because they are relatively conspicuous and charismatic, but also because they can serve as indicators of the health of the larger ecosystem in which they reside. Through focusing appropriate conservation efforts on a well-chosen suite of "focal" desert bird species, many other animals and plants may also benefit (Lambeck 1997). For example, demographic monitoring of bird species is especially valuable if those species serve as indicators of the presence of a threatened biological community (Chase et al. 2000), or are sensitive to a particular type of environmental change, such as habitat fragmentation (Noss 1990). Other species, especially those with large area requirements, may qualify as umbrella species, i.e., species whose protection will result in the protection of many other species (Noss 1990). Thus, this conservation plan focuses on a subset of Mojave and Colorado Desert bird species, with the aim of contributing to the conservation of desert ecosystems as a whole.

Conservation Plan Framework and Objectives

The California Partners In Flight Desert Bird Conservation Plan (Desert BCP) will address bird populations east of California's major mountain axis in the Mojave and Lower Colorado River Valley section of the Sonoran Desert, also referred to as the Colorado Desert (Figure 2) as defined in detail in Chapter 2. The Colorado Desert is one of six subsections of the Sonoran Desert first defined by Forrest and Wiggins, and is found in southeastern California, Arizona, Sonora, and Baja California Norte at elevations under 2000' (600 m) above Sea Level (Shreve and Wiggins 1964).

Desert habitats are also covered in the CalPIF Sagebrush Bird Conservation Plan (Great Basin Desert), the CalPIF Coniferous Forests Bird Conservation Plan, and in the CalPIF Riparian Bird Conservation Plan. The Desert BCP will generally relegate itself to Mojave Desert habitats found below the lower montane zone of the Mojave Desert, which begins at 3,500 (1500 m) above Sea Level, to avoid overlap with the Coniferous Forests BCP. The Desert BCP will also touch upon desert riparian habitats, but it is targeted at bird populations of "dry riparian" washes and at Mojave and Sonoran scrubland, to avoid overlap with the Riparian BCP.

Though the Desert BCP was originally conceived to address desert habitats in California, interest in a comprehensive, habitat-based desert plan extends beyond California's borders into Nevada, Arizona, and Mexico. State-based Partners In Flight conservation plans written for Nevada and Arizona do address desert habitats, yet due to myriad other habitats of these states, a conservation plan tailored specifically for desert habitats will provide managers and researchers with a more detailed look at bird assemblages generally unique to the desert. The CalPIF Desert BCP will address Mojave and Colorado Desert habitats in Arizona and Nevada with the goal of complementing and adding to existing bird conservation plans for these states. Desert conservation planning has not been addressed outside of riparian habitats in northwest Mexico, and the Desert BCP will represent an introduction to desert bird conservation south of the border.

The Salton Sea is also located within the Colorado Desert in California, and much has been written on its current demise, as well as its crucial importance for breeding and migrant birds. Version 1.0 of the Desert BCP will serve as a literature review of this non-traditional desert habitat, with a goal of additional chapters of Salton Sea information in subsequent versions of the Desert BCP. In the future, we hope to address desert riparian, coniferous, and habitats of the Salton Sea in greater detail.

Partners in Flight

This Conservation Plan is one of many to be created under the aegis of the international movement known as Partners in Flight (PIF), which seeks to protect North American landbirds throughout their ranges by reversing species declines, stabilizing populations, and "keeping common birds common." PIF is an international cooperative endeavor initiated in 1990 in response to alarming population declines noted among species of Neotropical migratory birds. The program encourages conservation through partnerships before species and their habitats become threatened or endangered and provides a constructive framework for guiding nongame landbird conservation activities throughout the United States, Canada, Mexico, and Central America.

Photo by Justin Hite

Female Long-eared Owl (Asio otus) incubating on the Milpitas Wash, Imperial County, CA. In wet years, Long-eared Owls can be found to nest in old-growth desert wash habitats in the southern Lower Colorado River Valley, outside their expected breeding range (McCreedy 2006[b]).

California Partners in Flight (CalPIF) was formed in 1992 with the full participation of the state's land and wildlife managers, scientists and researchers, and private organizations interested in the conservation of nongame landbirds. Noting that the major cause of population declines in California appeared to be habitat loss, CalPIF began identifying critical habitats important to birds and worked cooperatively to protect and enhance remaining habitat fragments. Recognizing their critical importance, CalPIF initially focused on riparian zones throughout the state. However, CalPIF has developed plans for most other ecosystems, including oak woodlands, coastal scrub and chaparral, grasslands, coniferous forests, shrubsteppe, and the Sierra Nevada. Visit http://www.prbo.org/calpif/plans.html for more information and current versions of these plans.

California Partners in Flight Partners

Arizona Game and Fish Department
Bureau of Land Management
Bureau of Reclamation
California Department of Fish and Game
Department of Defense
Klamath Bird Observatory
Institute for Bird Populations
National Audubon Society
National Fish and Wildlife Foundation
National Park Service
Natural Resources Conservation Service
Northern Arizona University
PRBO Conservation Science
Pronatura Noroeste
San Francisco Bay Bird Observatory
Sonoran Joint Venture

The Hummingbird Network
The Nature Conservancy
University of California - Riverside
University of Nevada - Reno
U.S. Fish and Wildlife Service
U.S. Geological Survey
U.S.D.A. Forest Service
Ventana Wilderness Society/Big Sur Ornithology Lab

Justification for the Conservation Plan

The justification for conservation can be articulated from various philosophical perspectives:

- An ecological perspective
- A perspective that emphasizes intrinsic value
- A primarily utilitarian or humanist perspective

Ecological Perspective

"A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."

-Aldo Leopold, *The Sand County Almanac*.

The ecological arguments for conserving birds as a component of biodiversity emphasize the critical role that birds play in ecological systems. A conservation plan based on the needs of birds makes sense for a number of reasons. Birds are critical components of natural ecosystems, and they occupy an extremely diverse range of niches within desert systems. By managing for a diversity of birds, we will also protect many other elements of biodiversity and the natural processes that are an integral part of desert ecosystems. Also, because of their high metabolic rate, their relatively high position in the food chain and their distribution across a wide variety of habitats, birds are sensitive indicators of environmental conditions (Temple and Wiens 1989, Uliczka and Angelstam 2000, Bryce et al. 2002). Finally, birds are relatively easy and cost effective to monitor and they provide an excellent means by which to track larger changes in natural systems. Our rapidly expanding capacity to monitor demographic processes in birds (reproduction and survivorship) provides us with the ability to proactively address root causes of population declines and increases (Pienkowski 1991, DeSante and Rosenberg 1998).

Intrinsic Perspective

Modern philosophers and environmental leaders have increasingly recognized the intrinsic value of plants, animals, and even the inanimate physical environment (Callicott 1986, Sober 1986). Throughout human history, many cultural belief systems have greatly valued birds and other elements of the natural world for reasons other than materialistic needs. This tradition continues today and is meeting with broader acceptance in political and public life.

Utilitarian or Humanist Perspective

A strictly utilitarian or humanist argument for conservation of bird species focuses on the direct, tangible benefits that people and society derive from their ecosystem services. For example, many passerine species (including Neotropical migrants) play an indispensable role in control of forest and agricultural insect pests, saving millions of dollars in the application of deleterious pesticides. Additionally, bird watching is a popular outdoor recreation and is currently enjoyed by an estimated 67.8 million Americans according to the 2000-2002 National Survey on Recreation and the Environment (NSRE 2000-2002). Non-consumptive bird use contributes 16,000 jobs and more than $622 million in retail sales annually to the California economy, which leads the nation in economic benefits derived from "birders." Ecotourism, with bird watching as a primary component, is increasingly seen as the best new source of income that can cushion resource-based economies as they transition to a sustainable level of resource use.

Black-throated Sparrow *Photo by Laura Hughes*

Chapter 2. Desert Habitats in California

The Desert Bird Conservation Plan is written for lower elevation habitats in the Mojave and Sonoran Desert bioregions east of California's major mountain axis. The Desert BCP will generally exclude traditional desert riparian habitats such as those found at the Amargosa, Mojave, Colorado, Virgin, Muddy, Bill Williams, and Gila Rivers, which are represented in the Riparian Bird Conservation Plan. The habitats covered by the Desert BCP align with Bird Conservation Region 33, which covers the Mojave and Sonoran Deserts.
(http://www.nabci-us.org/aboutnabci/bcrdescrip.pdf)

Deserts in general are defined as places that receive less than ten inches (250 mm) of annual precipitation (Dimmitt 2000[a]). However, climatologists also factor potential water loss (potential evapo-transpiration, or PET) into annual precipitation when defining aridity. Sunny, hot, and wind-exposed places have higher PET values, which equates to higher metabolic stresses to plants and animals. Thus Tucson, Arizona receives over ten inches of annual rainfall, but high PET values still render Tucson to be classified as Sonoran Desert. In general, PET:P (precipitation values) of over 3.0 signify a desert environment. Tucson's PET:P is 4.3, while Yuma, Arizona's ratio is 30 (Dimmitt 2000[a]).

The Mojave Desert and Colorado Desert are rain shadow deserts that receive the majority of their annual precipitation from sporadic winter storms that are strong enough to overcome the precipitation-draining coastal ranges to the west. The region also receives occasional bouts of tropical moisture during summer months, which can create intense thunderstorms referred to as "monsoons". Monsoonal moisture tends to enter the Sonoran and Mojave Deserts from the southeast, and the Sonoran Desert in particular harbors what is considered to be a bi-modal precipitation pattern. Summer rainfall becomes less common moving to the west and north, as successions of desert mountain ranges wring moisture from tropical summer systems.

In combination with a bi-modal precipitation pattern, the Sonoran Desert rarely freezes in the winter, enabling a diverse flora to exist, including columnar cacti and trees. However, due to the Colorado Desert's relative dryness in comparison to the eastern and southern Sonoran Desert (where columnar cacti such as Saguaro (*Carnegia gigantean*) and Organ Pipe Cactus (*Stenocereus thurberi*) are more common), these structurally diverse habitats tend to be relegated to valley floors as one moves west across the region. Columnar cacti and arboreal vegetation are largely absent in the Mojave Desert, which experiences frequent hard freezes during winter months. In the Mojave, structural diversity is primarily represented in the form of Joshua Trees (*Yucca brevifolia*), which often attain heights of over 4 m.

In general, the flora of the Mojave and Colorado Deserts is dominated by annuals. Shreve and Wiggins (1964) reported over 250 annual plant species, while in drier sites of the Colorado Desert, annuals represent close to ninety percent of the flora (Dimmitt 2000[b]).

Colorado Desert

The Sonoran Desert consists of six sections first defined by Forrest Shreve in 1951 (a seventh has since been re-classified as a non-desert biome). These include the Magdalena, Vizcaino, Central Gulf Coast, Plains of Sonora, Arizona Upland, and Lower Colorado River Valley sections (Figure 2-1). The Lower Colorado River Valley section (or Colorado Desert) is centered at the head of the Gulf of California and extends into Baja California Norte, Sonora, Arizona, and California. It is the hottest and driest of the six Sonoran sections, as well as the largest. It is this section of the Sonoran Desert that will be discussed in the California BCP.

In Arizona, habitats of the Colorado Desert typically extend to roughly 2000 feet (600 m) above Sea Level, where they begin to intergrade with habitats typical of the Arizona Upland section. The Colorado Desert extends south into Sonora, Mexico, where it dissolves into the Plains of Sonora and Central Gulf Coast sections. The Plains of Sonora section receives more summer moisture and freezes less often than the Colorado Desert, and it supports a greater diversity of tropical flora. Conversely, the Central Gulf Coast section is as dry as the Colorado Desert, but its aridity stems from its latitude (it is characterized as a horse latitude desert rather than a rain shadow desert) and it is characterized by many plant species not found in the Colorado Desert (Dimmitt 2000[a]).

To the west, the Colorado Desert's boundary follows the region's major mountain axis through eastern Baja California Norte and north to San Gorgonio Pass near Palm Springs. The Colorado Desert's northern boundary is somewhat indistinct, as it gradually fades into the Mojave Desert as the frequency of cold winter nights becomes too high to support Sonoran Desert vegetation.

Summer highs can exceed 120°F (49°C), and surface temperatures approach 180°F (82°C). Average rainfall can be below 3 inches (76 mm) at drier sites of the Colorado Desert, resulting in an early breeding season and a summer exodus of desert breeding species such as Phainopeplas, Costa's Hummingbirds, and Lucy's Warblers to wetter, cooler regions surrounding the Colorado Desert (Corman and Wise-Gervais 2005, Chu and Walsberg 1999).

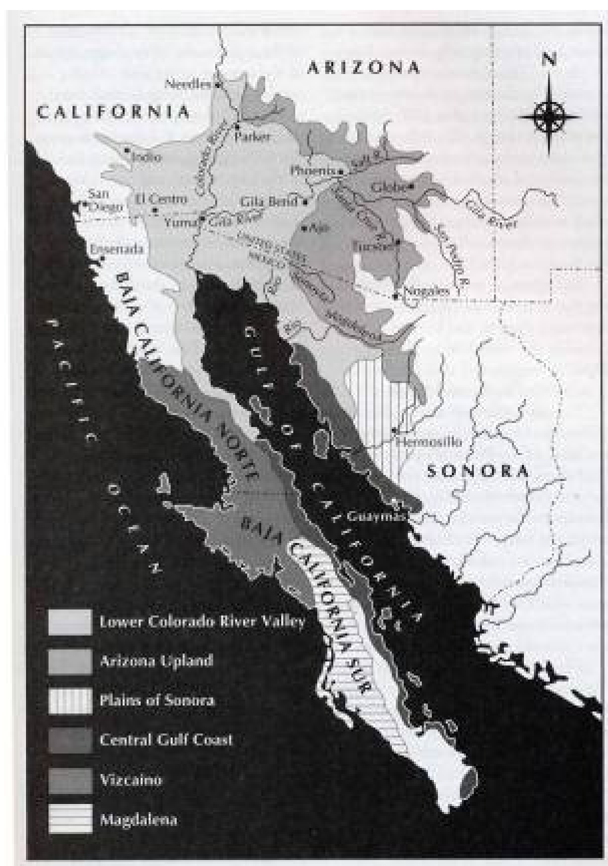

Figure 2-1. The Lower Colorado River Valley Section of the Sonoran Desert, also referred to as the Colorado Desert (Dimmitt 2000a).

Mojave Desert

The Mojave Desert is the smallest of North America's four desert regions, but it is also perhaps the hottest and driest. Due to frequent hard freezes in the winter, Mojave cacti species are typically limited to representatives from the *Opuntia* and *Ferrocactus* genuses that are typically less than one meter in height. Traditional desert woodlands are limited to mesquites (*Prosopsis*) and Catclaw Acacia (*Acacia greggii*) that exist at springs, in washes, and in dune habitats where the roots of these phreatophytes can reach groundwater (The Nature Conservancy 2001).

The Mojave Desert extends from the northern boundary of the Colorado Desert in California west and then north along the eastern face of California's major mountain axis to the Owens Valley, where it meets the Great Basin Desert to the north. The Mojave Desert's northern boundary wends its way through a succession of basins and ranges to the east, where it meets a more abrupt delineation with the Colorado Plateau and Apache Highland ecoregions of Utah, Nevada, and Arizona (Figure 2-2)

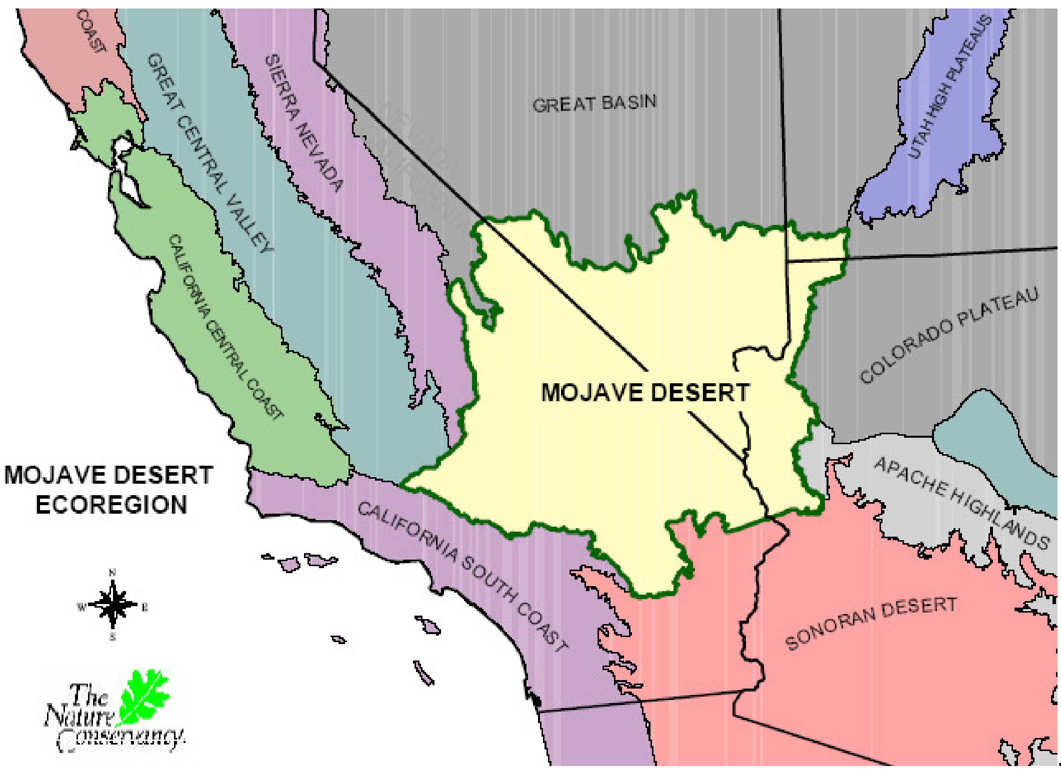

Figure 2-2. The Mojave Desert ecoregion, from the Nature Conservancy (2001).

As in the Colorado Desert, summer highs can exceed 120°F (49°C), and surface temperatures can approach 180°F (82°C). Annual rainfall ranges from 4 to 9 inches (101 – 229 mm), depending on location and elevation (The Nature Conservancy 2001).

The California Wildlife Habitat Relationships (CWHR) system of classification provides general descriptions of wildlife habitats in California. The following brief descriptions (developed by the California Department of Fish and Game) of the major desert habitats in California offer a window into the diversity of desert vegetation. For complete accounts, see Mayer and Laudenslayer (1988), updated periodically by the CA Department of Fish and Game (http://www.dfg.ca.gov/whdab/html/wildlife_habitats.html). For Latin names of species please refer to Appendix A.

Classification of Desert Habitat Types

The vegetation associations that define the habitats considered in this plan are dominated by shrubs. Shrubs are woody perennials that typically have multiple stems growing from the base. With few exceptions, California shrublands comprise associations of *xerophytes*, or species adapted to arid conditions. More specifically, these shrublands are composed of *drymophytes*, which experience regimes of alternating short, wet seasons and long, dry seasons (McMinn 1939). Pure forms of these shrub associations do not include trees of any kind, although old individuals of some species may resemble and/or function ecologically as trees. Despite superficial similarities in general growth form, there are notable structural and physiological differences among the major shrubland formations. These differences, in turn, translate variably into habitat features of importance to birds.

Desert wash habitats (also termed "dry riparian" or "xeric riparian") span a transition from upland to riparian habitat, as well as a transition from "shrubs" to "trees". Washes hold physiological traits similar to traditional riparian habitats, in that they collect precipitation and nutrients from the surrounding watershed, promoting greater floral diversity (Dimmitt 2000[a]). In the Mojave Desert, washes may hold the same species as upland habitats, and simply support taller and denser vegetation. As one moves south and east, washes are better able to support a variety *pheatophytes* which have their deep roots in a water table that is closer to the ground surface. Desert phreatophytes include mesquite, acacia, desert-willow, smoketree, palo verde, and ironwood. Cold winters in the Mojave Desert limit washes to holding only mesquite, acacia, desert-willow, and in the southern Mojave, smoketree.

The warmer Colorado Desert washes support these Mojave phreatophytes, as well as palo verdes and ironwood. Depending on the size of the watershed drained by the wash, Colorado Desert phreatophytes can attain "tree" status, with heights over 10 m and trunk diameters of over one meter. The Milpitas and Chemehuevi Washes in southeastern California are examples of desert washes that hold both traditional desert scrub vegetation and old growth Sonoran Desert wash woodland. In addition, desert wash phreatopytes typically form transition zones between true desert riparian habitats and desert scrub upland in both the Mojave and Colorado Deserts. Dimmitt (2000[a]) estimated that dry washes occupy less than five percent of the Colorado Desert but support 90% of the Colorado Desert's bird life.

Several major shrubland groupings are recognized by the California Wildlife Habitat Relationships System (CWHR). Those that occur primarily in the Mojave and Sonoran bioregions that are covered in this plan include: 1)alkali desert scrub; 2)Mojave desert scrub; 3)Sonoran desert scrub; 4)desert succulent scrub; 5)desert wash; and 6)Joshua tree stands.

Alkali Desert Scrub

Alkali desert scrub is found in broad valleys in the Mojave and Colorado Deserts, and consists of two phases, xerophytic and halophytic (Rowlands 2003). The xerophytic phase occurs on relatively dry soils and consists of widely-spaced, physiognomically similar shrubs typically less than two meters in height. The halophytic phase consists of denser stands of suffrutescent shrubs with varying degrees of succulence. Halophytic stands can withstand occasional flooding and survive in soils high in salinity (Rowlands 2003).

Halophytic alkali desert scrub represents an important transition zone and vegetative buffer between desert riparian and upland scrub habitats in the Mojave Desert. Black-tailed Gnatcatchers, Crissal Thrashers, Bewick's Wrens, Greater Roadrunners, Verdin, and Phainopepla all utilize and nest in halophytic alkali desert scrub/riparian transition zones (McCreedy 2006[a]).

Desert alkali scrub is typically found on the margins of large prehistoric lakebeds or alkali playas, or in riparian floodplains such as those of the Mojave, Amargosa, Colorado, and Gila Rivers. Large sections of Gila River alkali scrub has been converted to agriculture (Latta et al. 1999). This habitat has been found to be important for Arizona LeConte's Thrasher populations (Corman and Wise-Gervais 2005). Where halophytic alkali scrub exists, groundwater is generally close to the surface and is highly mineralized. Xerophytic alkali scrub exists further from the groundwater table, but traditionally exists in soils less well-drained than those that contain surrounding creosote (Rowlands 2003).

Primary perennial species of xerophytic alkali desert scrub include saltbushes, such as Allscale, Desert-holly, Fourwing Saltbush, Nuttall Saltbush, Big Saltbush, Parry Saltbush, Shadscale, Torrey Saltbush, and Western Mojave Saltbush. Secondary shrubs include Bud Sagebrush, White Bursage, Creosote, Fremont Dalea, Nevada Ephedra, Black Greasewood, Spiny Hopsage, Spiny Menodora, Rabbit-thorn, Thurber Sandpaper-plant, Winterfat, and Anderson Wolfberry. Cacti diversity is low, but Cottontop, Hedgehog, Beavertail, Grizzlybear Pricklypear, Staghorn Cholla, and Red-spifned Sclerocactus can be locally common. Trees are generally absent from xerophytic alkali desert scrub (Rowlands 2003).

Primary perennial species of halophytic alkali desert scrub include Arrow-weed, Black Greasewood, Alkali Goldenbush, Kochia, Iodine Bush, Alkali Rubber Rabbitbrush, Seablite, Saltbush, and Tamarisk. Cacti are absent from halophytic alkali scrub, though sparse arborescent stands of Screwbean Mesquite, Honey Mesquite, and Tamarisk may be present (Rowlands 2003).

Sawyer and Keeler-Wolf (1995) habitat series common to alkali desert scrub include: Alkali Sacaton, Pickleweed, Saltgrass, Allscale, Fourwing Saltbush, Rubber Rabbitbrush, Greasewood, Hop-sage, Iodine Bush, Mixed Saltbush, Shadscale, Spinescale, and Mesquite. Plant zonation can occur in relation to soil salinity: Iodine Bush (tolerant to 6% salt), Saltgrass, Seablite, Tamarisk, Alkali Sacaton, Fourwing Saltbush, Arrow-weed, and Honey Mesquite (tolerant at 2% salt). At salinity below 2%, xerophytic alkali scrub predominates, and eventually grades into creosote scrub (Rowlands 2003).

Desert Succulent Scrub

Desert succulent scrub is dominated (at least visually) by succulent plants. Heights are generally less than 2 meters, unless Ocotillo or Saguaro are present, which can increase heights to over 5 m. Desert succulent scrub is generally an open scrub type, though it has a higher shrub density than Mojave or Sonoran desert scrub (Laudenslayer 2003[a]). Desert succulent scrub that holds stands of Joshua Trees is generally classified as Joshua Tree habitat.

Desert succulent scrub is more common in the warmer Colorado Desert. Succulent scrub habitats have greater floral and structural diversity than Mojave or Sonoran desert scrub habitats, and typically support a greater diversity of wildlife. Bird species found in succulent scrub include Northern Mockingbirds, Cactus Wrens, LeConte's Thrashers, Loggerhead Shrikes, and Black-throated Sparrows. Succulent scrub is generally found in rocky or well-drained soils with southern exposures

(Laudenslayer 2003[a]). This habitat type is slow to recover after fire disturbance; White Bursage and cacti species in particular take several years to recover from burns (Latta et al. 1999).

Dominant shrubs of desert succulent habitats include Ocotillo, Saguaro, Mojave Yucca, Desert Agave, Buckhorn, Teddy-bear, and Pencil Cholla, Grizzlybear Pricklypear, Hedgehog, Barrel, Hedgehog Barrel, and Fishhook Cacti. Understory shrubs include Creosote, White Bursage, and White Brittlebush (Laudenslayer 2003[a]).

Sawyer and Keeler-Wolf (1995) habitat series common to desert succulent scrub habitats include Mojave Yucca, Nolina, Ocotillo, and Teddy Bear Cholla.

Mojave and Sonoran Desert Scrub

Mojave and Sonoran Desert Scrub dominates the Mojave and Sonoran bioregions. It is described by open assemblages of broadleaf evergreen or deciduous microphyllous shrubs. Creosote signifies Mojave and Sonoran Desert scrub, though it may not necessarily dominate canopy cover. Shrub heights rarely exceed 3 m in height, and shrub height and density have been correlated to precipitation regimes and soil depth (Laudenslayer and Boggs 2003). Residents include Black-throated Sparrows, Loggerhead Shrikes, LeConte's Thrashers, and Greater Roadrunners.

This scrub type is generally found at low-mid elevations on coarse, well-drained soils. It dissolves into Joshua Tree and pinyon-juniper woodland at high elevations, and into Alkali Desert Scrub at lower elevations with higher salinity.

Mature creosote clones can persist for thousands of years, and are generally slow to recover after severe disturbance (Laudenslayer and Boggs 2003). Vasek (1979) reported that eight years after severe disturbance (in this case mining), only Brittlebush, White Bursage, Wire-lettuce, and Teddybear Cholla had re-established.

Mojave and Sonoran Desert scrub habitats tend to have lower shrub diversity relative to other scrub types. Perennial species include Creosote, Catclaw Acacia, Desert Agave, White Brittlebush, Burrobush, White Bursage, Barrel and Hedgehog Cactus, Pencil and Teddybear Cholla, Palmer's Coldenia, Wiggins Croton, Desert Globemallow, Jojoba, Littleaf Krameria, Ocotillo, Beavertail Cactus, Rabbitbrush, Sand Verbena, Desert Senna, Anderson's Wolfberry, and Mojave Yucca (Laudenslayer and Boggs 2003).

Keeler and Sawyer-Wolf (1995) habitat series associated with Mojave and Sonoran Desert Scrub include Alkali Sacaton, Big Galleta, Desert Needle-grass, Brittlebush, Brittlebush-White Bursage, White Bursage, California Buckwheat, Blackbrush, Creosotebush, Creosote-White Bursage, Desert-holly, Mojave Yucca, and Nolina.

Joshua Tree

Joshua Tree habitats provide far greater structural diversity than the above desert scrub habitats, and they generally have denser canopies of broadleaf evergreen and deciduous micropyllous shrubs that are also in found Mojave and Sonoran Desert Scrub. Joshua Trees themselves comprise only a small amount of the canopy cover and stem density of these habitats, but are visually dominant. Joshua Trees can exceed 6 m and may reach 12 to 15 m in height, providing arborescent cover that is missing from Mojave desert scrub communities (Laudensalyer 2003[b]). Though Joshua Tree stands in eastern Arizona contain several plant species that are more associated with the Sonoran Desert, Joshua Trees are perhaps the plant species most closely aligned with our image of the Mojave Desert bioregion. Joshua Trees provide song perches, canopy foraging, and cavity opportunities to desert birds – structural opportunities rare in the Mojave Desert. Birds nesting in Joshua Tree habitats include Scott's Orioles, Ladder-backed Woodpeckers, Ash-throated Flycatchers, Loggerhead Shrikes, Bendire's and LeConte's Thrashers, Black-throated Sparrows, Cactus Wrens, and Greater Roadrunners.

Joshua Tree habitats are found at moderate elevations between Mojave Desert Scrub and Pinyon-Juniper Woodland. They occupy well-drained soils that can vary in structural characteristics but which typically contain higher organic material and lower salt concentrations than nearby desert scrub habitats (Laudenslayer 2003[b]).

Joshua trees frequently mix with other arborescent vegetation such as California Juniper, Utah Juniper, Singleleaf Pinyon, and Mojave Yucca at higher elevations. Perennial understory species include Big Sagebrush, Blackbrush, Nevada Ephedra, California Buckwheat, Cooper Goldenbush, Burrobush, Creosote, Anderson's Wolfberry, Cooper Wolfberry, Squawthorn, Spiny Menodora, Opuntia Cacti, Bladdersage, Longspine Horsebrush, and Spanish Bayonet (Laudenslayer 2003[b]). Associated Sawyer and Keeler-Wolf (1995) habitat series include Joshua Tree and Mojave Yucca.

Desert Wash

Dry washes contain less than five percent of the Sonoran Desert's area, but are estimated to support ninety percent of Sonoran Desert birdlife (Dimmitt 2000[a]). Desert wash habitats are found in alluvial soils on and adjacent to washes or arroyos. They are also referred to as "xeric riparian" or "dry riparian" habitats, and are typically found at a watershed's lowest elevations. Size and density of desert wash vegetation typically relates to the size of the wash's drainage (Shreve and Wiggins 1964). Desert washes in the northern Mojave typically hold taller individuals representative of the surrounding vegetation type, but structural complexity of wash habitat greatly increases as one moves south and east into the Colorado Desert (Laudenslayer 2003[a]). Surface water may only be present for a few hours in a year (Dimmitt 2000[a]). Desert washes also provide: surface flooding for seed scarification, alluvial nutrient buildups, loose soils for burrowing, compacted banks for additional burrowing opportunities, and corridors for dispersion (The Nature Conservancy 2001).

Great structural diversity can exist in desert wash habitat, particularly in the Colorado Desert. Blue Palo Verde and Ironwood trees can attain heights greater than 13 m, and provide numerous foraging and nesting opportunities for breeding and migrant songbirds (McCreedy 2006[b]). Phainopeplas, Ash-throated Flycatchers, Verdin, Crissal, LeConte's, and Bendire's Thrashers, Long-eared and Western Screech Owls, Black-tailed Gnatcatchers, Gila and Ladder-backed Woodpeckers, Lucy's Warblers, Northern Mockingbirds, and Loggerhead Shrikes all populate desert wash habitats.

Canopy wash species include Blue Palo Verde, Foothills Palo Verde, Ironwood, Smoketree, Catclaw Acacia, Honey Mesquite, Screwbean Mesquite, Desert-willow, and Tamarisk. Subcanopy species include Arrow-weed, Wolfberry, Crucillo, and Desert Broom. Understory perennials include Cheesebush, Rabbitbrush, Desert Lavender, Goldenbush, Creosote, White Bursage, Snakeweed, and Saltbush (Laudenslayer 2003[a]).

Many desert wash dominants are phreatophytes which require high water tables and occasional, albeit brief above-surface flows. Desert wash species found in Colorado Desert washes are often unable to withstand frequent freezes common to the Mojave Desert. Several wash species, particularly palo verde, are sensitive to fire disturbance and recover slowly after burns.

A Standardized California Vegetation Classification

Recognizing the importance of broad, habitat-based classification schemes (e.g., CWHR), a detailed floristic system of California vegetation classification has been developed by Sawyer and Keeler-Wolf (1995). Their Manual of California Vegetation (MCV) provides a system of classification at a more specific level; floristically based on lower units of plant associations (referred to as series). With a standardized classification system one can describe vegetation associated with many aspects of bird biology and conservation across space and time. A single, widely accepted terminology provides land managers, natural resources specialists, and conservationists with a common language that promotes clear communication and hence better-informed decisions. CalPIF has adopted the Sawyer and Keeler-Wolf/MCV system of vegetation classification as the standard used for all CalPIF objectives. The Sawyer and Keeler-Wolf system ties in with continental planning efforts of The Nature Conservancy and is compatible with most previous schemes used in California, such as that of the California Biodiversity Council (see Chapter 7, Bioregional Conservation Objectives). As of 2004, the second edition of the Manual of California Vegetation, a new hierarchical vegetation classification system consistent with the National Vegetation Classification Standard (NVCS), is being developed by Sawyer and Keeler-Wolf, in coordination with a statewide committee (Sawyer and Keeler-Wolf *in prep*). In the NVCS, there are several upper levels of classification (currently six, may be reduced to three) representing growth form, leaf characters, hydrology, and environment and two lower levels, representing floristics (Alliance, Association). Alliances are defined by the dominant one to three species, while Associations are distinguished by secondary associated species, usually in the understory.

Joshua Tree habitat in the Mojave Desert *photo by Ryan DiGaudio*

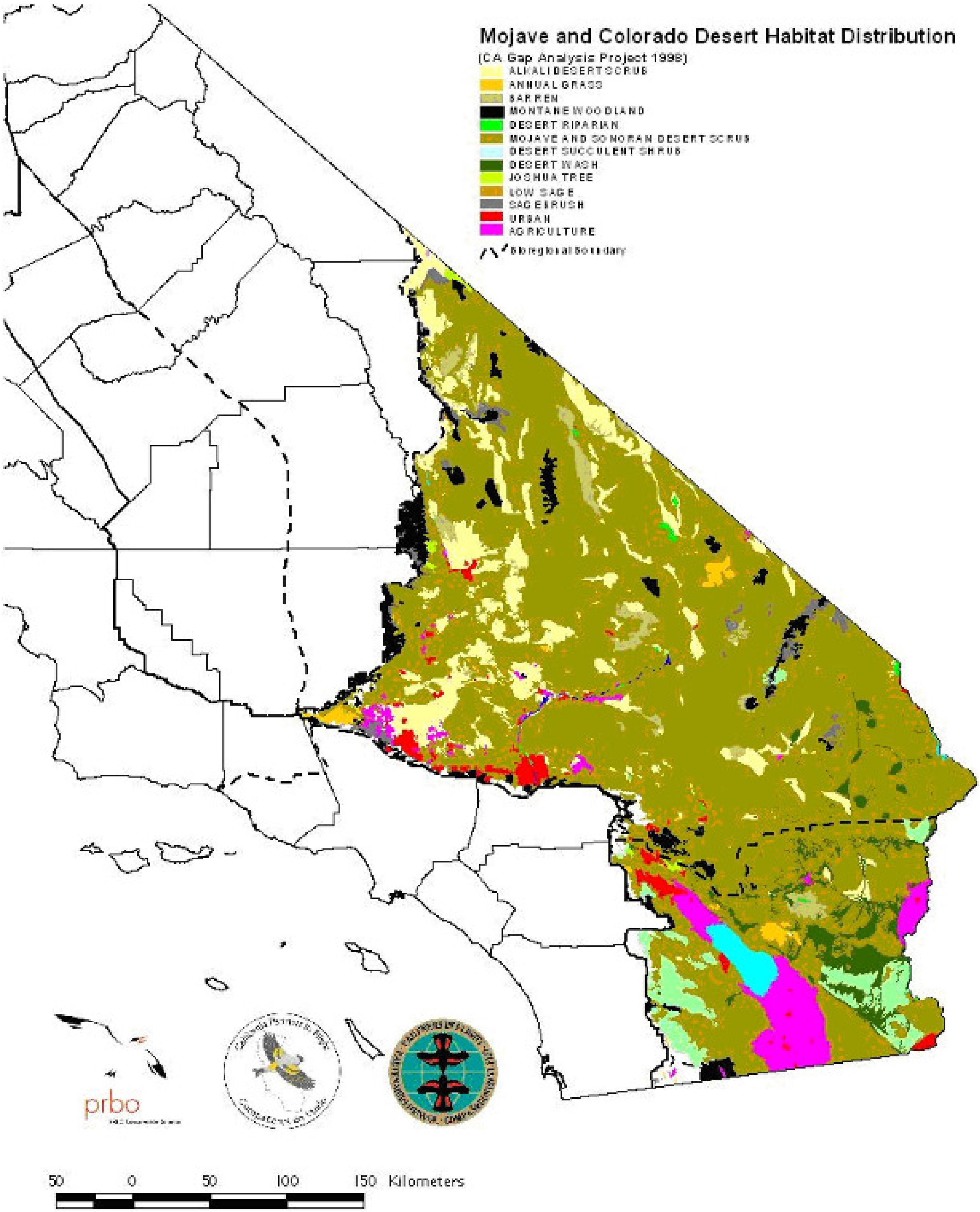

Figure 2-3. Approximate current coverage of desert habitats throughout California.

Chapter 3. Desert Habitat Conservation at the Landscape Scale

A number of issues covered in this Conservation Plan are united by the fact that they must be addressed on a relatively large spatial scale. When targets are set for restoring healthy population sizes of a given species (Chapter 6), researchers and land managers have to consider habitat at the scale of many hectares or square kilometers, and prioritizing land parcels for conservation and habitat restoration (Chapter 8) usually occurs at similar scales. Agricultural development in California's Central Valley, for example, has left remnant patches of riparian forest that measure from a few to a few hundred hectares (Hunter et al. 1999), and the conservation and restoration of this habitat involves consideration of the ecology of entire landscapes in which remnants are situated (Figure 3-1). Ecological conditions required for healthy wildlife populations in riparian habitats, such as complex vegetation structure that provides birds with nesting sites, are often measured at the scale of square meters (Kareiva and Andersen 1988); but additional conditions exist at much larger scales, and managers must also provide for these.

The need for research focused on large-scale issues has been stressed in bird conservation initiatives (Ruth et al. 2003) and other conservation efforts partly because this is the scale at which parcels of land are owned and managed, and partly because many important ecological processes occur, and can only be studied, at large scales. Since the emergence of landscape ecology, research has increasingly been directed toward understanding the consequences for wildlife of alterations to, and the potential restoration of, natural habitats at large scales.

What is Landscape Ecology?

Landscape ecology takes into consideration the large-scale heterogeneity of areas containing species or natural communities that might be targeted for conservation. Although the size of a landscape is not strictly defined and can vary widely, landscapes typically exist at the general scale of a vista that can be seen in all directions around an observer from a single point. Such a landscape is normally a complex mosaic of multiple component areas (landscape elements or *patches*) under varying management practices or natural succession regimes (Forman and Godron 1986). Different patches may have different values for wildlife; some may be largely unoccupied by a given species while other areas are densely occupied, and occupied areas may be sites of largely successful or largely unsuccessful breeding and reproduction (i.e., population sources and sinks—Pulliam 1988, With and King 2001).

Landscape ecology, then, is concerned with interactions among these patches, in terms of the flow of species, materials, and energy among them. It also focuses on the ways that the specific shapes and spatial arrangements of landscape elements affect their interactions. That is, landscape ecology is a spatially explicit science (Forman and Godron 1986, Wiens et al. 1993, Forman 1995). While patches can be defined at nearly any scale, landscape ecology often investigates interactions of biological populations or communities with relatively large-scale environmental features and processes, such as regional topography, the expansion of urban areas into wildlands, and forest fragmentation. The growth of landscape ecology as a discipline has been paralleled by growing recognition that conclusions drawn from ecological investigations can depend upon the scale at which a system is studied (Wiens 1989, Riitters et al. 1997, Saab 1999, Wiens 1999, Schneider 2001). Environmental factors may affect bird populations differently at different scales, may only have important effects at certain scales, and may affect different species at different scales. For example, Hochachka et al. (1999) found for sites across the western U.S. that, while rates of songbird nest parasitization by Brown-headed Cowbirds decreased with increasing forest cover within 10 km of nesting sites, the relationship reversed when forest cover within 50 km was considered. Thus, the explicit consideration of scale has become an important aspect of ecological investigations, with consequences for conservation activities (Schneider 2001).

Landscape-scale factors that affect desert birds

Many environmental factors can affect desert bird populations at large scales. We mention here some of the more important ones that are of immediate conservation relevance.

Altered hydrology

Little research has investigated the impacts of California's large-scale alteration of natural hydrologic regimes to bird communities. Artificial flow regulation with local or upstream dams and diversions, as well as channel alteration and containment with levees and channelization, can alter plant communities at watershed scales (Ohmart 1994, Hunter et al. 1999). Transportation departments may channelize or re-direct sheet flow to manage rainfall events, altering hydrologic input to desert wash habitats (The Nature Conservancy 2001). Vegetation, and therefore vegetation-dependent wildlife, can be dramatically affected by distant upstream water management practices (Ohmart 1994), so that restoration efforts at specific sites may depend ultimately on the cooperation of partners managing water in the wider landscape.

Habitat fragmentation and landscape condition

More attention has been paid to the topic of habitat fragmentation because fragmentation has been perhaps the most apparent human-caused transformation of natural systems, aside from their outright reduction in size (Meffe and Carroll 1997). As Gila River Valley saltbush scrub has been converted to agricultural fields, for example, remnant undeveloped habitat has been left as a disconnected series of fragments of varying size and shape (Latta et al. 1999). Such habitat fragments have been likened to islands in a "sea" of inhospitable habitat. The theory of island biogeography (MacArthur and Wilson 1967) maintains that smaller, more isolated islands (or fragments) support fewer species, due to a higher likelihood of local population extirpation. This general property of small populations results from numerous ecological mechanisms working at relatively small scales within islands or fragments, as well as at larger scales around them. For example, small remnant patches of breeding bird habitat in urban areas may contain such low numbers of a particular species that small increases in predation rates can cause extirpation. In such cases, increased densities of cats and other predators subsidized by the surrounding urban landscape can be sufficient to cause the loss of several songbird species (Soulé et al. 1988, Bolger et al. 1991, Crooks and Soulé 1999, Crooks et al. 2001). Donovan et al. (1997) found that in Midwestern forest habitats, nest predation was higher on habitat edges within moderately and highly fragmented landscapes, compared to unfragmented landscapes. Chalfoun et al. (2002) found that edge effects on nest predators were stronger in agricultural landscapes than in more heavily forested landscapes. In western riparian and wash habitats, which are more naturally fragmented than eastern deciduous forests, densities of both nest predators and nest parasites (such as the Brown-headed Cowbird) in forest fragments may depend more on surrounding land use, such as the prevalence of agriculture in the landscape, than on fragment size or amount of edge (Tewksbury et al. 1999). Nest parasitism by Brown-headed Cowbirds can affect the reproductive success of songbirds (Chapter 4), so landscape features that influence cowbird abundance are an important consideration.

In some respects, the Mojave and Colorado Deserts provide us with great conservation opportunity. Ricketts et al. (1999) reported that approximately one-half of the Mojave Desert remains as intact habitat. A high degree of public ownership in the Mojave and in United States portions of the Colorado Desert provides some buffer to fragmentation.

However, localized and explosive urban growth within the Mojave and Colorado Desert may seriously impact desert flora and fauna unaccustomed to habitat fragmentation and its ecological effects. Studies near Tucson have shown that Black-throated Sparrows and Black-tailed Gnatcatchers in particular require undisturbed, native vegetation (Germaine et al. 1998). Cavity species, insectivores, ground-nesting species, and ground feeders are all sensitive to fragmentation from urbanization and conversion of desert scrub to agriculture (Latta et al. 1999). Phillips et al. (1964) noted that LeConte's Thrashers are sensitive to disturbance and have withdrawn from agricultural habitats in the Gila Valley. Northern Flickers, Pyrrhuloxia, Verdin, Gambel's Quail, Ash-throated Flycatchers, Greater Roadrunners, Rufous-winged Sparrows, and Ladder-backed Woodpeckers have all shown sensitivity to urbanization and resultant habitat fragmentation (Latta et al. 1999).

Barriers to Movement

In addition to affecting habitat patch quality, surrounding landscape conditions can also affect wildlife movement among habitat patches. In naturally patchy systems such as desert riparian woodland, and possibly in artificially fragmented systems, it may be appropriate to consider bird populations in patches as parts of a metapopulation, or group of interconnected populations (Hanski and Gilpin 1997). In this framework, the probability of a local population's extirpation is reduced by occasional immigration from other patches, so that the long-term stability of the entire metapopulation depends on some minimum level of patch interconnectivity. In other words, a particular habitat fragment may be too small to meet minimum requirements for a stable population of a given species, but effective movement of individuals (such as dispersing juveniles or adults seeking mates) among multiple fragments can render each fragment a functioning component of the whole population. Movement among fragments may be hindered by hostile conditions in developed areas around fragments, and such movement can become increasingly unlikely with increasing distance between fragments (e.g., Norris and Stutchbury 2001, Cooper and Walters 2002). For sedentary species such as Crissal and LeConte's Thrashers, increased fragmentation and barriers to movement can result in local population extirpation (Laudenslayer et al. 1992).

Conservation Approaches

Clearly, the quality of remnant habitat fragments can depend not only on their size and internal characteristics, but also on their configuration relative to one another and the characteristics of the surrounding landscape (Andren 1992, 1994; Sisk et al. 1997; Tewksbury et al. 1998; Saab 1999; Tewksbury et al. 2002). Prioritization of sites for bird conservation should therefore consider surrounding landscape conditions, such as the proximity and prevalence of other natural areas, urban areas, agricultural areas, or Brown-headed Cowbird foraging areas. Managing for healthy wildlife populations in remnant natural areas may entail developing cooperative relationships with the managers of adjacent lands.

Weaselhead.org photo.

Female Brown-headed Cowbird.

The Nature Conservancy has taken the lead in identifying habitat fragmentation and land classification status relating to conservation protection (Table 3-1; The Nature Conservancy, 2001).

Table 3-1. Land classification types developed by The Nature Conservancy (2001).

LAND CLASS	DESCRIPTION
Class I (L1)	Lands owned by private entities and managed for biodiversity conservation or administered by public agencies and specially designated for biodiversity conservation through legislative action where natural disturbance events proceed without interference. The agency acting alone cannot change these designations without legislative action and public involvement. Examples include many TNC preserves and other private preserves committed to biodiversity conservation and dedicated as state preserves or natural areas, some national parks, some national wildlife refuges, federal wilderness areas, and some state parks and nature preserves.
Class II (L2)	Lands generally managed for their natural values, but that may incur use that degrades the quality of natural Communities (e.g., habitat manipulation for game species). Also includes public lands with administrative designations for biodiversity conservation. Examples include many national wildlife refuges, state wildlife management areas, private preserves managed for game species, BLM areas of critical environmental concern, and federal research natural areas.
Class III (L3)	Lands maintained for multiple uses, including consumptive or recreational values, and not specifically or wholly dedicated to biodiversity conservation, and lands with restricted development rights. Examples include most nondesignated (i.e., multiple-use) public lands administered by the U.S. Department of Agriculture, Forest Service, and BLM, Department of Defense buffer lands, state forests, regional and large local parks and open space, and private lands protected from subdivision by conservation easements and other title restrictions.
Class IV (L4)	Lands with no known protection, including lands used for intensive human activity; agricultural, residential, and urban lands; public buildings and grounds; and transportation corridors.

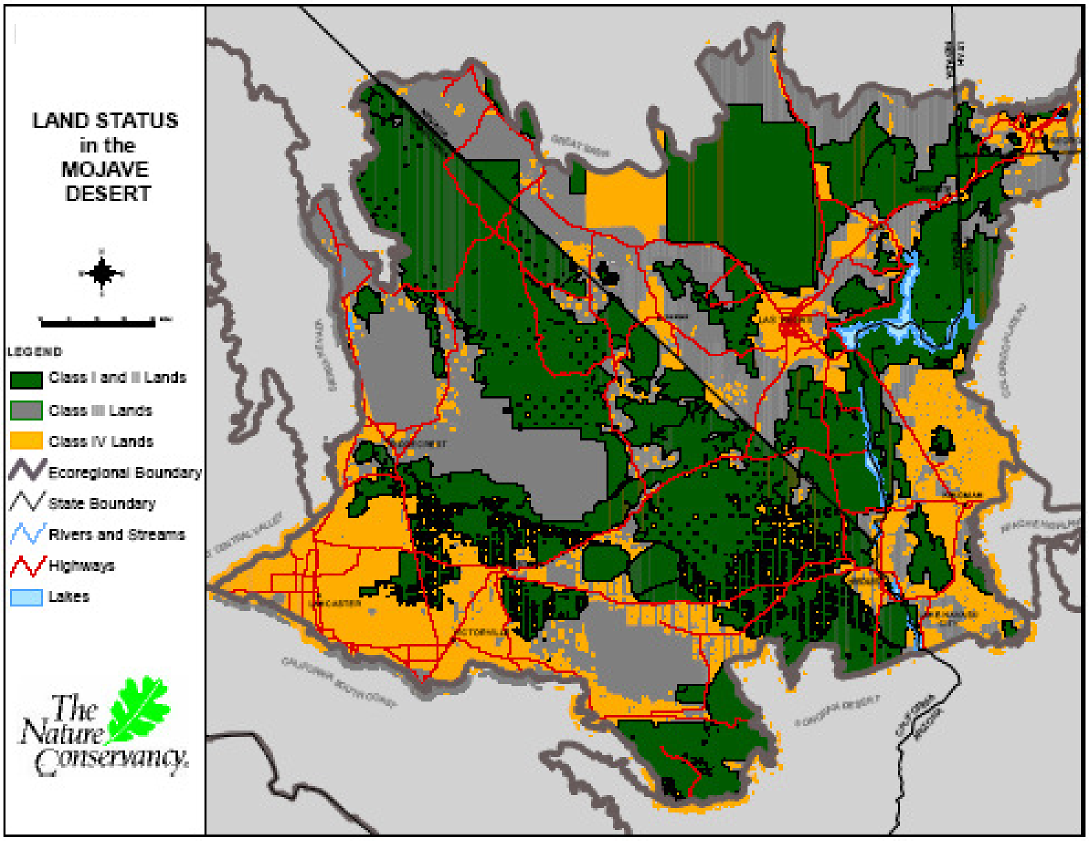

Figure 3-1. Land classification using land ownership and management analysis by The Nature Conservancy provides us a means to determine conservation priorities in across the Mojave Desert at the landscape scale.

Fragmentation vs. natural patchiness

The fragmentation of formerly contiguous habitat can reduce the usefulness of remaining habitat for wildlife conservation in some cases, so preservation and restoration efforts should in these cases prioritize large contiguous blocks of habitat and connectivity among those blocks. However, many natural systems are patchy or heterogeneous at large scales, and organisms can be adapted to naturally patchy environments. For example, desert riparian gallery forests often occur naturally as discreet patches along river stretches where conditions are favorable. This contrasts with the riparian forests of California's Central Valley, which were historically relatively wide, contiguous stands following river courses for long distances. Natural patchiness generates habitat heterogeneity that single organisms may use, as when bird species nest in one habitat and forage in another. In desert riparian systems, many riparian woodland-dependent species also forage in surrounding scrub habitat (Szaro and Jakle 1985). Thus, efforts to restore natural conditions must be tailored to the needs of specific systems, with consideration for the natural large-scale heterogeneity of many systems. In extreme cases of critical habitats that are very patchy, such as freshwater wetlands, conservation efforts may be best directed towards multiple small reserves where remnant habitat exists (Haig et al. 1998).

The landscape paradigm

It is increasingly recognized that viewing habitat remnants as islands embedded in a sea of unsuitable habitat is an oversimplification of reality for most species, and conservation planning should not necessarily follow this model. Each of the patches that compose a landscape is more accurately seen as falling somewhere along a continuous gradient of habitat quality, and quality varies depending on what particular wildlife species or community one considers as well as the scale at which patches are defined (Wiens 1995). As discussed above, habitat quality is also mediated by landscape composition and interactions among patches.

Advances in landscape ecology have therefore generated a framework for conservation planning within which the structure and function of all elements of a landscape can be considered together in a spatially explicit, scale-explicit manner. Resulting conservation approaches might identify priority areas for strict preservation of remnant and restored natural systems surrounded by areas with less strict forms of mixed-use conservation management, and management applications in permanently degraded areas that will minimize their adverse impacts on the broader landscape.

"Placing the conservation reserves firmly within the context of the surrounding landscape and attempting to develop complementary management strategies seems to be the only way to ensure the long term viability of remnant areas… This has important implications for land managers since it involves a radically new way of viewing management and requires that neighboring land uses, and hence neighboring landowners, interact in a positive way. This is difficult, but not impossible…"(Saunders et al. 1991).

Photo by James Gallagher, Sea and Sage Audubon.

Declines in Cactus Wren populations have been correlated to urbanization

Chapter 4. Problems Affecting Desert Birds

The PIF North American Landbird Conservation Plan characterizes species of the Southwestern Avifaunal Biome to have generally low population sizes, narrow distributions, high threats, and, when trend data exist, generally declining populations (Rich et al. 2004). PIF scored these characteristics to assess breeding vulnerabilities for landbirds that nest in the United States and Canada (Figure 4-1). In general, species of the Intermountain West, Southwest, and Pacific Avifaunal Biomes have the highest vulnerabilities on the continent.

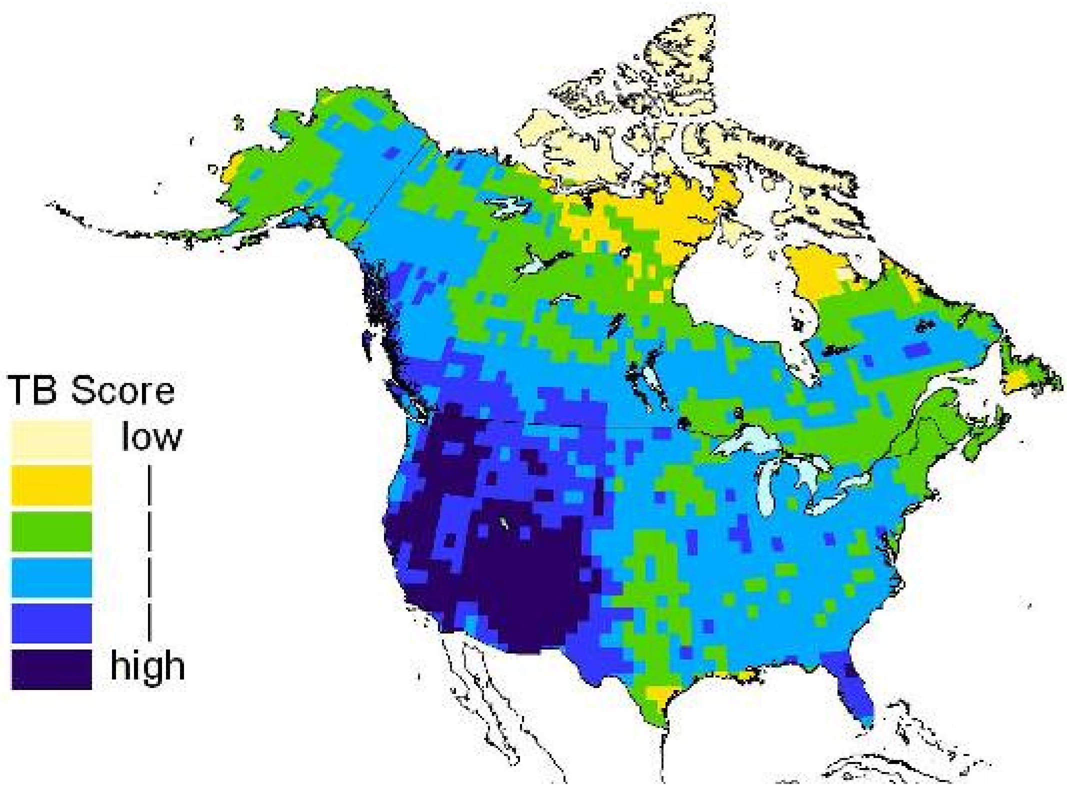

Figure 4-1. Average vulnerability among species occurring in each lat-long block during the breeding season, based on Threats to Breeding (TB) scores for 448 landbirds species. Severe threats = highest vulnerability (high TB score); no threats = lowest vulnerability (low TB score). Taken from Rich et al. 2004.

Threats to landbird populations can generally be traced to anthropogenic causes. Southwestern landbird breeding species' high vulnerability, the region's exploding human population growth, and desert ecosystems' generally slow recovery from disturbance are potent ingredients of potential declines in desert bird populations.

Base causes of landbird population declines include loss of habitat, habitat fragmentation, habitat degradation, and the introduction of predators and nest parasites into landbird communities. These engines for population decline are in turn powered by specific threats to landbird populations, many of which are present in the Mojave and Sonoran Deserts.

Urbanization

The Arizona Partners In Flight Bird Conservation Plan identified urbanization and resultant habitat fragmentation and habitat loss as the number one threat to desert bird populations (Latta et al. 1999). The Las Vegas and Yuma metropolitan areas were the first and third fastest-growing urban areas in the United States from 1990-2000 (U.S. Census Bureau 2000). The population of Arizona increased 64.3% from 1980-1996 (Latta et al. 1999). In the western Mojave Desert, the population has tripled in the last twenty years. These population trends are expected to continue through the twenty-first century.
Urbanization obliterates and simplifies desert scrubland communities, reducing the amount of native vegetation necessary for nesting and foraging opportunities for many desert bird species. Urban habitats are typically exploited only by traditionally urban species (often exotic) while only a handful of native desert species have succeeded in taking advantage of greater foraging, watering, and altered structural diversity found in urban environments (Beissinger and Osborne 1982, Emlen 1974). This results in a decrease in avian diversity in urban habitats, with the concomitant obliteration of several desert species. Black-tailed Gnatcatchers and Black-throated Sparrows have been found to be particularly sensitive to urbanization and the replacement of native desert scrub with exotic vegetation (Germaine et al. 1998 and Emlen 1974). Declines in Verdin, Pyrrhuloxia, Northern Flicker, Cactus Wren, LeConte's Thrasher, Crissal Thrasher, Bendire's Thrasher, Loggerhead Shrike, and Greater Roadrunner populations have all been correlated to urbanization, though Verdin and Cactus Wrens have also been found to be unaffected by urban development if nest-site alternatives are present in the urban matrix (Corman and Wise-Gervais 2005, Germaine et al. 1998, Emlen 1974).

Emlen (1974) identified two factors key to the decline of native desert avifauna in urban habitats: changes in the nature and quality of vital resources, and changes in the nature and magnitude of population suppressants.

Urbanization results in the rapid increase of foraging and watering opportunities, but these opportunities are generally skewed toward ground-foraging, seed-eating guilds (Beissinger and Osborne 1982, Emlen 1974). Thus while White-winged Doves, Mourning Doves, House Finches, and Common Ravens profit, the majority of native desert species are neutral to these increases in vital resources, and do not take advantage of foraging opportunities presented by exotic vegetation common to desert urban environments.

Urbanization also results in the alteration of vegetation structure important to desert avifauna (Germaine et al. 1998, Emlen 1974). Low desert scrub and thick understory vegetation are replaced with manicured lawns or sculpted canopy trees, which favors arborescent foraging and nesting species and penalizes ground and low-nesting species (Emlen 1974). Of 15 Desert BCP focal species, only Common Ravens, Gila Woodpeckers, and Ash-throated Flycatchers have gained from an increase in arboreal urban vegetation (Germaine et al. 1998, Emlen 1974). Phainopeplas and Lucy's Warblers will also nest in arborescent vegetation, but have not been found to increase in urban areas (Corman and Wise-Gervais 2005)

The majority of desert breeding species traditionally nest in low, scrub vegetation. Median nesting height for 579 Arizona Breeding Bird Atlas nests (1994-1996) was 1.8 m (Corman and Wise-Gervais 2005). Nesting habitats for these species are severely compromised in alteration to an urban and generally exotic environment. Exotic vegetation or desert urban communities is a poor substitute for desert scrub habitats traditionally occupied by the majority of desert nesting species, and only a small minority of nests located for Desert BCP focal species have been located in exotic vegetation (one notable exception is the Lucy's Warbler, which has successfully adapted to dense tamarisk vegetation (Johnson et al. 1997)).

In addition, low-nesting species are susceptible to population suppressants such as alteration of predation pressures and increased anthropogenic disturbance/traffic (Emlen 1974). Ground-nesting Gambel's Quail, Greater Roadrunners, and Black-throated Sparrows have been found to be especially sensitive to these urban predation and disturbance threats (Emlen 1974). Rosen and Schwalbe (2002) found that feral domestic cats have resulted in the loss of the native mammal community and the restructuring of the lizard assemblage at Tucson, AZ.

Exotic Vegetation

The introduction and insidious spread of exotic plant species into the Sonoran and Mojave Deserts is one of the leading threats to desert landbird populations. Roughly 11% of the flora of the Sonoran Desert and 7% of the flora of the Mojave Desert are now comprised of exotic species (Lovich 2002, Wilson et al. 2002). While these percentages are relatively low compared to invasions in other bioregions, nearly all of the exotic introductions to the Mojave and Sonoran Deserts have occurred in the last one hundred years. Importantly (as in the case of buffelgrass or tamarisk), it takes only a handful of highly successful naturalized plant species to severely alter desert ecosystems.

It is crucial to recognize that presence and success of exotic species can often be correlated to anthropogenic disturbance. Disturbed soils and soils lacking intact microbiotic crusts are more susceptible to exotic plant colonization (Wilson et al. 2002). Altered hydrologic regimes brought about by municipal diversions and water impoundments have fostered conditions ideal for the spread of saltcedar in riparian systems (Stromberg and Chew 2002). Agriculture, ranching, and recreation have provided introduction of exotic flora into previously undisturbed habitats (USFS 2003, Esque and Schwalbe 2002, Stromberg and Chew 2002).

The introduction and spread of exotic flora into the Mojave and Sonoran Deserts can come back to haunt desert bird populations through several, often complex mechanisms. These include fundamental ecosystem alteration, reduction in native plant diversity and abundance, and outright extirpation of native plant communities (Mack 2002).

One of the most important exotic plant threats may be the spread of exotic annual grasses initially brought to the desert as livestock feed. Red Brome and Mediterranean grasses have been shown to alter fire regimes in the Arizona Upland section of the Sonoran Desert (Esque and Schwalbe 2002), and these non-native grasses have become widespread in the Colorado Desert as well. Red brome and Mediterranean grasses build up fuel loads during wet seasons, quickly drying as winter rains end in March. They are aggressive colonizers and are notable in their ability to fill open spaces between desert scrub vegetation, providing vectors for the spread of wildfires presumed to be absent prior to exotic grass introduction. They respond quickly after burns, promoting future wildfires once habitats are initially stricken by fire.

The introduction of African Buffelgrass may be potentially even more devastating to Sonoran Desert scrub habitats. African Buffelgrass was originally brought to the Americas in the 1940s by the Soil Conservation Service of the USDA for erosion control. It was heavily introduced in Sonora and Tamaulipas, Mexico to increase cattle forage in the 1960s (Burquez-Montijo et al. 2002). It has spread rapidly from the Plains of Sonora section of the Sonoran Desert both northward and to the south, and is now found in Arizona as well (Burquez-Montijo et al. 2002). It is now estimated that Buffelgrass is the dominant herbaceous plant across an area of 8 – 10 million hectares. It can spread to undisturbed habitats via windborne seeds, but livestock and anthropogenic disturbance have hastened its spread (Burquez-Montijo et al. 2002).

Buffelgrass habitats contain three-to-four times the above-ground biomass held by desert scrub habitats, yet floral diversity decreases tenfold from native scrub to Buffelgrass habitats. While this increase in forage is much more ideal for cattle production, few native flora and wildlife benefit from introduced Buffelgrass habitat (Burquez-Montijo et al. 2002). In total, 800,000 hectares of Sonoran desert scrub habitat have been officially approved for conversion to buffelgrass by the Mexican government. Significantly more conversion occurs without approval, as privatization of communal ejido lands to large landowners has coalesced resources for the conversion of scrub to grassland.

The National Park Service halted buffelgrass invasion of Organ Pipe National Monument with active management through manual removal and subsequent re-visits (Rutman and Dickson 2002). This example highlights that, as is the case of many exotic invasions, early and rigorous management can control outbreaks before they reach critical levels. Yet across areas of Sonora, the spread of Buffelgrass and the elimination of native arborescent and succulent desert vegetation through subsequent fires may have reached an irreversible ecological threshold, with permanent and increasing loss of native Sonoran Desert Scrub habitats (Burquez-Montijo et al. 2002).

While a minority of the perennial flora native to the Mojave and Sonoran Deserts respond positively to fire disturbance, the great majority do not (Esque and Schwalbe 2002). In particular, succulent species (primarily columnar cacti), palo verde, and White Bursage respond poorly to fire damage (Esque and Schwalbe 2002, Latta et al. 1999).

Buffelgrass, Red Brome and Mediterranean grasses have become ubiquitous in the Colorado Desert and are outside control (Wilson et al. 2002). It is not a question of *if* exotic grasses will alter fire regimes and native vegetation cover in the Mojave and Colorado Desert, but a question of when and to what degree (Esque and Schwalbe 2002).

Of all wildlife, Esque and Schwalbe (2002) put forward that birds are most susceptible to loss of native Sonoran Desert perennial vegetation. Thirty-five percent of 579 Arizona Breeding Bird Atlas nests located between 1994 and 1996 were constructed in palo verdes (Latta et al. 1999). In Colorado Desert washes, McCreedy et al. (2006) reported that up to 69% of nests were built in either palo verdes or ironwoods. On the Chemehuevi Wash, San Bernardino County, CA (where ironwood is absent), 64% of nests were built in blue palo verde (McCreedy et al.2006). Yet Esque and Schwalbe (2002) found that repeatedly-burned areas near Phoenix and Tucson have become nearly devoid of perennial scrub, which has been replaced by exotic grasses. The potential loss of fire-sensitive Fabaceous desert woodland and columnar cacti scrub will continue to menace desert bird populations as exotic grasses continue to spread throughout the Mojave and Sonoran Deserts.

Recreation

Off-highway vehicle (OHV) use increased 32% in the United States from 1994-2000, and OHV sales more than tripled between 1995 and 2003 (The Wilderness Society, 2006). In California, there has been a 108% increase in off-road license registrations since 1980, and a 74% increase in street-licensed four-wheel vehicles since 1994 (California State Parks Off-Highway Motor Vehicle Recreation Division 2006). Impacts from OHV use include erosion, soil compaction, damage to cultural resources and sites, creation of new roads (leading to habitat fragmentation), disrupted wildlife and their habitats, and spread of exotic vegetation (USFS 2003).

While it is widely known that off-highway vehicles are both highly popular and carry the potential to negatively impact bird populations in a number of ways, actual research into this problem is only beginning (McCreedy et al.2006, Barton and Holmes 2004). It may be difficult to demonstrate direct OHV-impacts on desert bird populations, but indirect impacts such as destruction of microbiotic soil crusts, introduction of exotic flora to undisturbed areas, potential for fire ignition, and damage to native vegetation highlight the importance for land agencies and non-governmental organizations to identify and protect portfolio desert habitats (such as desert washes) that hold the highest densities of plant and wildlife diversity.

Domestic and feral livestock grazing

Livestock grazing has contributed to the degradation of coastal sage scrub habitat by preventing the growth of young shrubs, opening up the scrub canopy to invasion by exotic annuals, and reducing the ability of native forbs and grasses to compete with exotics (McBride and Heady 1968, McBride 1974, O'Leary 1990). Domestic livestock grazing is most prevalent in the western Mojave (The Nature Conservancy 2001).

Feral burro populations are heaviest in the Lower Colorado River Valley, where preferential grazing in desert wash habitats has resulted in significant losses to canopy cover and palo verde regeneration (Hanley and Brady 1977, Woodward and Ohmart 1976). Palo verdes and White Bursage were found to be particularly palatable for feral burros at sites on the Standard Wash and Chemehuevi Mountains. Given the high preference for Blue Palo Verde as a nesting substrate at nearby Chemehuevi Wash (McCreedy et al.2006), heavy grazing pressure from feral burros on young palo verde plants could significantly reduce vital nesting habitat in primary and secondary washes near the Colorado River.

In addition, McCreedy et al.(2006) reported average nest heights on the Chemehuevi Wash of 2.49 m (n=156), and Latta et al. (1999) reported Arizona Breeding Bird Atlas nest height averages of 2 m (n=579). These heights are within reach of feral burro grazing disturbance, and significant amounts of habitat cover for low-nesting desert birds could be lost to feral burro overgrazing in desert wash habitats.

Nest Parasitism

Brown-headed Cowbirds (*Molothrus ater*) and Bronzed Cowbirds (*Molothrus aeneus*) have been found to parasitize nests in Mojave and Sonoran Desert habitats (McCreedy et al.2006, Corman and Wise-Gervais 2005). Urbanization and irrigated agriculture have significantly aided these species' expansion in arid desert habitats, enabling them to parasitize nests in scrub habitats otherwise hostile to cowbird foraging and watering requirements. McCreedy et al.(2006) reported Brown-headed Cowbird parasitism over 18 km from the closest urban area capable of providing foraging habitat for commuting females.

While Bronzed Cowbirds have spread throughout Arizona in the twentieth century, they are still considered rare. Icterids (particularly Hooded Orioles) represented the majority of hosts parasitized by Bronzed Cowbirds in nests found by the Arizona Breeding Bird Atlas program (Corman and Wise-Gervais 2005).

Like Bronzed Cowbirds, Brown-headed Cowbirds have only become widespread in Mojave and Sonoran Desert habitats during the twentieth century. However, Brown-headed Cowbirds are much more common, and will parasitize a much greater diversity of host species' nests. Black-tailed Gnatcatchers represented over ten percent of 225 incidents of Brown-headed Cowbird parasitism recorded by the Arizona Breeding Bird Atlas. Yellow Warblers, Bell's Vireos, Black-throated Gray Warblers, and Black-throated Sparrows were the other most common host species found by the atlas (Corman and Wise-Gervais 2005).

Though Brown-headed Cowbirds are present in the Mojave and Sonoran Desert throughout the winter, they are generally only found in large flocks (generally in urban or agricultural settings), and do not begin to parasitize nests until March. In addition, the Brown-headed Cowbird breeding season's timing is variable, and is likely related to climatic conditions. This is crucial for desert bird species, which often initiate first clutches well before the Brown-headed Cowbird breeding season begins. In the Lower Colorado River Valley, McCreedy et al.(2006) found that while zero Black-tailed Gnatcatcher first brood attempts were parasitized, three out of four double brood attempts were parasitized (the fourth nest, which was suspiciously abandoned during incubation, was too high to view nest contents). As Brown-headed Cowbirds have only recently re-occupied Mojave and Sonoran Desert habitats, it will be interesting to see if their breeding phenology evolves to more closely match the breeding seasons of their desert hosts.

Though the following sections on habitat loss and fragmentation pertain to problems facing bird communities in the Mojave and Sonoran Deserts, they were originally written for the California Partners in Flight Coastal Scrub Bird Conservation Plan. The three ecoregions share patterns of habitat loss, fragmentation, and degradation due to rapid development, escalating fire frequency, and increasing recreation pressure. Bird conservation in the Mojave and Sonoran Deserts - which share several species discussed in the Coastal Scrub Plan - will be handicapped without a concerted effort by land managers and local and state elected officials to address these problems.

Habitat Loss

The most profound factor that threatens shrubland birds is the direct and permanent loss of habitat. Permanent habitat loss is most often the result of human land uses, such as residential development, agriculture, or associated factors such as high fire frequencies. In addition to directly reducing the amount of habitat available for birds, habitat loss also changes the size, shape, and connectedness of the remaining habitat. The spatial pattern of habitat loss is very important in determining how habitat loss will affect birds, as discussed below. Thus, the loss of habitat area may cause not only a proportional reduction in the size of bird populations, but also may have more insidious effects on remaining populations, such as reduced reproductive success.

Habitat Fragmentation

Theoretically, a given amount of habitat loss within a landscape can occur in any number of configurations. However, in most topographically varied areas the patterns of human land use are fairly predictable and often result in the creation of many isolated fragments of natural vegetation (Swenson and Franklin 2000). Another consequence of human settlement patterns is that some vegetation types are lost at higher rates than others. In this sense, some shrublands are relatively protected from loss by virtue of their occurrence on steep slopes. Nevertheless, remaining fragments of shrub vegetation may be quite small and isolated from other native landscape elements, such as watercourses. Even where remaining shrublands are still relatively large and connected, the presence of urbanization in the landscape appears to affect the abundance of shrubland birds in remaining habitat (Stralberg 2000).

Fragmented shrubland areas may not provide enough continuous acreage to support those birds that require large areas of habitat for an individual to survive (Soulé et al. 1992, Lovio 1996). However, even birds that can survive in smaller patches of habitat may disappear from fragmented areas. This may be caused in part by individual birds that have difficulty moving from one habitat fragment to another when the fragments are separated by inhospitable developed areas. Sedentary species, such as Crissal and LeConte's Thrashers are particularly vulnerable to this outcome of habitat fragmentation (Laudenslayer et al. 1992). Movement through fragmented habitats becomes more risky for the individual birds that move (usually juveniles) and thus the number dispersing successfully from one population to another is reduced. This movement of individuals (dispersal) is necessary to prevent the extirpation of bird species because the survival of a bird population in one habitat patch may depend on the influx of new individuals from other habitat patches. Also, if local extirpation occurs (i.e., a distinct population dies out), the colonization of that habitat by other individuals of that species may be delayed or prevented. Such systems of isolated habitat remnants connected by occasional dispersal events are referred to as "metapopulations." A reduction in dispersal also can cause a reduction in genetic exchange between populations.

A landscape containing many isolated habitat fragments can be compared to an ocean with many islands. As suggested earlier, the equilibrium theory of island biogeography (MacArthur and Wilson 1967) states that colonization and extinction rates on habitat islands are influenced by the size of islands and degree of isolation from other islands or "mainlands." This means that more species are typically present on larger and less isolated islands, and the same pattern often holds true for habitat fragments. As the size of fragments decreases and isolation increases, "faunal relaxation" (loss of species) in the region initially results, although the rate of decline depends on many factors. These long term patterns of extinction and recolonization of habitat fragments are also called "metapopulation dynamics." The existence of metapopulation dynamics in particular areas such as coastal southern California is somewhat controversial. Soulé et al. (1992) provide evidence that habitat remnants are rarely if ever "rescued" by dispersal, whereas other studies (ERC 1991, Lovio unpublished data) have documented fairly frequent movement of birds among remnants. However, even fragmentation of shrubland habitats into relatively large remnants will result in the decline or loss of shrubland specialists (Lovio 1996). More recently, Crooks et al. (2001) found that extirpation were more common than colonizations in shrubland fragments.

Fragmentation frequently creates patches of shrubland that have long boundaries with developed areas, and this can create conditions that further compromise the ecological integrity of the habitat. Although natural ecotones (edges) between native habitat types usually provide conditions that enhance diversity (Brown and Gibson 1983), anthropogenic edges often are accompanied by reductions or losses of specialist species (e.g., Bolger et al. 1997). In California wildland-urban interfaces, improving vegetation structure and increasing the availability of water and food may improve habitat value near edges for some species. Complex interfaces often mimic natural ecotones in that they support enhanced diversities of birds (Guthrie 1974, Lovio unpublished observations). However, negative edge effects include the creation of barriers to dispersal, increases in native and non-native predators (Crooks and Soulé 1999), and potential increases in nest parasitism by the Brown-headed Cowbird. A complex causal relationship between the decline of large predators (e.g., coyotes and bobcats) associated with human development, the resultant increase in mid-sized native and non-native predators, and the predator-mediated declines of nesting birds has been postulated (Soulé et al. 1988, Crooks and Soulé 1999), but needs more study.

Chapter 5. The Conservation Planning Process

The Desert Bird Conservation Plan has been developed cooperatively by leading bird researchers in California through a process designed to:

- Capture the conservation needs of the complete range of desert habitat types throughout the state.
- Develop, by consensus, biological conservation objectives for selected desert bird species.

Criteria for Selecting Desert Focal Species

The majority of the PIF planning efforts use the national PIF database (Carter et al. 2000) to prioritize species in need of conservation attention and then select focal species by region for conservation plans. CalPIF elected against this method for the Desert Bird Conservation Plan for a number of reasons. The national PIF prioritization scheme relies heavily on BBS trend estimates that likely do not adequately monitor desert birds in California. Additionally, the PIF database does not yet recognize many subspecies including the Western Yellow-billed Cuckoo, a California endangered species. These factors render such a "priority" species list less representative than CalPIF preferred. Instead, CalPIF chose to emphasize the ecological associations of individual species *as well as* those of conservation concern (Chase and Geupel 2005). In doing so, CalPIF included a suite of focal species whose requirements define different spatial attributes, habitat characteristics, and management regimes representative of a "healthy" system (Table 5-1). Additionally, CalPIF decided that some of the most useful indicators were those with populations and distributions large enough to be easily monitored and to provide sufficient sample sizes for statistical analysis across sites and/or regions.

CalPIF included species in the conservation planning process based on five factors:

- Use desert vegetation as their primary breeding habitat in most bioregions of California.
- Warrant special management status—endangered, threatened, or species of special concern on either the federal or state level.
- Have experienced a reduction from their historical breeding range.
- Commonly breed throughout California's desert areas—allowing adequate sample sizes for statistical comparisons and therefore the ability to rapidly assess responses to changes in management (such as restoration).
- Have breeding requirements that represent the full range of successional stages of desert ecosystems—to assess the success of restoration efforts.

Because birds occupy a wide diversity of ecological niches in desert habitat, they serve as useful tools in the design of conservation efforts. Birds are relatively easy to monitor in comparison with other taxa and can serve as "focal species," whose requirements define different spatial attributes, habitat characteristics and management regimes representative of a healthy desert system (Chase and Geupel 2005). For example, the bird that requires the largest area to survive in a certain habitat will determine the minimum suitable area for that habitat type. Likewise, the requirements of non-migratory birds that disperse short distances to establish new territories will define the attributes of connecting vegetation. The species with the most demanding or exacting requirements for an ecological characteristic, such as stream width or canopy cover, determines its minimum acceptable value. Therefore, the assumption is that a landscape designed and managed to meet the focal species' needs encompasses the requirements of other species (Lambeck 1997).

Focal Species

The following were selected as focal species for preparing the Conservation Plan. They are listed below followed by the species account author and any special-status designations. Latin names are given in Appendix B.

Burrowing Owl: California species of special concern. Christine Bates, Arizona BLM

Costa's Hummingbird: Susan Wethington and Barbara Carlson, The Hummingbird Network

Gila Woodpecker: California listed as endangered**.** Chris McCreedy, PRBO Conservation Science

Ladder-backed Woodpecker: Dennis Jongsomjit and Lishka Arata, PRBO Conservation Science

Ash-throated Flycatcher: Debra Hughson, National Park Service

Common Raven: William Boarman, United States Geologic Survey

Verdin: Roy Churchwell, San Francisco Bay Bird Observatory

Black-tailed Gnatcatcher: Jason Tinant, California BLM

Crissal Thrasher: California species of special concern. Justin Hite, PRBO Conservation Science

LeConte's Thrasher: California species of special concern. James Weigand, California BLM, and Sam Fitton, Audubon Ohio.

Phainopepla: Lisa Crampton, University of Nevada-Reno

Lucy's Warbler: California species of special concern. Chris Otahal, U.S. Fish and Wildlife Service

Black-throated Sparrow: Matt Johnson, United States Geologic Survey

Scott's Oriole: Ronald Gartland, California BLM

Range maps of each focal species, including site-specific breeding status are shown in Figures 5-1 – 5-15. Additional key findings from the species accounts are available at http://www.prbo.org/calpif/htmldocs/desert.htm. These findings and the detailed information found in each species account provide the basis for the conclusions and conservation recommendations presented in this Conservation Plan. Account authors and other conservation and land management experts gathered to discuss and synthesize their results into a summary of concerns, habitat requirements, conservation objectives, and action plans (or recommendations). The species accounts and the results from this meeting form the backbone of this Conservation Plan.

A focal species of the California Partners In Flight Shrubsteppe Plan, Loggerhead Shrikes are also found throughout the Mojave and Sonoran Deserts, which are considered their population's stronghold. *Photo by Justin Hite.*

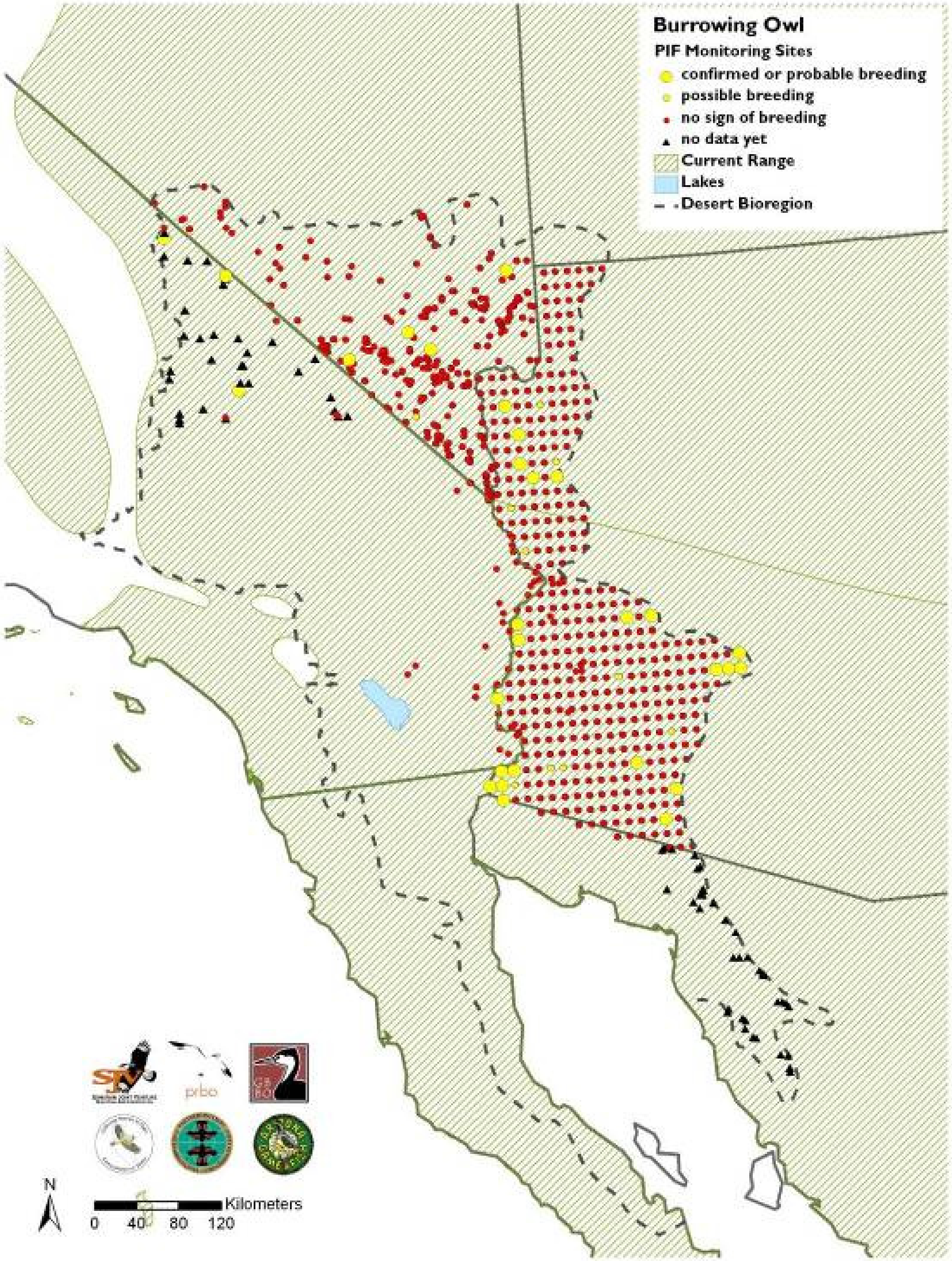

Figure 5-1. CalPIF monitoring sites, breeding status, and current range for the Burrowing Owl in California.

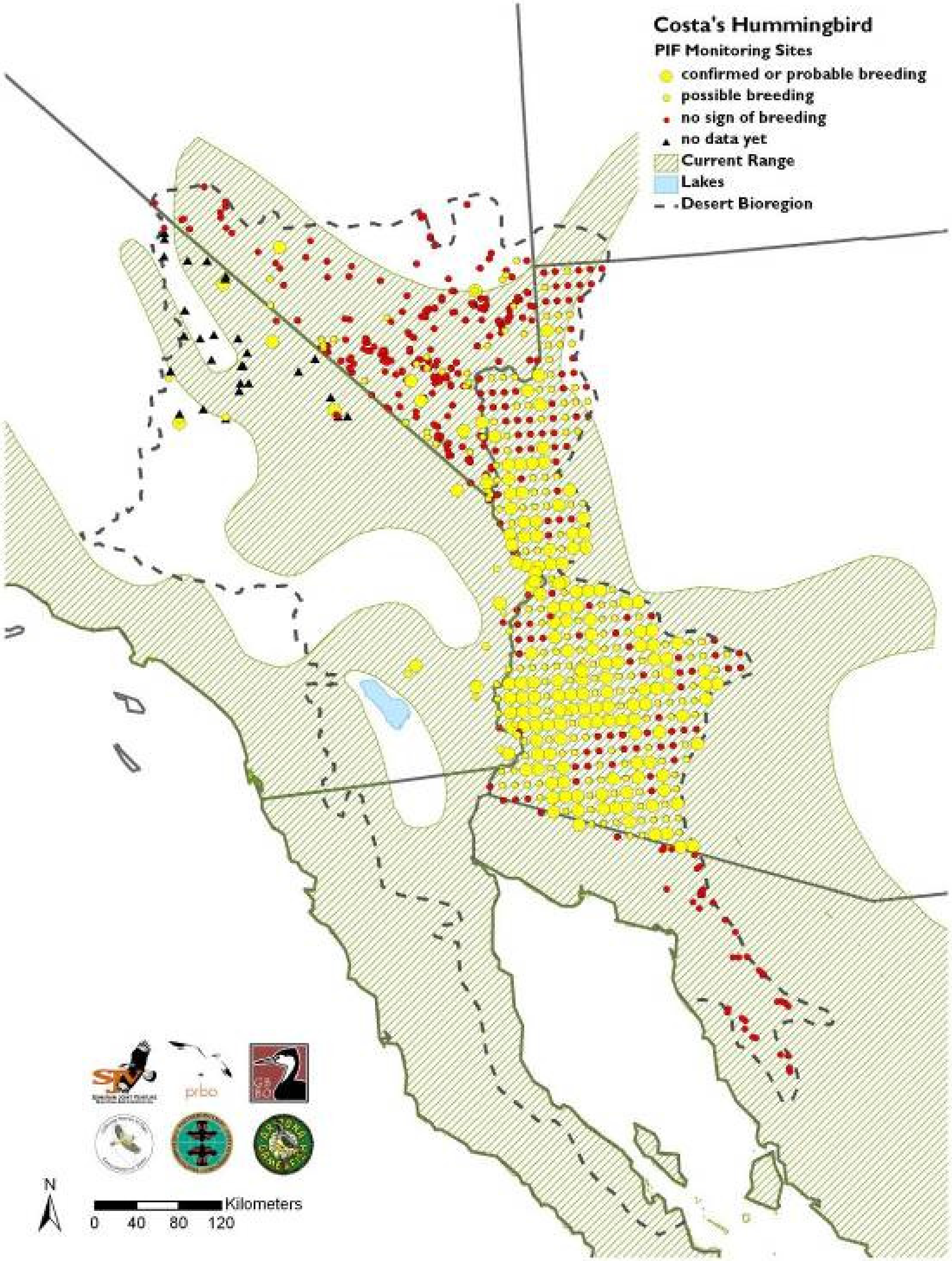

Figure 5-2. CalPIF monitoring sites, breeding status, and current range for the Costa's Hummingbird in California.

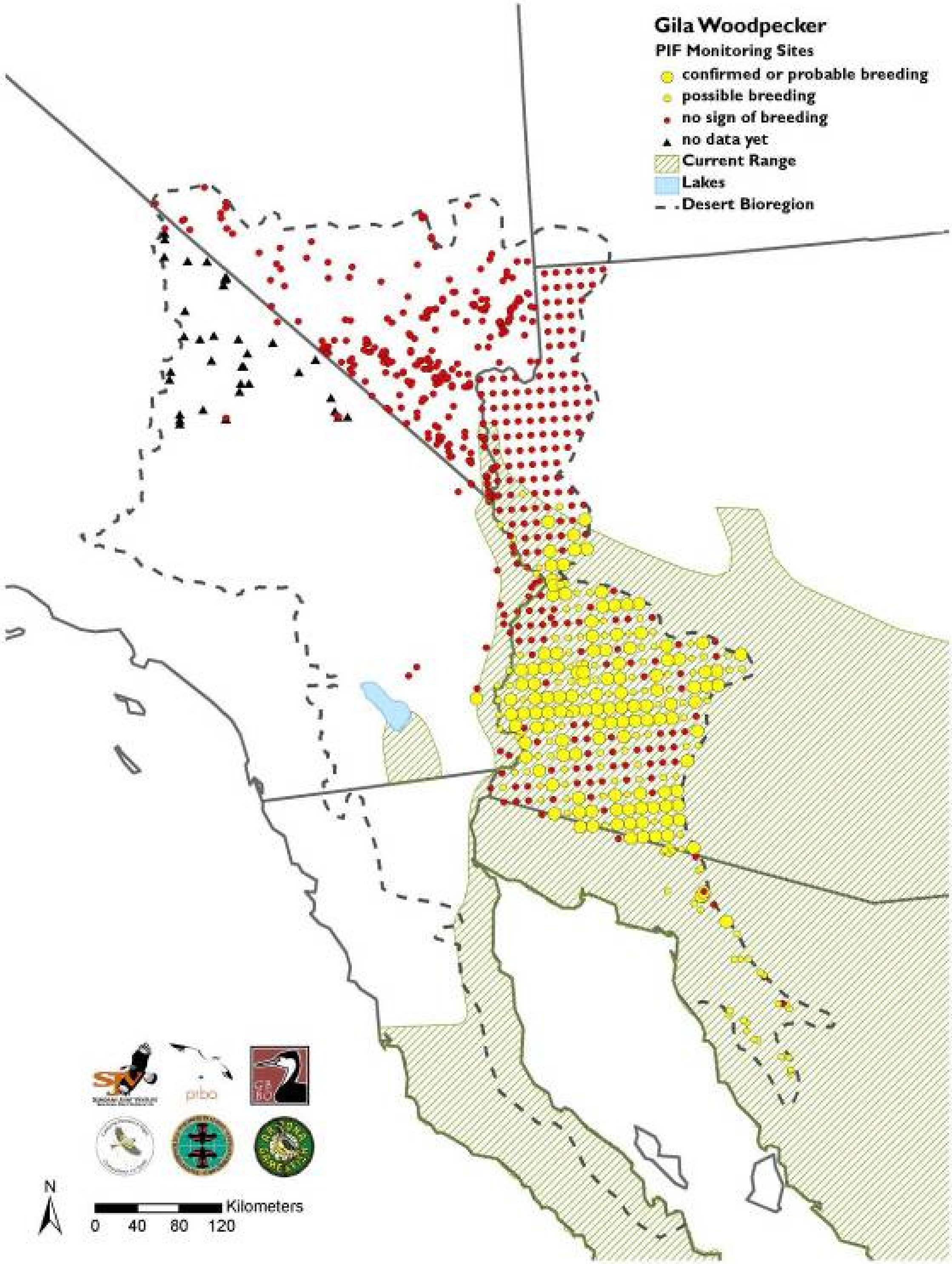

Figure 5-3. CalPIF monitoring sites, breeding status, and current range for the Gila Woodpecker in California.

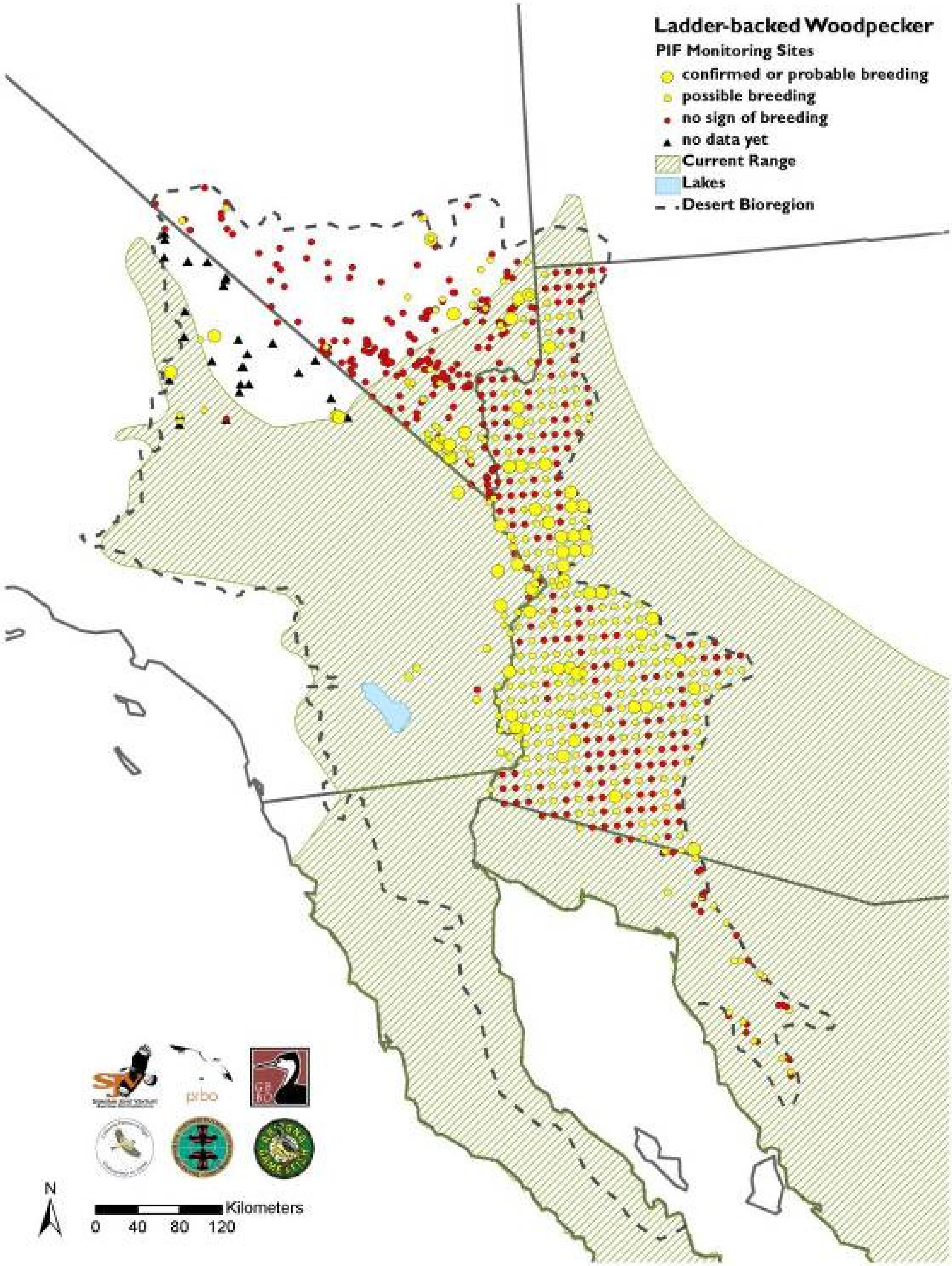

Figure 5-4. CalPIF monitoring sites, breeding status, and current range for the Ladder-backed Woodpecker in California.

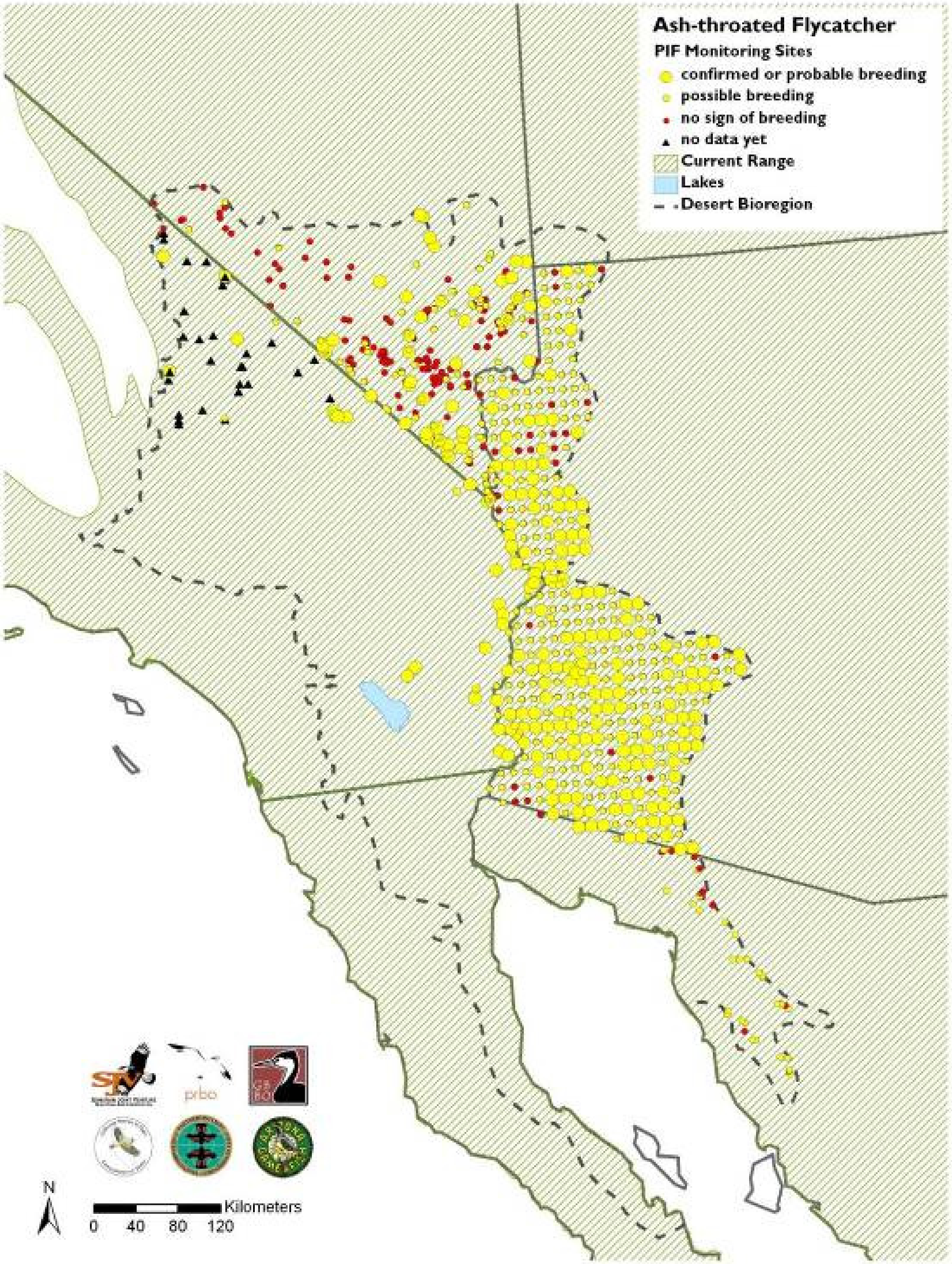

Figure 5-6. CalPIF monitoring sites, breeding status, and current range for Ash-throated Flycather in California.

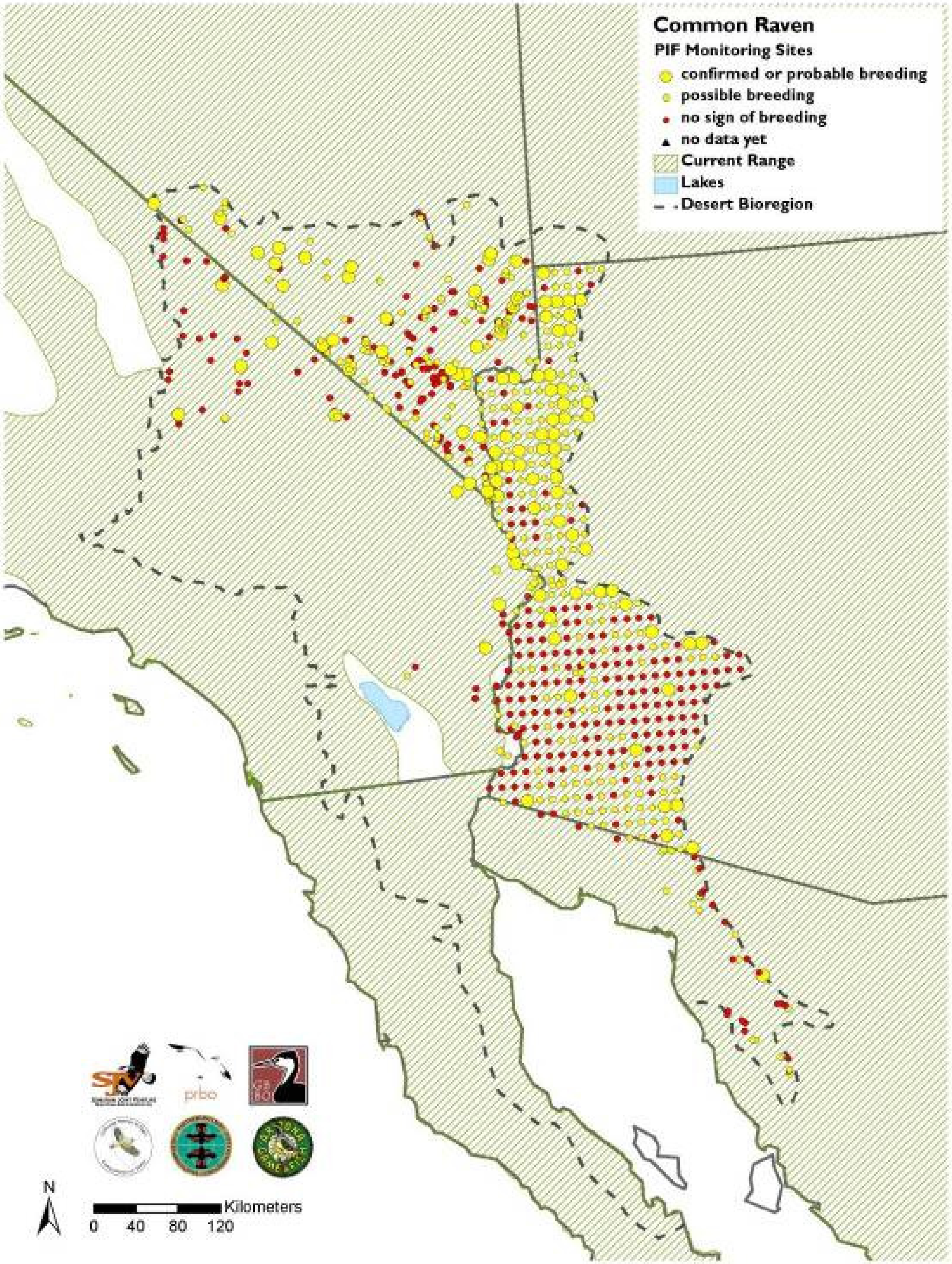

Figure 5-6. CalPIF monitoring sites, breeding status, and current range for the Common Raven in California.

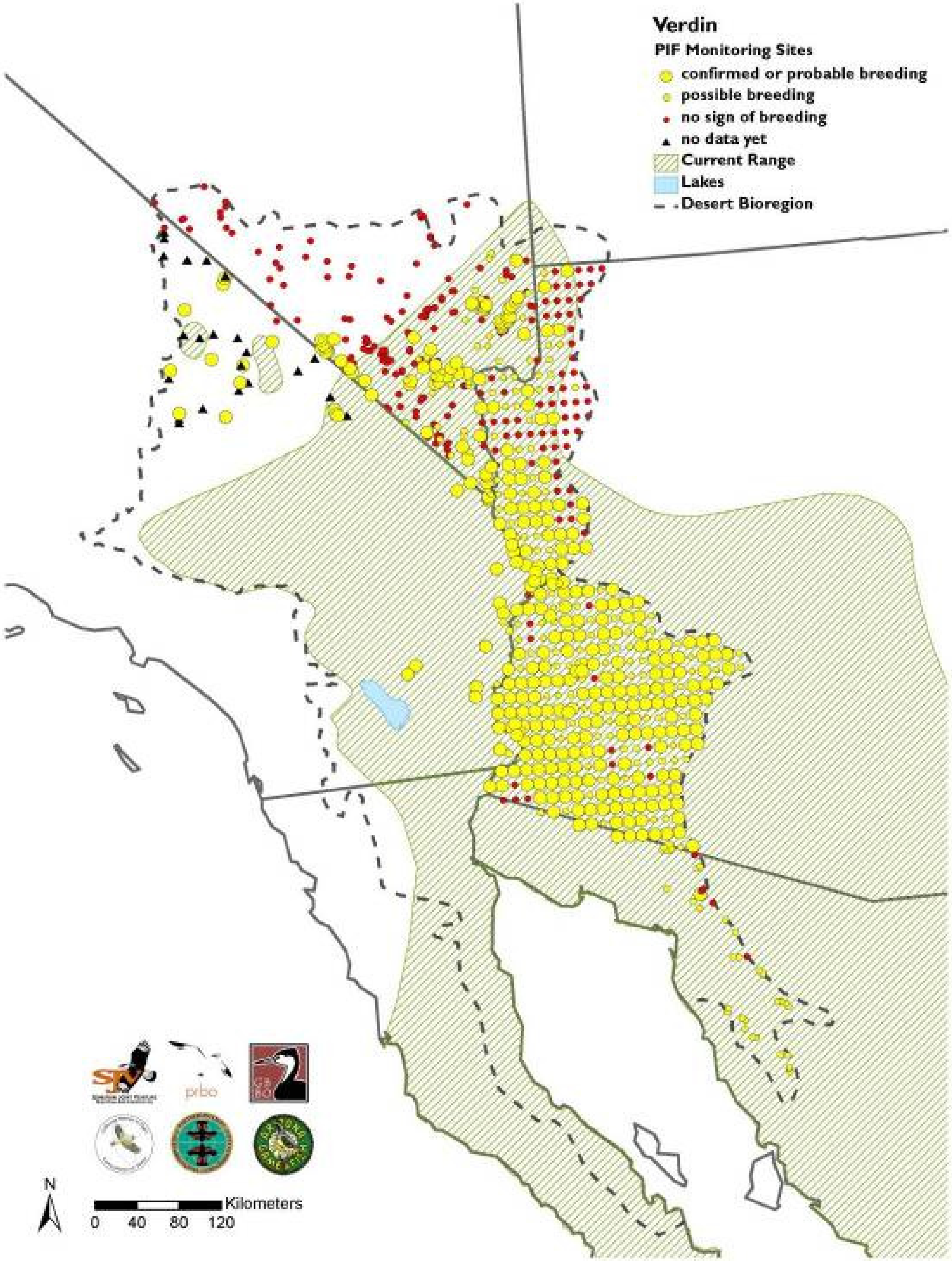

Figure 5-7. CalPIF monitoring sites, breeding status, and current range for the Verdin in California.

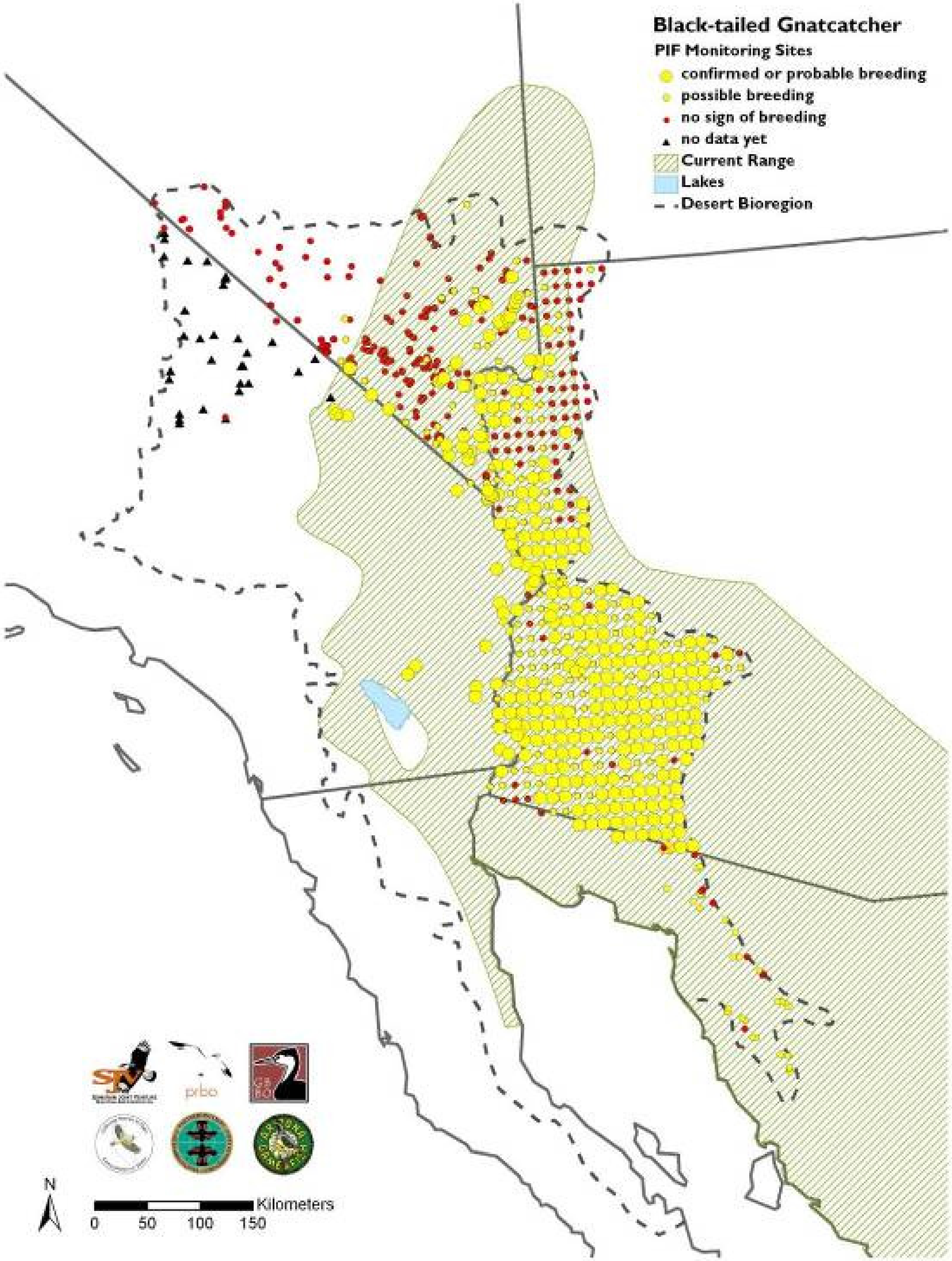

Figure 5-8. CalPIF monitoring sites, breeding status, and current range for the Black-tailed Gnatcatcher in California.

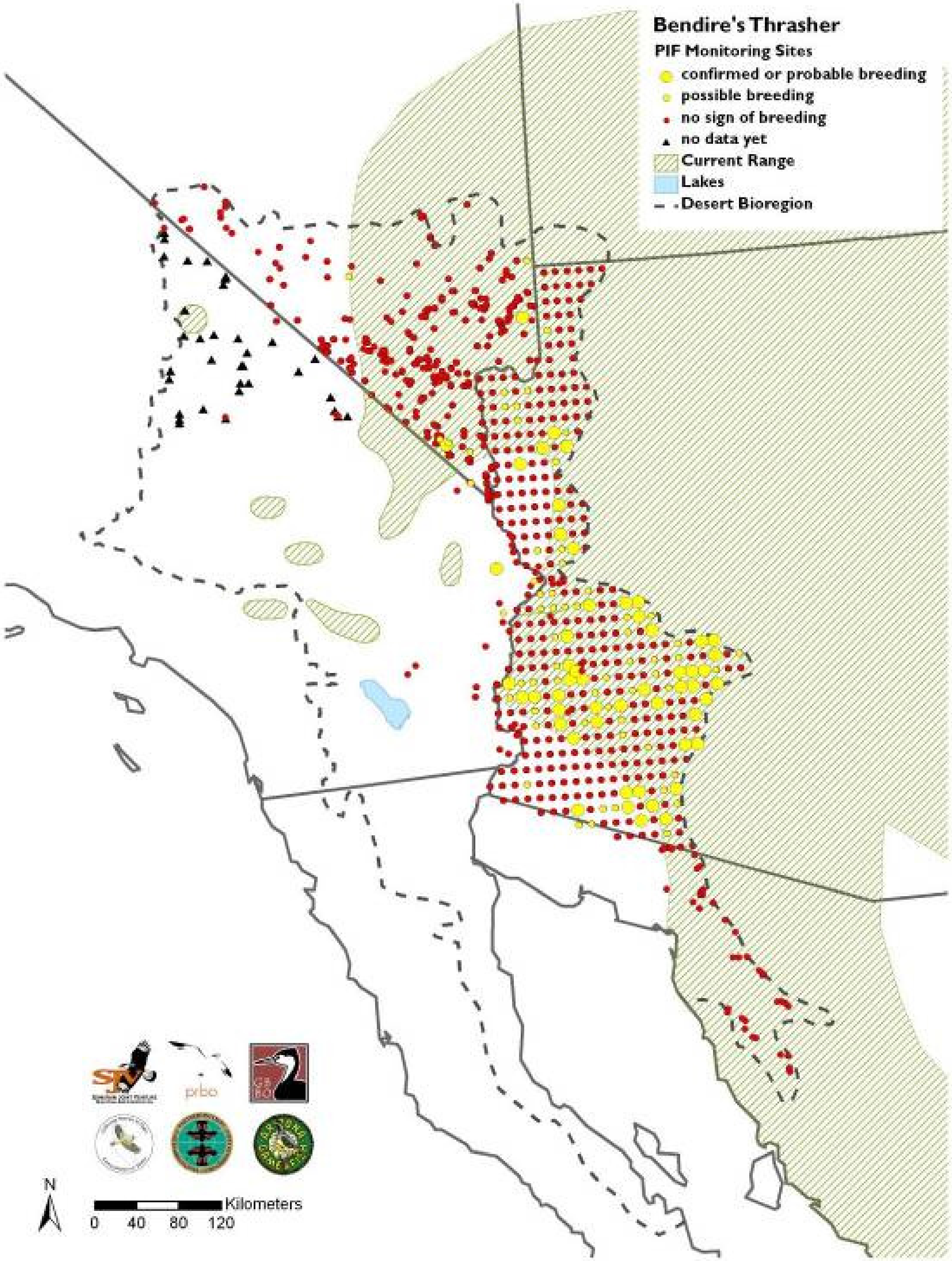

Figure 5-9. CalPIF monitoring sites, breeding status, and current range for the Bendire's Thrasher in California.

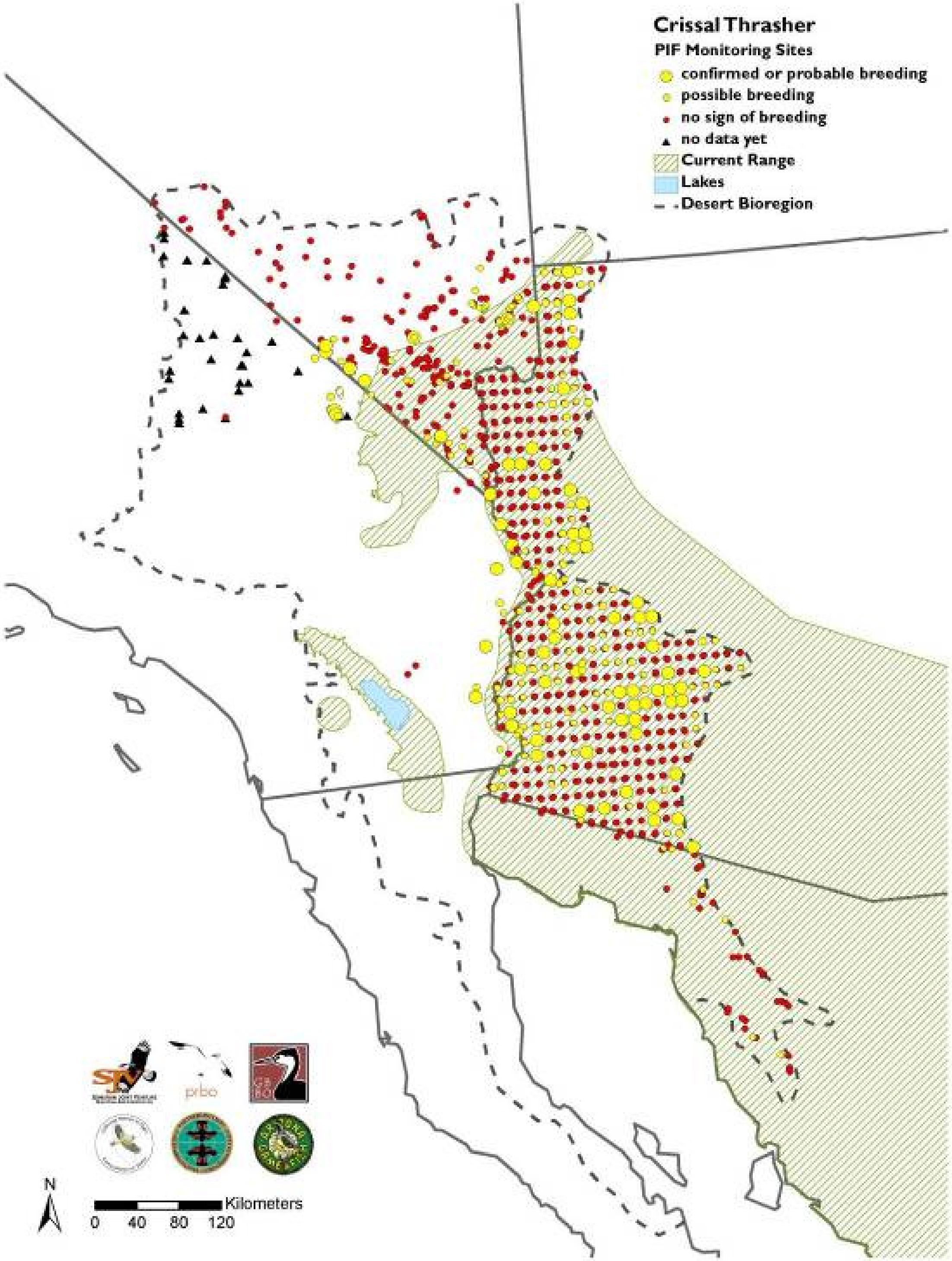

Figure 5-10. CalPIF monitoring sites, breeding status, and current range for the Crissal Thrasher in California.

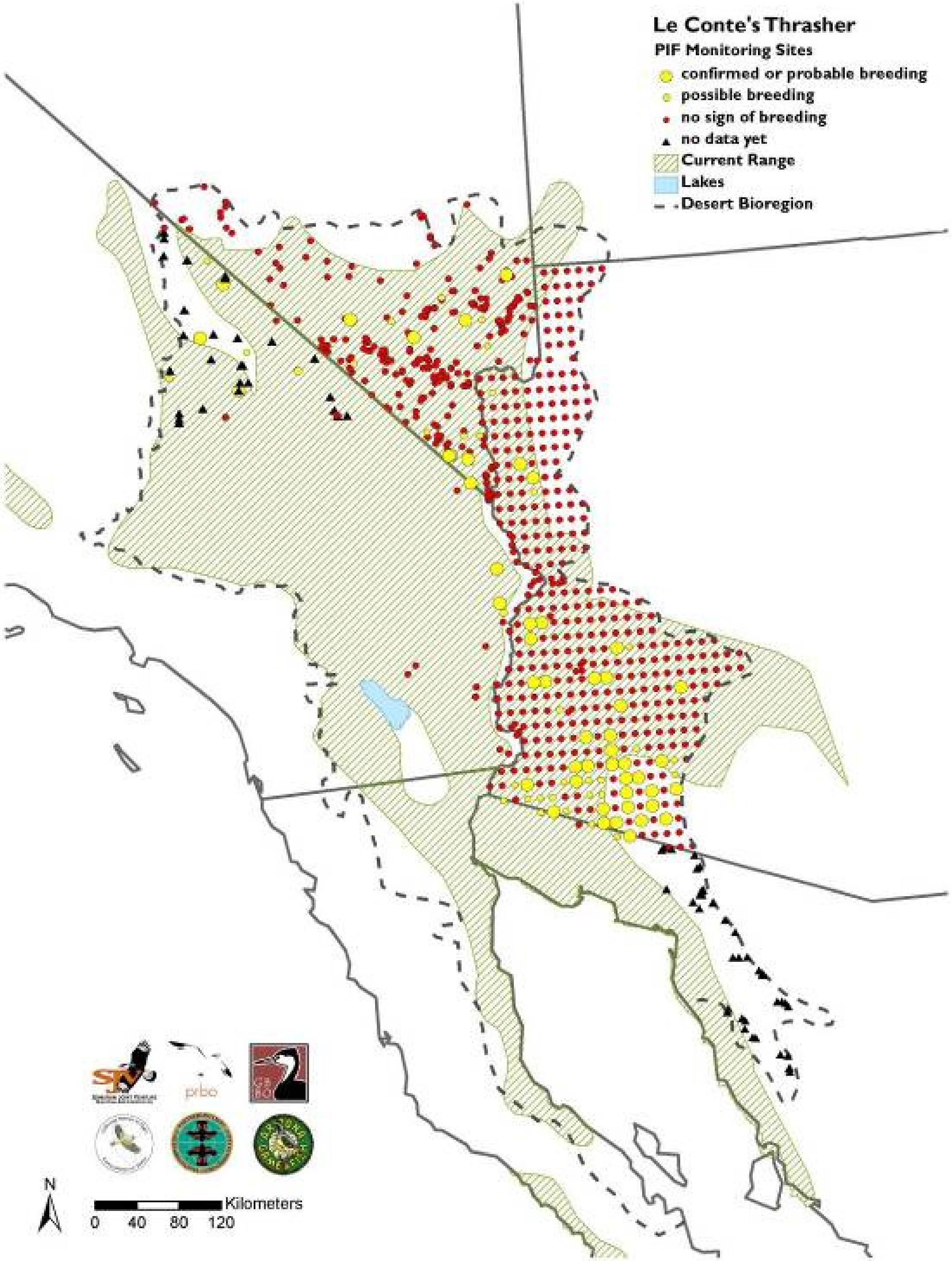

Figure 5-11. CalPIF monitoring sites, breeding status, and current range for the LeConte's Thrasher in California.

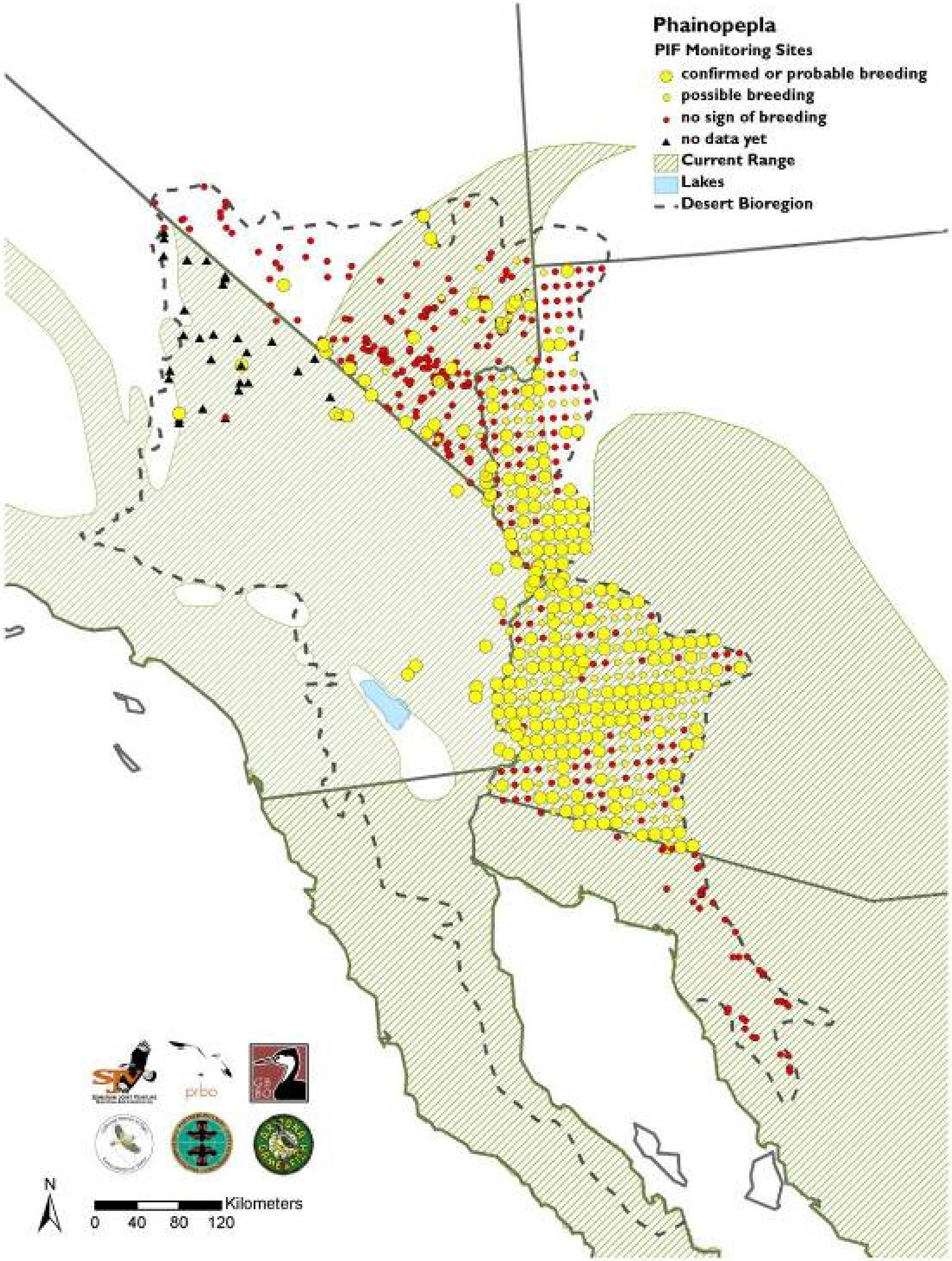

Figure 5-12. CalPIF monitoring sites, breeding status, and current range for the Phainopepla in California.

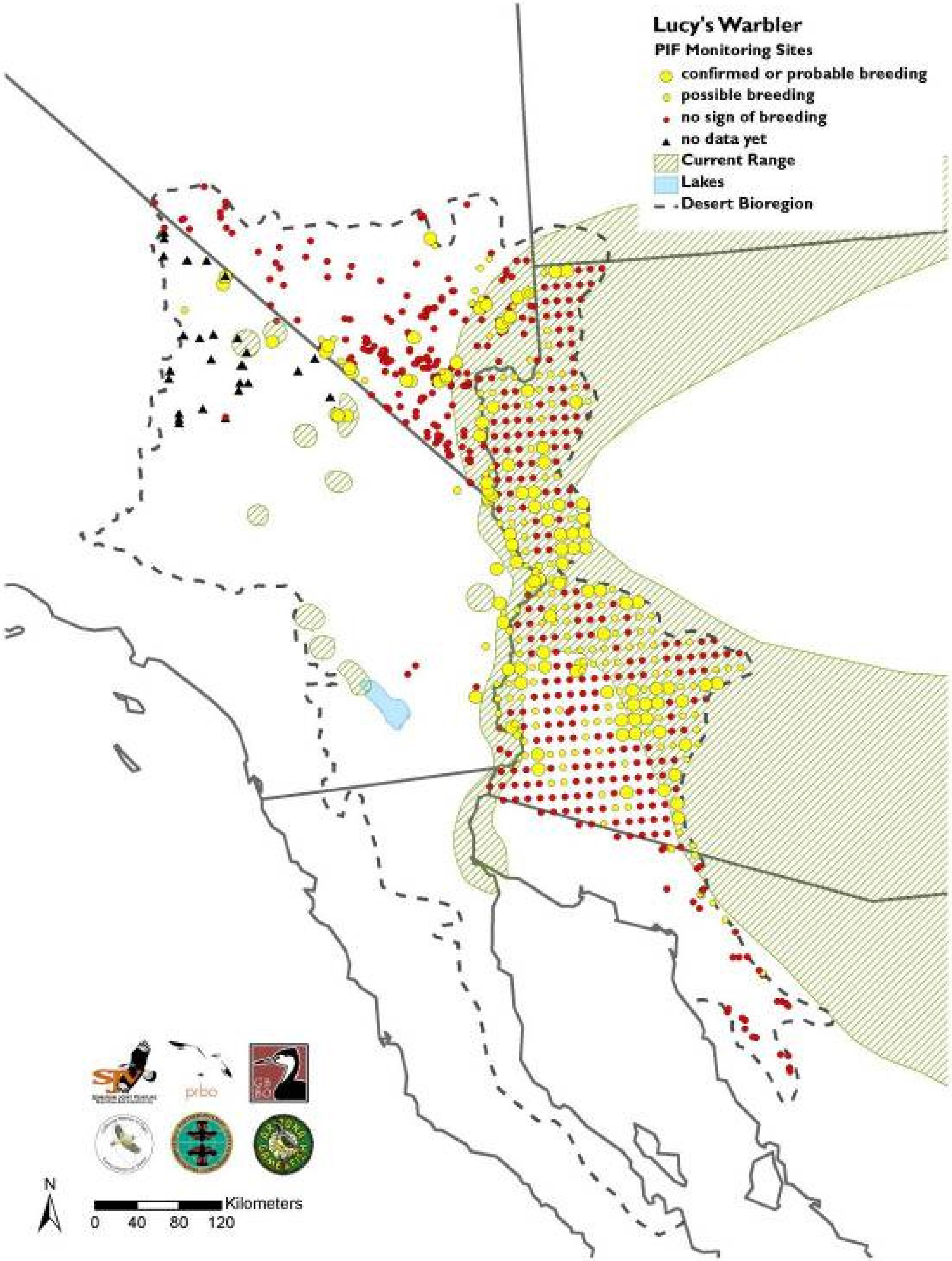

Figure 5-13. CalPIF monitoring sites, breeding status, and current range for the Lucy's Warbler in California.

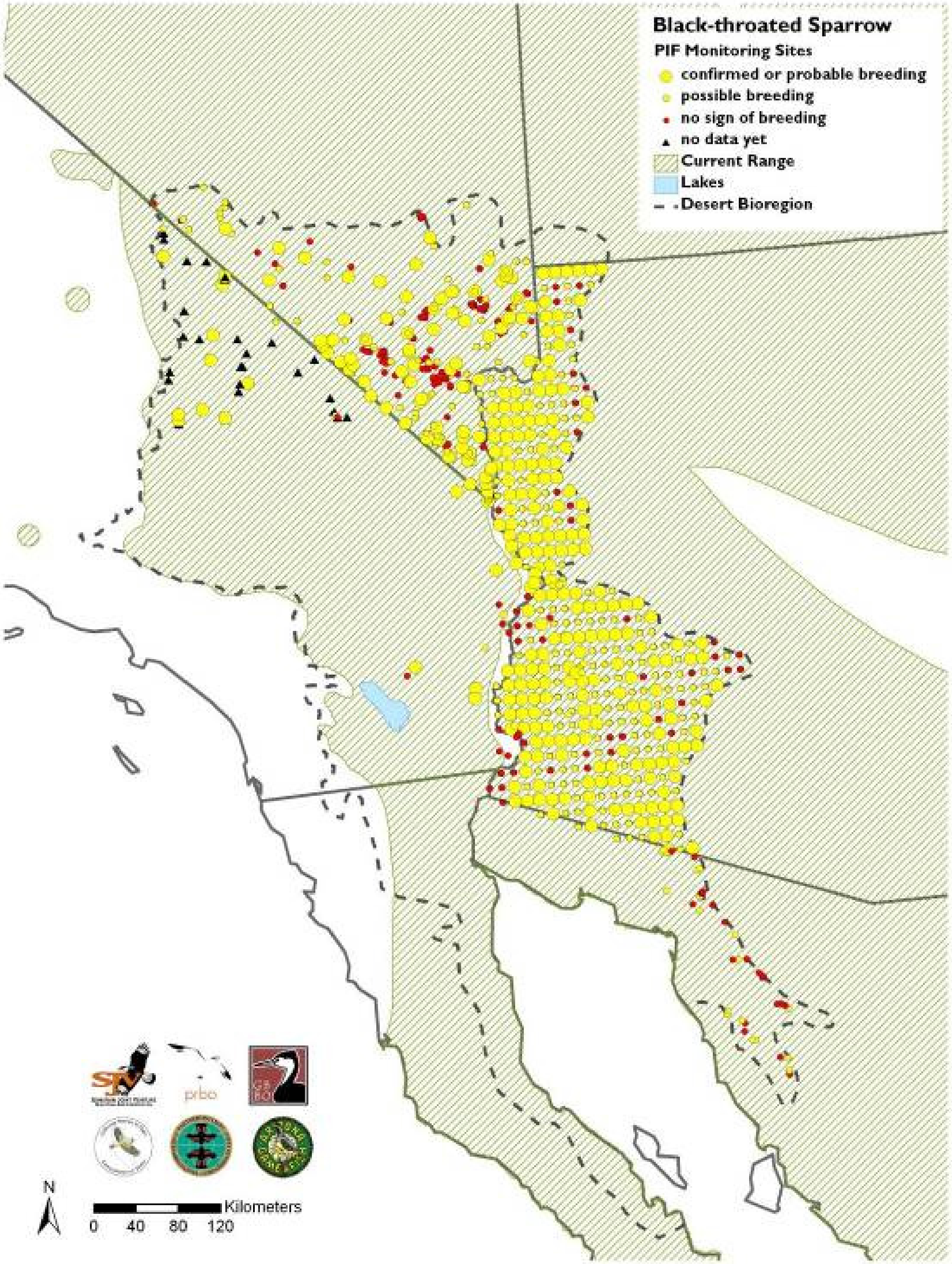

Figure 5-14. CalPIF monitoring sites, breeding status, and current range for the Black-throated Sparrow in California.

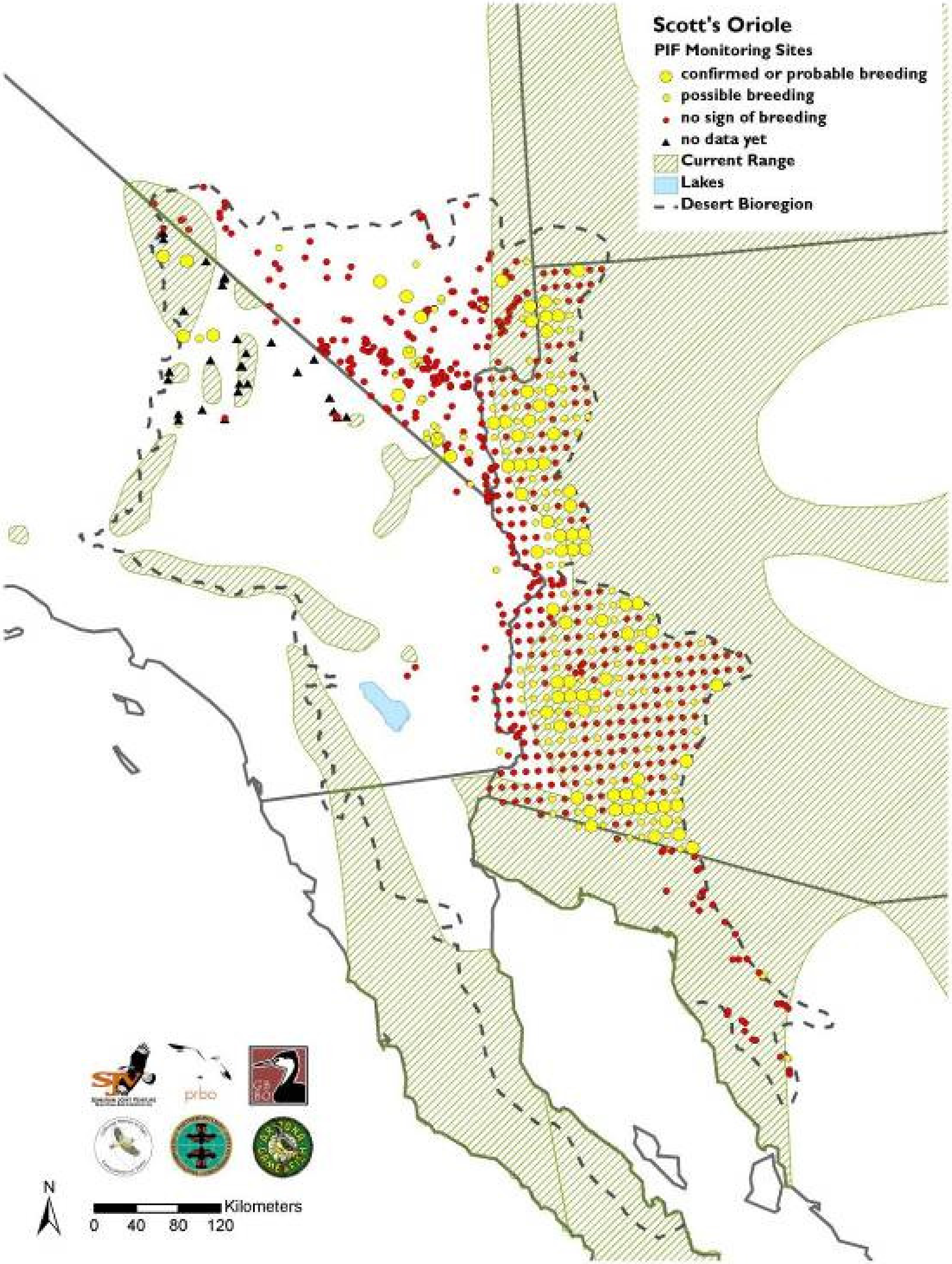

Figure 5-15. CalPIF monitoring sites, breeding status, and current range for the Scott's Oriole in California.

Data-Gathering Effort

Identifying the causes of population fluctuations requires an understanding of how demographic and physiological processes—annual survival, reproductive success, dispersal, and recruitment—vary across habitats, landscapes, and management practices. This information must be gathered using scientifically sound research and monitoring techniques (Appendix C, Ralph et al. 1993, Bonney et al. 2000 for review). The Breeding Bird Survey (BBS), coordinated by the USFWS and the Canadian Wildlife Service, produces most of the available information regarding changes in the sizes and ranges of landbird populations in North America (Sauer et al. 2005). These roadside counts provide an excellent baseline by which to assess long-term population trends, but they do not identify factors contributing to these changes (e.g., habitat and landscape variables) and may fail to adequately monitor bird populations away from roads and human disturbance (Peterjohn et al. 1995). Furthermore, the inability of BBS data to detect trends within certain habitats, particularly patchily distributed habitats, contributes to the need for more intensive, site-specific monitoring techniques.

Biologists throughout California have contributed data to this document. They have sent information garnered from constant-effort mist netting, nest searching, point counts and other standardized techniques. The locations of study areas, contact information, types of data collected, and breeding status information for all focal species are stored and updated in real time through the California Avian Data Center at www.prbo.org/cadc via an interactive map interface to a relational database system (Ballard et al. 2003a). In some cases, more extensive data will be linked to this interface, allowing for calculations of population estimates and demographic parameters. Figure 5-16 provides a map of desert bird data showing biodiversity "hotspots" in California desert habitats as defined by the richness of 10 focal species.

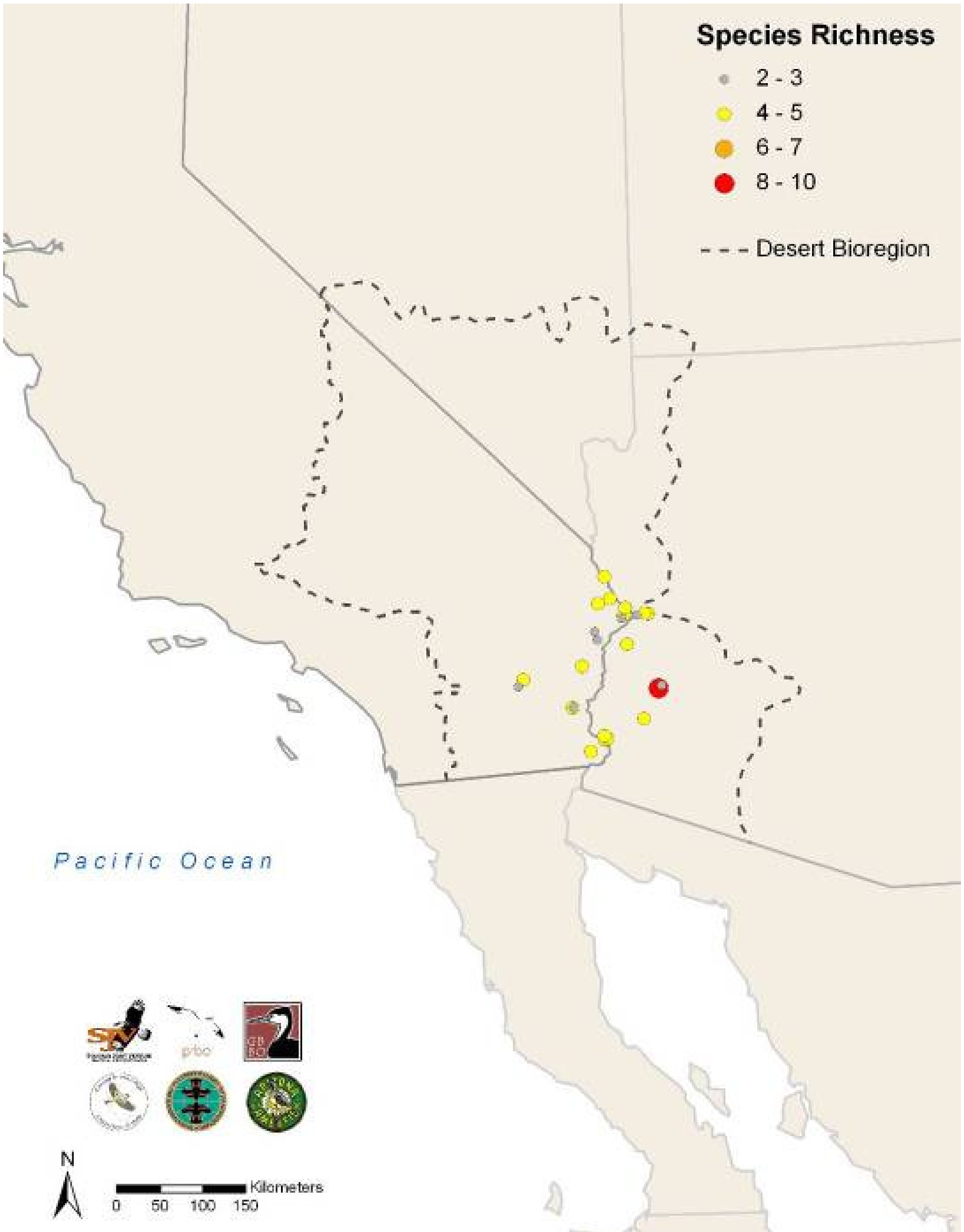

Figure 5-16. Species richness for 10 focal desert species at census sites throughout California. Data were collected and submitted by CalPIF contributors.

Table 5-1. Status, special factors, and nesting requirements of desert focal species.

Species	Statewide Status	Historical Breeding Range[1]	Reliable BBS trend?	Special Factors	Nest Site	Breeding Grounds Description	Territory Size and Breeding Density
Burrowing Owl	California Species of Special Concern	Statewide, but extirpated from parts of BA/DE	COLD = No MOJA = No	Loss of nesting and foraging habitat due to intensive agriculture and urbanization Negatively affected by control programs for burrowing mammals	Burrows created by other animals, surrounded by bare ground or short grass	Uses a variety of arid and semi-arid environments characterized by sparse vegetation and bare ground	Territory size in NM ranged from 4.8-6.4 ha. Density estimated at 0.9 pairs/km^2 in SAJO and 8.3 pairs/km^2 in COLD
Costa's Hummingbird	None	CECO, SINE, COLD, MOJA, SOCO	COLD = No MOJA = No	Loss of habitat due to agriculture, urbanization, and conversion of desert scrub to cattle forage Intense drought may result in skipped breeding season	Nests located in cacti, paloverde, jojoba, smoke tree, and other xeric shrubs, usually within 3 meters of ground	Prefers desert scrub and desert wash habitats	Territory size varies depending on resource availability.
Gila Woodpecker	California Endangered Species	COLD, extirpated from MOJA	COLD = Yes	Absent from riparian areas where tamarisk has usurped cottonwood and willow Competition for nest sites with European Starling could be detrimental	Uses cavities primarily in large saguaro cacti; occasionally nests in honey mesquite or screwbean mesquite	Prefers sparsely covered desert habitats containing large saguaro cacti	Estimated territory size was 4.57 ha in AZ desert wash. Breeding densities were 14.8-24.9 birds/ km^2 in desert wash and 9.8 birds/ km^2 in open desert
Ladder-backed Woodpecker	None	COLD, MOJA, SOCO	COLD = No MOJA = No	Grazing may have adverse effects on the quantity and quality of habitat available for this species	Uses cavities primarily in Joshua tree, willow, and cottonwood.	Prefers shrub desert dominated by Joshua trees.	Density estimated at 1.15 birds/40 ha for lower plateau of Deep Canyon, CA
Ash-throated Flycatcher	None	Statewide	COLD = Yes MOJA = Yes	Loss of habitat from clearing for agriculture, urbanization, and suburbanization, and from flood-control projects	Nests primarily in natural cavities, woodpecker holes, and nest boxes	Prefers arid and semiarid scrub and open woodland, as well as riparian woodland	In n. Pinal Co., AZ, densities 4.6–6.7 individuals/40 ha in desert-wash habitat, and 6.4–6.8/40 ha in desert-upland habitat.

Table 5-1. Status, special factors, and nesting requirements of desert focal species.

Species	Statewide Status	Historical Breeding Range[1]	Reliable BBS trend?	Special Factors	Nest Site	Breeding Grounds Description	Territory Size and Breeding Density
Common Raven	None	Statewide	COLD = Yes MOJA = Yes	Implicated as a causative factor in the decline of the desert tortoise Desert populations increasing rapidly due to food subsidization from humans	Highly variable. Uses manmade structures such as power line towers, telephone poles, abandoned buildings	In desert habitats, occurs near humans; in significantly greater numbers at landfills, ag fields and along highways	Territory size varies greatly. Nests as little as 300m apart in human-dominated landscape in Mojave.
Verdin	None	COLD, MOJA, SOCO	COLD = Yes MOJA = No	Land-clearing for agriculture and rapid development of resort areas and golf courses has reduced available habitat	Nests often are located along desert washes or at edge of vegetative boundaries	Desert scrub, chiefly in areas along washes where thorny vegetation occurs or in desert riparian zones	Territory size of 8 ha recorded in NM. Breeding densities ranged from 16-28 indiv/40 ha
Black-tailed Gnatcatcher	None	COLD, MOJA	COLD = No MOJA = No	Requires native vegetation; cannot adapt to exotic vegetation or high density of buildings Highly sensitive to cowbird presence, nearly non-existant in urban areas	Nests in dense, thorny or leafy shrub or tree.	Desert thorn scrub and thickets. Densely lined arroyos and washes dominated by creosote bush and saltbush	Territory size ranged from 1.1-2.7 ha in NM. BBS densities of 4-10 birds/route/2.5 hrs of observation in MOJA
Bendire's Thrasher	California Species of Special Concern	COLD, MOJA	COLD = No MOJA = No	Degradation of habitat due to off-road vehicle activity	Nests in shrubs, cacti, or trees. Substrates include cholla, mesquite, and juniper.	Prefers relatively open, grassland, shrubland, or woodland with scattered shrubs or trees	Territory size unknown. Density estimates difficult due to secretive nature.
Crissal Thrasher	California Species of Special Concern	COLD, MOJA, SOCO	COLD = No MOJA = No	Loss of habitat to clearing for agriculture or urban and suburban development Tolerant of tamarisk, but significant habitat losses due to groundwater mining	Nest site generally well hidden in interior of densest shrubs in habitat.	Prefers foothill scrub, desert washes, mesquite thickets	Breeding densities range from 0.2-18.5 pairs/40ha, depending on habitat type

Table 5-1. Status, special factors, and nesting requirements of desert focal species.

Species	Statewide Status	Historical Breeding Range[1]	Reliable BBS trend?	Special Factors	Nest Site	Breeding Grounds Description	Territory Size and Breeding Density
LeConte's Thrasher	California Species of Special Concern	COLD, MOJA, SAJO	COLD = No MOJA = Yes	Degradation of habitat due to destruction of substrate, litter, or shrubs or repeated All Terrain Vehicle (ATV) usage	Nests in thick, dense, and thorny desert shrubs or cholla cactus	Typical habitat throughout range consists of sparsely vegetated desert flats, dunes, alluvial fans, or gently rolling hills of saltbush	Breeding densities range from 0.2-7.3 pairs/km^2
Phainopepla	None	BA/DE, CECO, SOCO, COLD, MOJA, SINE	COLD = No MOJA = No	Closely associated with desert mistletoe. Loss of riparian woodlands and mesquite thickets to agriculture.	Often nests in trees and shrubs that are parasitized by desert mistletoe.	Breeds along desert washes and desert riparian habitats.	In desert habitats, territories of 0.40 ha have been recorded. Density estimates of 3-10 pairs/ha in summer range.
Lucy's Warbler	None	MOJA	COLD = No MOJA = No	Closely associated with mesquite bosques. Loss and degradation of mesquite habitat has led to local extirpations.	Nests behind loose bark of tree, in natural cavities, or amongst roots along riverbanks.	Breeds most often in dense lowland riparian mesquite woodlands.	Densities up to 12.5 pairs/ha.
Black-throated Sparrow	None	MODO, SINE, COLD, MOJA	COLD = Yes MOJA = Yes	Long-term fire suppression may make habitat unsuitable Negatively affected by urbanization.	Nests in creosote bush, chaparral, mesquite, acacia and intermixed areas of Joshua trees.	Desert scrub, washes, and canyons.	Mean territory size in AZ was 0.84 ha. Densities range from 5.2 individuals/km^2 to 87.4/ km^2 depending on habitat.
Scott's Oriole	None	SINE, MOJA	COLD = No MOJA = Yes	Loss and degradation of yucca and pinon-pine woodlands Increasing fire frequency threatens Joshua tree and yucca habitats	Nests partially suspended from overhanging leaves at the top of a yucca tree.	Yucca and pinon-pine woodlands	Territory size not well studied; probably depends on availability of Yucca spp. or other suitable nesting trees

1. Bioregions included in historical breeding range as estimated from Grinnell and Miller 1944: BA/DE=Bay/Delta; SINE=Sierra Nevada; CECO=Central Coast; MOJA=Mojave; SOCO=South Coastal; COLD=Colorado Desert; SAJO=San Joaquin. See the range maps and species accounts at http://www.prbo.org/calpif/data.html for more information.

Chapter 6. Population Targets and Species Specific Recommendations

California Partners in Flight seeks to develop avian population targets that will guide conservation efforts and provide land managers with a gauge of success for their restoration and management activities. Although ambiguous and based on assumptions difficult to test, numerical population targets provide a compelling means of communicating with the public and policy makers. Furthermore they provide: 1) monitoring objectives and an evaluation procedure of project's success ("accountability"); 2) ranking criteria for project proposals that allow reviewers to determine which sites or projects will be more advantageous for a particular species or suite of species; 3) current data for scientifically sound biological objectives; and 4) integration and comparison with population objectives of larger regional, national, and international schemes (e.g., Rosenberg and Blancher, 2005). In some cases, targets may simply require maintenance of populations at existing levels. However, targets for rare or declining species will encourage actions that increase existing populations to sustainable levels.

Bioregionally-based population targets for many of the desert bird focal species have been developed using currently available data (Tables 6-1). These targets are simply the highest densities (either indirectly through point counts, or directly through spot mapping) found for that species within a given bioregion. The targets presented indicate suggested breeding bird densities in terms of the number of birds per a 10 hectare area. These data are currently lacking for many species in many bioregions. More data likely exist for some of these species, and contributions of data to California Partners in Flight is encouraged for incorporation into future versions of this living document.

Two types of target population densities are presented based on two field methods used to measure bird density. The first method is the point count census method, in which all adult birds detected within a 100 meter radius around a fixed point are recorded. The second is spot map data, in which each breeding territory is mapped within a defined study area (see Ralph et al. 1993 for explanation of these two nationally standardized monitoring methods). These two types of data are not necessarily comparable to one another, nor convertible. Such reference density estimates are useful as population density targets that can translate into habitat acreage protection for some species, or be considered in restoration goals.

Burrowing Owl, a desert focal species *Photo by Colin Woolley*

Table 6-1. Suggested Population Targets (birds per 10 hectares) by Species and Bioregion[1].

Species	Sonora Desert			Mojave Desert
	Lower Colorado		Arizona Upland	
	Point Count	Spot Map	*No data*	*No data*
Burrowing Owl	-	-	-	-
Costa's Hummingbird	2.7	4.1	-	-
Gila Woodpecker	0.4	-	-	0
Ladder-backed Woodpecker	0.5	1.5	-	-
Ash-throated Flycatcher	2.1	4.6	-	-
Common Raven	0.1	0.5	-	-
Verdin	2.8	7.7	-	-
Black-tailed Gnatcatcher	1.9	6.6	-	-
Bendire's Thrasher	0.1	-	-	-
Crissal Thrasher	0.4	2.0	-	-
Le Conte's Thrasher	0.1	0.6	-	-
Lucy's Warbler	3.0	8.7	-	-
Black-throated Sparrow	2.9	1.1	-	-
Scott's Oriole	-	-	-	-

[1]Suggested population targets were developed from PRBO Conservation Science unpublished data. Target densities derived from point count data represent the highest density measured among 20 individual study sites, whereas target densities derived from spot map data represent the density measured at one site, the Chemahuevi Wash. Reference populations such as these may not be representative of healthy populations. More research is needed, particularly for the Mojave and Arizona Upland deserts. Point count data provide an *index* of abundance, generally thought to be conservative. Spot mapping numbers are probably closer to true abundance. Dashes represent "no data." Zeroes indicate the species probably never bred in that bioregion.

Species-Specific Objectives

The birds of California's desert habitats are threatened in a variety of ways, though habitat loss due to human encroachment is a common theme for all species. The rapid growth of human population in the Sonoran and Mojave deserts and the associated large-scale changes in land use, invasion of exotic species, and changes in disturbance regimes threaten all native bird species. Large-scale conversion due to urbanization, ranching, agriculture, and pumping of ground water continues to rapidly reduce available habitat. Cowbirds, ranching, and the encroachment of exotic plants are particular threats for certain species.

Although California Partners in Flight strongly endorses the concept of multiple-species management, it recognizes that the needs of select focal and secondary species, representative of the different aspects of California's Mojave and Sonora Desert habitats, may need to be specifically addressed. It also recognizes that managing for the specific requirements of some species is likely to affect, in either positive or negative ways, other species in the community. The challenge is that conservation actions must attempt to benefit multiple species while simultaneously tailoring their management activities for birds with very specific requirements. Furthermore, conservation planners must bear in mind that population dynamics are influenced by many factors other than breeding habitats (e.g., overwintering survival, juvenile recruitment into the breeding population) and may result in population declines even as efforts increase available quality habitat.

In preparation for this conservation plan, California Partners in Flight developed a series of species accounts on a suite of desert-associated bird species in California. Species were chosen because they represented niches and particular habitat needs, with the rationale that they represented other species with similar requirements. These detailed accounts described historical and current ranges, life history traits, habitat needs, and management concerns for each species. Information in the species-specific recommendations is derived from these accounts unless otherwise cited. The accounts will be available as electronic appendices to this plan at http://www.prbo.org/calpif/htmldocs/desert.htm. Below are recommendations for five of the focal species.

These recommendations need to be implemented, monitored, and altered as necessary. As this plan is a "living document," so should be these recommendations. With future research, management decisions can be made that best benefit both the birds and humans using desert habitats.

Black-tailed Gnatcatcher (*Polioptila melanura*)

Population:
The Black-tailed Gnatcatcher is a resident species restricted to arid and semiarid zones of the Lower Sonoran Life Zone in the southwestern United States and central Mexico (Figure 5-8). P.m. lucida occurs throughout the Sonoran, Colorado, and Mojave deserts (Farquhar 2002). The northernmost breeding area is in the Panamint Mountains (Wauer 1964). In California, the main range extends south from extreme southern Inyo County (along the Amargosa R.) through eastern San Bernardino, Riverside, and Imperial counties to the Mexican border, and west through the Colorado and Mojave

Photo by Ian Tait

Deserts to as far west as Barstow and Morongo Valley San Bernardino County, San Gorgonio Pass Riverside County, and Anza Borrego State Park (Small 1994). Southwestern Riverside County constitutes an area of sympatry with the California Gnatcatchers (Weaver 1998). Range extends through western and central Arizona, southwestern New Mexico (Farquhar 2002).

Breeding bird survey data show Black-tailed Gnatcatcher populations to be stable or declining slightly throughout much of its range. In areas where gnatcatcher habitat has been lost to agricultural or urban use, populations have experienced significant declines or even extirpation.

Habitat needs:
The Black-tailed Gnatcatcher prefers nesting and foraging in densely lined arroyos and washes dominated by creosote bush and salt bush. Black-tailed Gnatcatchers are very sensitive to human disturbances, such as urbanization, irrigated agriculture, or intensive off-highway vehicle use.

Concerns:
Destruction of the mesquite brushland in the Coachella, Imperial and Colorado River valleys is the main factor causing the decline of the Black-tailed Gnatcatcher in California. Off-road vehicle use in desert washes may also contribute to population declines.

Black-tailed Gnatcatchers are highly sensitive to habitat fragmentation, and housing developments dominated by exotic vegetation will not support this species. The invasion of salt cedar along ephemeral drainages reduces habitat quality for gnatcatchers.

Research and Monitoring:
Continued monitoring of Black-tailed Gnatcatcher populations is clearly necessary. The primary objective should be to locate, monitor and protect the remaining key breeding locations for Black-tailed Gnatcatcher in the Mojave Desert, the Coachella, Imperial and Colorado River valleys.

Action:
Continue and expand the study of bird populations in xeric riparian woodlands along the lower Colorado River.

Coordinate and maintain data sharing among appropriate agencies and organizations including the Bureau of Land Management, National Park Service, PRBO Conservation Science, and Department of Defense.

Mesquite bosque, riparian areas and washes must be left vegetatively intact and undisturbed by excluding off-road vehicle use and limiting feral burro populations.

Protect dense catclaw acacia-smoke tree washes in the Colorado and Mojave deserts.

Protect mesquite brushlands in the Coachilla, Imperial, and Colorado River valleys.

In areas where urban or agricultural development is imminent, working with developers to retain native Sonoran vegetation patches of greater than 1-ha, especially along washes and arroyos, is critical. These patches must be interspersed throughout the urban or agricultural matrix at a distance of less than 0.5 kilometers.

Black-throated Sparrow (*Amphispiza bilineata*)

Population:

Photo by Laura Hughes

This small migratory sparrow is found in desert areas in California east of Cascades and Sierra Nevada Mountains and through San Joaquin Valley east to Owens Valley and Mojave Desert, north through Santa Barbara County, south through San Diego County; throughout Baja California and adjacent Islands in the Gulf of California (Banks 1963, Grinnell and Miller 1944, Small 1994, Garrett and Dunn 1981, Unitt 1984, George 1987, Howell and Webb 1995; Figure 5-14). Black-throated Sparrows are also found throughout year in southeast and central California and Baja California, Sonora (Mexico) west to Gulf of California where winter range overlaps with breeding range, casual along coast (Garrett and Dunn 1981, Weathers 1983, Small 1994).

Breeding Bird Survey (BBS) data suggest highest average numbers in Nevada, Arizona, California and Utah where major deserts overlap (Chihuahuan, Great Basin, Sonoran, and Mojave). Highest average densities are in Chihuahuan Desert (x = 43.2 per route, *n* = 34, 1966 – 1998),); followed by Great Basin Desert (x = 40.6 per route, *n* = 27, 1966 – 1998), ; Mojave Desert (x = 39.2 per route, *n* = 27, 1966 – 1998), ; and average lowest densities are in Sonoran Desert (x = 16.4, *n* = 19, 1966 – 1998; BBS) .

Habitat Needs:

Throughout its range generally prefers semi-open habitat with evenly spaced shrubs and trees 1-3 m high. Common in desert alluvial fans, canyons, washes, flats, badlands and desert scrub type ranging from creosote bush (*Larrea tridentata*), ocotillo (*Fouquieria splendens*), cholla (*Opuntia spp.*), mesquite (*Prosopis spp.*), catclaw (*Acacia greggii*), blackbrush (*Coleogyne ramosissima*), sagebrush (*Artemisia spp.*), antelope brush (*Purshia tridentata*) and rabbitbrush (*Chrysothamnus spp.*), interspersed with taller plants such as Joshua trees (*Yucca brevifolia*), pinyon-juniper, and canotia (*Canotia holacantha*). Habitat and vegetation density may influence habitat selection more than specific shrub species, however, Black-throated Sparrows are closely associated with creosote bush throughout southern part of its range**.** Black-throated Sparrows prefer semi-open areas of evenly spaced 1-3m high shrubs or trees (Hastings 1965). At higher elevations (1219-2133 m) can be found in pinyon/juniper forests. (Bent 1968). Their winter habitat is structurally similar to their breeding habitat; these include desert washes in creosote bush, mesquite, cactus shrub, sagebrush, arid grasslands and pinyon/juniper woodlands (Weathers 1983, Unitt 1984).

Landscape fragmentation and connectivity:

Black-throated Sparrows appear to be particularly susceptible to urban development and habitat fragmentation. Preservation of unfragmented suitable habitat and maintaining connectivity between habitat patches is therefore essential for maintaining local populations. Numbers of breeding Black-throated Sparrows and Brown Towhees were found to be greatly reduced in urbanized environments, regardless of the use of native vegetation (Mills et al.1989). Also, where Brown-headed Cowbird feeding habitat has been created in agricultural and urban areas, and in other situations where cowbird numbers are high they greatly affect reproductive success of Black-throated Sparrows (Johnson and van Riper in press).

Fire management:
Long term fire suppression throughout the southwest alters plant succession, allowing shrub communities to become thicker and taller, reducing habitat for Black-throated Sparrows which prefer semi-open areas of evenly spaced 1-3m high shrubs or trees (Hastings 1965). Due to fuel build up, fire suppression enables high intensity wildfires to destroy large tracts of desert shrub habitat. Increased intensity of fires in the Great Basin adversely affects native grass and shrubs, which are often replaced by exotic, fire tolerant cheatgrass (Cooperrider and Wilcox 1995). Cheatgrass (*Bromus tectorum*) retards or prevents recovery of native plants by capturing water and fueling recurring fires. It has spread virtually throughout the entire Great Basin and is prevalent in other areas of the southwest (Hasting 1965, Cooperrider and Wilcox 1995).

Monitoring and research needs:
Most studies involving Black-throated Sparrows are community wide, multi-species studies, with little detail focused on *A. bilineata.* Population and breeding studies that focus specifically on *A. bilineata* would provide needed additional information on survivorship, longevity and causes of death.

Presently, one of the fastest growing human populations in North America exists in the desert southwest. Specific habitat requirements of Black-throated Sparrows are needed on both breeding and wintering grounds in order to aid wildlife managers to preserve and protect this unique desert species and the fragile habitat it inhabits.

Gila Woodpecker (Melanerpes uropygialis)

Population:
Though Gila Woodpeckers are not difficult to find in sprawling cities like Phoenix and Tucson, this species faces significant declines across its range and an increased and persistent threat of habitat loss to fire and urbanization into the foreseeable future. The Gila Woodpecker was added to the California State Endangered List in 1988. Using Breeding Bird Survey data, the Patuxent Wildlife Research Center reports a significant negative population trend of -2.2% (P= 0.04) for Gila Woodpeckers in Arizona from 1980-2007, which is the time period for which most surveys have occurred (Sauer at al. 2008). In addition, Rosenberg et al. (1991) and Hunter (1984) have recorded near extirpation of this species from southeastern California, and Laymon and Halterman (1986) estimated that less than 30 pairs survive in California altogether. Population trends for this species in Mexico is totally unknown, though conversion of Sonoran Desert scrub to exotic buffelgrass has been much more dramatic than in the United States (Búrquez-Montijo et al. 2002). It is reasonable to suggest that Gila Woodpecker population declines in Mexico may be even more significant than in the United States.

Generally permanent resident where found. In the United States, from extreme southwestern New Mexico (Hidalgo and Grant Counties), through southern Arizona north to the Mogollon Rim west to extreme southeast California (Figure 5-3). Edwards and Schnell (2000) report Gila Woodpeckers in Clark County, Nevada, but Floyd et al. (2007) did not find evidence of Gila Woodpeckers breeding in the state. Nevada and California populations generally constrained to the last riparian remnants of the Colorado River, though small numbers - perhaps up to 100 pairs (G. McCaskie, pers. comm..) - may be still found in the Imperial Valley (Alcorn 1988, Hunter 1986). Researchers recently discovered a small population in *Cercidium – Olneya* woodland near the Palo Verde Mountains, raising the possibility that more Gila Woodpeckers may be found in large, old-growth xeric riparian woodlands in Imperial County (McCreedy *in prep.*).

Habitat needs:
Require environments with large boles for nesting substrate, either columnar cacti or large trees, including riparian woodlands, old-growth xeric-riparian wash woodlands, uplands with concentrations of large columnar cacti, dry subtropical forests, and urban residential areas (Edwards and Schnell 2000). It is questionable why Gila Woodpeckers have not succeeded in colonizing urban residential areas of southern California west of the species' traditional breeding range. It is also questionable why Gila Woodpeckers have not managed to occupy other large wash woodlands in California outside of Imperial County.

Exotic Species Invasion / Encroachment:
Large-scale conversion of cottonwood-willow riparian forest to monotypic salt-cedar (*Tamrix* sp.) stands due to altered hydrology and fire regimes has robbed Gila Woodpeckers of much of the remaining desert riparian habitat left in the Sonoran Desert. Though Gila Woodpeckers will occasionally nest in large Athel Tamarisk, the more common salt-cedar stands that dominate the Lower Colorado River and Gila River are not viable Gila Woodpecker nesting habitat (Rosenberg et al. 1991). Large-scale cottonwood-plantation and *Tamarix*-removal projects are underway in the Lower Colorado River Valley and may add Gila Woodpecker habitat in the future.

Widespread invasion of Sonoran Desertscrub by exotic grasses has resulted in increased fire frequency and large-scale eradication of saguaro cactus stands across southern Arizona and Sonora.

Research and Monitoring:
Demographic data virtually nonexistent for this species, including productivity, productivity in rural versus urban environments (which would consider Starling presence/absence), survivorship, reliance of urban populations on immigration from rural populations, individual response to catastrophic fire events (nest success, emigration, carrying capacity of habitats adjacent burns, etc.).

An unknown number of Gila Woodpeckers may breed in xeric riparian habitats in Imperial County, CA: only Milpitas Wash has been surveyed. The remainder of the largest wash systems in Imperial County should be censused, and it would be instructive to learn what happens to young produced at these sites/why more xeric riparian habitats in southeastern California are not colonized.

Virtually no demographic information exists for Mexico. Distribution in should be addressed throughout Sonora in the face of increasing development, competition for water resources, and conversion of Desertscrub habitats to exotic grass-dominated habitats.

Le Cont's Thrasher (*Toxostoma lecontei*)

Population:
Le Conte's Thrasher [*sensu stricto* Zink (1997)] is non-migratory and occurs in two disjunct geographic areas: (1) the Sonoran and Mojave deserts (Figure 5-11) and (2) the west side of the San Joaquin Valley. All populations in the San Joaquin Valley and in regions around urban centers in the Mojave and Sonoran deserts have declined because of habitat loss. Sheppard (1996) reports that 26 percent of historical localities no longer had suitable Le Conte's Thrasher habitat within three kilometers.

Habitat needs:
Le Conte's Thrashers nest preferably in thorny shrubs or small desert trees. This species favor settings with higher fertility and above-ground biomass so that vegetation is thick and able to support and hide a substantial nest. Shrubs in the Chenopodiaceae plant family, especially in alkaline or saline soils, are common settings for nests. Although Le Conte's Thrashers do not build nests in creosote (*Larrea tridentata*), they occur frequently in the widespread creosote – burrobush (*Ambrosia dumosa*)

plant association, where desert-thorns (*Lycium* spp.) have stout stems to support thrasher nests (Hill 1980). Joshua tree (*Yucca brevifolia*) woodlands with abundant shrubs are also widely used in the Mojave Desert. Dense mesquite thickets close to extensive shrub lands are also good sites, but more massive Sonoran Desert woodlands do not support Le Conte's Thrasher except at woodland-shrubland edges.

Research and monitoring:
Because Le Conte's Thrashers have large territories, they have low density and thus low likelihood to be recorded with conventional point counts. Detecting them is also made difficult because their ventriloqual vocalizations carry over long distances, vocalizations are crepuscular, and birds are secretive.

Long-term tracking of resident birds would provide the best demographic and range data for local populations. The cost and labor for remote sensing to track individual birds and the remoteness of sites for monitoring are deterrents to study.

Lucy's Warbler (*Vermivora luciae*)

Population:
A denizen of desert riparian mesquite thickets, the migratory Lucy's Warbler breeds from southeastern California, southern Nevada and Utah south to southern Arizona, northern Mexico, and extreme western Texas (DeGraaf and Rappole 1995; Figure 5-7). This species breeds in southeastern California mainly along the lower Colorado River, but locally north to Death Valley National Monument and west to Morongo and Borrego Valleys (Dunn and Garrett 1997). Lucy's Warbler may also breed in Chihuahua, Mexico, adjacent to the Rio Grande Valley of western Texas (Scott 1987). Lucy's Warbler population numbers may be diminishing throughout its breeding range because of riparian habitat loss and mesquite cutting throughout the southwestern United States. However, the population seems to be increasing and expanding to new locations in some areas. Some population fluctuations are unexplained and need further investigation (Johnson et al. 1997).

Habitat needs:
The cavity nesting Lucy's Warbler breeds mainly in thickets of mesquite (*Prosopis* spp.) bosques, mainly honey mesquite (*Prosopis glandulosa*) but also screwbean mesquite (*Prosopis pubescens*), and frequently along watercourses or near ponds that have willows (*Salix* spp.) and cottonwoods (*Populus* spp.). However, Lucy's Warblers tend to shun mature cottonwood-willow riparian associations (Dunn and Garrett 1997) but will occasionally nest in lowland cottonwood-willow riparian gallery forests (Johnson et al. 1997) and less often in mid-elevation sycamore-ash-live oak (*Platanus-Faxinus-Quercus*) associations (Johnson et al. 1997). This species ranges into sparser thorn-scrub of palo verde (*Cercidium* spp.), ironwood (*Olneya tesota*), and catsclaw acacia (*Acacia greggii*) where such habitat borders stands of mesquite (Dunn and Garrett 1997). Lucy's Warbler has also recently begun breeding in tamarisk (*Tamarix ramossisima*) forests in the Grand Canyon region of Arizona (Johnson et al. 1997).

Grinnell (1914) in (Bent 1953) referring to the Colorado Valley states: "On the California side, both at Riverside Mountain and above Blythe, Lucy's Warblers were numerous, and very closely confined to the narrow belt of mesquite. The birds foraged out to a limited extent from the mesquite towards the river into arroweed (*Tessaria sericea*) and willows, and away from the river at the mouths of washes into the ironwoods and palo verdes. But the metropolis was always most emphatically the mesquites."

Management Issues:
Riparian ecosystems have been greatly reduced locally throughout much of the southwestern United States, extirpating many breeding populations of Lucy's Warbler. Degradation and loss of riparian mesquite habitat is generally detrimental to this species and has extirpated some local populations, although current habitat losses do not appear to present a threat to the species as a whole (Johnson et al. 1997). Based on a few sightings elsewhere in San Diego County, Lucy's Warbler could colonize additional stands of mesquite. However, the future of bosques in Borrego Valley where they now occur is endangered by the continued pumping of groundwater (Unitt 2004).

Unlike many cavity-nesting species, Lucy's Warblers will not use nest boxes (Johnson et al. 1997). Since Lucy's Warbler also breeds in cottonwood and willow, degradation and destruction of southwestern riparian habitats has had a heavy impact on this species. No direct management actions specifically targeting this warbler have been taken, but generalized riparian restoration efforts should eventually benefit this species. However, in a few instances, population increases have been noted in tamarisk thickets along the Colorado River in the Grand Canyon, Arizona (Johnson et al. 1997).

Research and Monitoring:
Aside from the review of Bent, a complete life history study has never been conducted for this species. Complete information is lacking on this species' breeding ecology (e.g., mate selection and copulation, nest building, incubation, and parental care) as well as information on demographics, causes of population fluctuations, and general life history and ecology. The following research needs are taken from Johnson et al. 1997.

1. Investigate general natural history and ecological traits such as song types and vocalization patterns, and breeding/nesting phenology.

2. Verify current life history assumptions including monogamy, only males sing, only females build nests, only females incubate.

3. Examine the possible breeding area in Chihuahua, Mexico

4. Determine basic migration information including whether they are nocturnal or diurnal migrants, whether they migrate singly or in flocks, the speed of migration.

5. Investigate wintering grounds needs, especially regarding the recently discovered (1990's) wintering in the Big Bend region of Texas.

6. Expand Christmas Bird Counts into western Mexico.

7. Establish standardized population monitoring.

8. Expand existing banding programs.

Chapter 7. Bioregional Conservation Objectives

California has a higher biodiversity of wildlife and plants than any comparable area in the northern temperate zone (Biosystems Analysis 1994). The state also has more endemic species, particularly plants and birds, than any other state except Hawaii. This great diversity provides significant challenges in conservation planning, particularly over a state as large and geographically diverse as California.

As with the other habitat plans, we have adopted the California Biodiversity Council's 10 bioregions as a guideline for dividing the geography of California into natural communities organized by biota, climate, topography and soils (RAC 1998). See Figure 6-1 for bioregion boundaries. These contrast slightly with the 11 discrete regions recognized by Sawyer and Keeler-Wolf (1995) and Biosystems Analysis (1994).

Unlike several of California Partners In Flight's Bird Conservation Plans, the Desert Plan extends well-beyond California's boundaries. However, the Desert Plan is defined by two of the California Biodiversity Council's 10 bioregions: the Mojave Desert and the Colorado Desert, which is also referred to as the Lower Colorado River section of the Sonoran Desert. The Desert Plan's coverage into other states and Mexico simply represents the extension of these bioregions outside California.

Setting conservation goals by bioregion helps facilitate planning site-specific projects in a broader context, and provides a similar framework to other conservation planning efforts. Setting and achieving conservation goals by bioregion will:

- Ensure that a suite of ecological communities representative of California's diversity will be conserved.
- Ensure that the broadest range of biodiversity and locally adapted races of species will be conserved.
- Facilitate action at the local level.

Portfolio Sites

For each bioregion, we list potential "Portfolio Sites," i.e., areas that are distinguished by their protected status and potential for managing desert habitat for birds. Many of these Portfolio Sites contain desert habitat located near other habitats of concern. Thus, there is considerable potential for management of such areas to achieve goals for many CalPIF habitat plans, particularly the Riparian Plan and the Coastal Scrub and Chaparral Plan. This list is not comprehensive and will be updated as the Plan is revised. We ask that individuals and groups working in these bioregions bring important sites and activities to our attention.

It is important to make a distinction between our use of the term "Portfolio Site" and its use by other organizations. Most notably, The Nature Conservancy of California has identified a list of sites that are prime candidates for conservation and are prioritized based on their biological richness and the immediacy of threats to them. Some of these sites are also considered as Portfolio Sites in this and other CalPIF Bird Conservation Plans, and more may be included in the future as they become protected and efforts to manage for desert birds are expanded.

Mojave Desert Bioregion

Much of the Mojave Desert bioregion falls within the jurisdiction of the following multiple-species habitat conservation plans, not all of which were released to the public:

West Mojave Plan
Clark County Multiple Species Habitat Conservation Plan
Ecoregion-based Conservation in the Mojave Desert (TNC)
Northern and Eastern Mojave Desert Management Plan (NEMO)
Sonoran Joint Venture Conservation Plan

These plans have been developed to resolve conflicts between development and conservation and have been driven occasionally by economic and aesthetic values, rather than by science (Scott and Sullivan 2000). The best way currently to incorporate conservation science into the plans may be through the development and improvement of plans for long-term management of multi-species reserves. Such management must help mitigate problems associated with less-than-optimal reserve design, for example problems caused by habitat fragmentation and edge effects.

Portfolio Sites of the Mojave Desert

The following list of sites briefly describes ecologically important desert habitat areas within the Mojave Desert Bioregion of southern California, Nevada, Utah, and Arizona. This list is by no means complete, but highlights some of the larger and more contiguous habitat areas that offer the greatest potential for management and conservation of desert habitat for birds. Sites with an active monitoring and/or management program for desert birds are noted, but many of these areas are not currently protected and managed for habitat and species preservation.

Inyo County

Death Valley National Park

While Death Valley is well known as the hottest and perhaps driest place in North America, Death Valley National Park also hosts over 1000 species of plants and 440 species of animals, many of which are endemic. Death Valley NP is the largest national park outside of Alaska (over 3.3.million acres) and extends from 282 feet below sea level to over 11,000 feet above sea level. Death Valley NP contains a wide variety of Mojave Desert habitat types and, in total, 307 bird species have been recorded within the park. Over 95% of Death Valley NP is protected as wilderness.

Amargosa Canyon Area of Critical Environmental Concern

One of the most important riparian areas of the Mojave Desert, the Amargosa Canyon ACEC also hosts several Desert Plan focal species that breed in screwbean and honey mesquite stands in drier sections of the riparian corridor. Ladder-backed Woodpecker, Costa's Hummingbird, Ash-throated Flycatcher, Common Raven, Verdin, Black-tailed Gnatcatcher, Crissal Thrasher, Phainopepla, and Lucy's Warbler all breed here.

San Bernardino County

Mojave National Preserve

Elevations range from 880 feet to nearly 8,000 feet above sea level, encapsulating Sonoran, Mojave, and Great Basin Desert habitats. This is the third largest National Park Service area outside Alaska. Its bird populations are not well documented, but the Mojave National Preserve may contain the largest Bendire's Thrasher population in California.

Riverside County

Joshua Tree National Park

Over 250 bird species have been recorded in Joshua Tree National Park, which is just over one million acres in area. Seventy-eight species breed within park boundaries, which straddles the Mojave and Sonoran Desert boundary and which contains habitats unique to each. Desert Plan focal species breeders include Ladder-backed Woodpecker, Costa's Hummingbird, Ash-throated Flycatcher, Common Raven, Verdin, Black-tailed Gnatcatcher, Verdin, LeConte's Thrasher, Bendire's Thrasher, Black-throated Sparrow, and Scott's Oriole.

Nye County

Ash Meadows National Wildlife Refuge

Over 23,000 acres of spring-fed wetlands and alkaline desert uplands in the Amargosa River Valley. Due to a network of springs releasing waters that precipitated over 10,000 years ago and rise in one of the hottest and driest locations in North America, Ash Meadows has high concentrations of endemic plants and animals. Two hundred and twenty bird species have been found in Ash Meadows NWR, with 57 breeding species. Breeding Desert Plan focal species include: Burrowing Owl, Costa's Hummingbird, Ash-throated Flycatcher, Common Raven, Verdin, Crissal Thrasher, Le Conte's Thrasher, Phainopepla, Lucy's Warbler, and Black-throated Sparrow.

Clark County

Desert National Wildlife Refuge

One-and-a-half million acres, the largest NWR in the lower 48 states. The Desert NWR contains six mountain ranges and spans in elevation from 2,500 feet above sea level to nearly 10,000 feet above sea level. Three hundred seventeen species have been documented at the Desert NWR, and 114 species have been found to nest here. Breeding Desert Plan focal species include: Ladder-backed Woodpecker, Ash-throated Flycatcher,Common Raven, Verdin, Black-tailed Gnatcatcher, Bendire's Thrasher, Crissal Thrasher, LeConte's Thrasher, Phainopepla, Lucy's Warbler, Black-throated Sparrow, and Scott's Oriole. Of the Desert NWR's 1.5 million acres, 1.4 million acres have been proposed as wilderness and have been managed as such since 1974.

Red Rock Canyon National Conservation Area

Nearly 200,000 acres, Red Rock NCA is administered by the Bureau of Land Management and was created in 1990. Adjacent to one of the fastest-growing metropolitan areas in the United States (Las Vegas), it attracts one million visitors annually.

Clark and Mohave Counties

Lake Mead National Recreation Area

Over 1.5 million acres, Lake Mead National Recreation Area has been administered by the National Park Service for over 70 years. Nine of the 18 Clark County wildernesses created by the 2002 Clark County Conservation of Public Land and Natural Resources Act are within LMNRA (there are no wilderness areas in the Arizona portion of LMNRA). Over 240 different bird species have been recorded at LMNRA.

Washington County

Zion National Park

Zion National Park contains the extreme northeastern edge of the Mojave Desert. It's wide variety of elevations and habitats are home to 291 bird species. Desert Plan Focal Species include Costa's Hummingbird, Ladder-backed Woodpecker, Ash-throated Flycatcher, Common Raven, Verdin, Crissal Thrasher, Phainopepla, Lucy's Warbler, Black-throated Sparrow, and Scott's Oriole.

Sonoran Desert (Lower Colorado section) Bioregion

Much of the Sonoran Desert (Lower Colorado section) bioregion falls within the jurisdiction of the following multiple-species habitat conservation plans, not all of which were released to the public:

- Northern and Eastern Colorado Desert Coordinated Management Plan (U.S. Bureau of Land Management 1998)
- An Ecological Analysis of Conservation Priorities in the Sonoran Desert Ecoregion (TNC, IMADES, Sonoran Institute)
- Arizona Partners in Flight Bird Conservation Plan (AZGFD)
- Sonoran Joint Venture Conservation Plan

These plans have been developed to resolve conflicts between development and conservation and have been driven occasionally by economic and aesthetic values, rather than by science (Scott and Sullivan 2000). The best way currently to incorporate conservation science into the plans may be through the development and improvement of plans for long-term management of multi-species reserves. Such management must be used to help mitigate problems associated with less-than-optimal reserve design, for example problems caused by habitat fragmentation and edge effects.

Portfolio Sites of the Sonoran Desert (Lower Colorado section)

The following list of sites briefly describes ecologically important desert habitat areas within the Sonoran Desert (Lower Colorado section) of southern California, Arizona, Sonora, and Baja California. This list is by no means complete, but highlights some of the larger and more contiguous habitat areas that offer the greatest potential for management and conservation of desert habitat for birds. Sites with an active monitoring and/or management program for desert birds are noted, but many of these areas are not currently protected and managed for habitat and species preservation.

Riverside County

Joshua Tree National Park

Over 250 bird species have been recorded in Joshua Tree National Park, which is just over one million acres in area. Seventy-eight species breed within park boundaries, which straddles the Mojave and Sonoran Desert boundary and which contains habitats unique to each. Desert Plan focal species breeders include Ladder-backed Woodpecker, Costa's Hummingbird, Ash-throated Flycatcher, Common Raven, Verdin, Black-tailed Gnatcatcher, Verdin, LeConte's Thrasher, Bendire's Thrasher, Black-throated Sparrow, and Scott's Oriole.

San Diego County

Anza-Borrego Desert State Park

California's largest state park, Anza-Borrego contains 12 wilderness areas. It preserves over 600,000 acres of land on the extreme western edge of the Sonoran Desert. As such, it represents the western edge of a number of ranges for Sonoran Desert bird species. Over 200 bird species and approximately 70 breeding species have been documented within Anza-Borrego. Desert Plan focal species include Costa's Hummingbird, Ladder-backed Woodpecker, Ash-throated Flycatcher, Common Raven, Verdin, Le Conte's Thrasher, Phainopepla, Black-throated Sparrow, and Scott's Oriole. Crissal Thrasher and Lucy's Warbler breed at an exceptionally isolated mesquite bosque at Borrego Springs, private land that is surrounded by the Park.

San Bernardino and Mohave Counties

Havasu National Wildlife Refuge

The Havasu National Wildlife Refuge was created in 1941. The refuge covers 44,371 acres on each side of the Colorado River, of which over 14,000 acres are managed as wilderness. The Havasu NWR is dominated by riparian and open water habitat, but it contains several small xeric riparian washes that support some of the densest breeding and migrant songbird populations of the region (McCreedy *in prep*). Two hundred ninety-nine bird species have been detected within the Havasu NWR, 83 of them breeders. Desert plan focal species include Burrowing Owl, Costa's Hummingbird, Gila Woodpecker, Ladder-backed Woodpecker, Ash-throated Flycatcher, Common Raven, Verdin, Black-tailed Gnatcatcher, Crissal Thrasher, Phainopepla, Lucy's Warbler, and Black-throated Sparrow.

Mohave and La Paz Counties

Bill Williams National Wildlife Refuge

The Bill Williams National Wildlife Refuge was established in 1941, and covers just over 6,000 acres of the Bill Williams River's final descent to the Colorado River. It contains one of the (perhaps the only) remaining cottonwood-willow gallery forests left in the Lower Colorado River Valley. While The Bill Williams NWR consists primarily of riparian habitat, it is likely an important source for several Desert Plan focal species, including Costa's Hummingbird, Gila Woodpecker, Ladder-backed Woodpecker, Ash-throated Flycatcher, Verdin, Crissal Thrasher, Phainopepla, and Lucy's Warbler. At least 290 species have been recorded here, including 80 breeders. Additional breeding Desert Plan species include Burrowing Owl, Common Raven, Black-tailed Gnatcatcher, and Black-throated Sparrow.

Riverside and La Paz Counties

Cibola National Wildlife Refuge

The Cibola National Wildlife Refuge was created in 1964 (16,600 acres), and largely consists of riparian habitat on the Colorado River, as well as large tracts of agricultural fields (2,000 acres) planted for forage. Two hundred eighty-eight bird species have been detected at the Cibola NWR, with 52 breeders. Desert Plan breeding species include Burrowing Owl, Costa's Hummingbird, Gila Woodpecker, Ladder-backed Woodpecker, Ash-throated Flycatcher, Verdin, Black-tailed Gnatcatcher, Crissal Thrasher, Phainopepla, and Lucy's Warbler.

Imperial and Yuma Counties

Imperial National Wildlife Refuge

The Imperial National Wildlife Refuge was also created in 1941, and stands at 25,768 acres on each side of the Colorado River. While the Imperial NWR is primarily a riparian corridor, it contains several small xeric riparian washes that host some of the highest breeding and migrant densities for that habitat type in the region (McCreedy 2007). Over 15,000 acres of the Imperial NWR are managed as wilderness. Two hundred seventy-five species have been detected here, with 76 breeding species. Desert Plan focal species that breed here include Costa's Hummingbird, Gila Woodpecker, Ladder-backed Woodpecker, Ash-throated Flycatcher, Verdin, Black-tailed Gnatcatcher, Crissal Thrasher, Phainopepla, and Lucy's Warbler.

La Paz and Yuma Counties

Kofa National Wildlife Refuge

Like the Desert NWR (above), and the Cabeza Prieta NWR (below), the Kofa NWR is a refuge whose emphasis is on the desert's (i.e. not water-based) resources. In the Kofa NWR's case, its establishment in 1939 was to help protect bighorn sheep. However, the Kofa NWR covers 665,400 acres of primarily pristine Sonoran Desert, and 82% of it is managed as wilderness. Draining the New Water Mountains in the northeast corner of the refuge, the Alamo Wash held the highest densities for a number of Desert Plan focal species in a study of 10 xeric riparian sites in western Arizona (McCreedy 2007). Species with highest densities recorded at Alamo Wash include Costa's Hummingbird, Gila Woodpecker, Ladder-backed Woodpecker, Verdin, Black-tailed Gnatcatcher, Crissal Thrasher, and Black-throated Sparrow. Prior to a 26,000 acre catastrophic burn caused by weapons testing on the adjacent Yuma Proving Grounds in 2005, the King Valley wash complex likely held high densities of desert breeders as well. In total, 185 bird species have been reported at the Kofa NWR, and 25 species have been recorded as nesting here. Additional Desert Plan breeders include Ash-throated Flycatcher, Bendire's Thrasher, Lucy's Warbler, and Scott's Oriole.

Yuma and Pima Counties

Cabeza Prieta National Wildlife Refuge

Also created in 1939, the Cabeza Prieta NWR contains 860,000 acres, over 90% of which are managed as wilderness. It shares a 56-mile border with Mexico to the south, and is bordered by the Barry Goldwater Air Force Range to the north and Organ Pipe National Monument to the east, rendering it one of the most remote locations in the lower 48 continuous states. Two hundred twelve bird species have been detected at Cabeza Prieta NWR, 42 of them breeding species. All Desert Plan focal species save Burrowing Owl have been found to breed here.

Pima County

Organ Pipe National Monument

Organ Pipe National Monument (established in 1937) contains the most intact Sonoran Desert ecosystems in the United States, and perhaps in Mexico as well. It is a United Nations Educational, Scientific, and Cultural Organization (UNESCO) biosphere reserve, and 95% of its 330,000 acres are managed as wilderness, comprising the third largest wilderness area in Arizona. The boundary between lower-elevation Lower Colorado section habitat and higher-elevation Arizona Upland section habitat runs north-south through the monument, and much more rainfall and columnar cacti occur in the eastern half of Organ Pipe. Two hundred seventy-eight bird species have been detected at Organ Pipe NM, 63 of them breeding species. All Desert Plan focal species have been found to breed here, save Burrowing Owl.

Sonora

El Pinacate y Gran Desierto de Altar Reserva de la Biosfera

Managed by the Mexican Ministry of the Environment and Natural Resources (SEMARNAT) and the State of Sonora (IMADES). El Pinacate hosts over 200 bird species, as well as several endemic animals and plants. The Nature Conservancy has identified cattle grazing, cinder mining, and unchecked off-highway vehicle use as important dangers to ecosystem integrity at the reserve. TNC's Parks in Peril program has worked with IMADES to install a park staff, control mining activity, and work with local ejidos to preserve the reserve's resources.

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Harris's Hawk *Photo by Colin Woolley*

Chapter 8. Conservation Action Recommendations

This chapter provides specific recommendations for desert habitat activities throughout the state. They consider habitat protection and restoration, land management, research and monitoring, and policy action. Conservation organizations, agencies, scientific researchers and the public provided the information used in developing this chapter and most recommendations were derived from the most recent scientific data and analyses available. Unless otherwise referenced, most information from this section is derived from the focal species accounts (see http://www.prbo.org/calpif/). Some, however, rely upon well-informed assumptions that require more scientific investigation. Standardized monitoring and adaptive management will test and develop these assumptions, continually improving our knowledge of conservation and restoration science.

These recommendations seek to reverse the current declines of many desert-associated bird populations. By restoring healthy, stable populations, we will avoid the expensive and intrusive last resort of listing more species as threatened and endangered. We hope that these recommendations will galvanize and guide conservation organizations, project funding, and the actions of land managers and owners across the state. All of the following objectives and recommendations seek to fulfill CalPIF's central mission, which is to promote conservation and restoration of desert habitat sufficient to support the long-term viability and recovery of native bird populations.

Habitat Protection Recommendations

OBJECTIVE 1

Prioritize desert sites for protection and restoration.

Recommendations

1.1. Prioritize potential desert protection sites according to current indicators of avian population health.

Conservation efforts should use the most recent information regarding the quality of existing habitat and wildlife populations to prioritize the acquisition and protection of sites. Reproductive success, in particular, is an important demographic parameter that provides a foundation around which to build desert conservation programs. Standardized data collection during a single breeding season (generally February 1 through July 1, though summer monsoons can extend breeding in eastern portions of the Sonoran Desert) provides only cursory assessment of habitat quality. Multiple years of data collection provides more insight into proximal determinants of habitat quality, and due to high annual climatic variation in desert environments, are necessary to properly gauge avian responses to habitat quality.

1.2. Prioritize restoration sites according to their proximity to existing high-quality sites.

Restoration sites near existing high-quality sites and population sources have a higher probability of being re-colonized by extirpated species. In addition, restoration of sites near high-quality sites provides buffers and offsets fragmentation of source population habitat.

1.3. Prioritize sites according to surrounding land use.

Landscape scale land use patterns may significantly affect the sustainability of desert bird populations over the long term (The Nature Conservancy 2001, Germaine et al. 1998). Surrounding land uses influence the population sizes of Brown-headed Cowbirds and predators such as domestic cats, jays, skunks, raccoons, ravens, and crows. More research is needed regarding habitat buffers and their influence on predation and parasitism rates. It is known that Brown-headed Cowbirds may commute more than 18 kilometers between foraging grounds and the nest sites of their hosts (McCreedy et al. 2006). For more information, refer to Recommendation 6-3.

OBJECTIVE 2

Promote desert ecosystem health (i.e., a self-sustaining, functioning system).

Recommendations

2.1. Ensure that the patch size, configuration, and connectivity of restored desert habitats adequately supports the desired populations of desert dependent species.

The size and connectivity of desert habitat patches may be limiting to bird species' occupancy and population size. A habitat patch is a contiguous area of similar vegetation, usually defined by the dominant vegetation (e.g., Joshua Tree). Patch sizes must not fall below the minimum necessary to support populations based on:

- Territory size requirements.
- Community dynamics.
- Sensitivity of some species to fragmentation and edge effects (increased predation/parasitism rates).

When determining the minimum acceptable patch size for a site, managers should consider the mean territory size of their target species as a guideline. When considering a suite of species, managers should use the species with largest territory needs (e.g., Gila Woodpeckers, or *Toxostoma* thrashers) to set the minimum patch size requirement, and they should design corridors to connect habitat fragments according to the needs of the species with the highest sensitivity to fragmentation (Bolger et al. 2001).

Restoration Recommendations

OBJECTIVE 3

Increase the value of ongoing restoration projects for bird species.

Recommendations

3.1. Restore and manage desert habitats to promote structural diversity and volume of the understory. Desert breeding birds often do not have arborescent vegetation available for nest site selection, and they traditionally place nests less than 2.5m above the ground (Corman and Wise-Gervais 2005, McCreedy et al. 2006). Even when arborescent vegetation, such as palo verdes or ironwood are available, many nests are placed in low, brushy sections of palo verdes or in secondary shrubs such as wolfberry (*Lycium* spp.), cacti, or desert lavender (*Hyptis emoryi*). Desert understories provide cover, shade, and foraging opportunities that complement overstory vegetation.

3.2 Actively protect site integrity through fencing, vertical mulching, gating, lining trails with rocks, etc. A great deal of desert restoration will be focused on eliminating illegal off-highway vehicle trails, construction sites, and grazing activity. In general, the majority of off-highway vehicle users will not create new trails, but they will follow illegal trails and tracks. Once illegal trails are removed, restored habitat can be effectively protected by simply providing vegetative or rock obstruction to restored ground, which deters drivers from accessing the restored site.

3.3 Guide restoration activity through monitoring components that include habitat assessment. Due to a relative paucity of avian data from non-riparian desert habitat, restoration projects should be equipped with avian monitoring to assess the success of restoration. Any monitoring should thus include a habitat assessment component that evaluates what habitat attributes are responsible for highest avian abundance and productivity. Desert vegetation is slow-growing, and managers may lose several years of effort if restoration projects need to be re-done.

3.4 Develop silvicultural knowledge for desert tree species. Sonoran Desert breeders and migrants largely depend on arboreal species such as ironwood, palo verde, mesquite, and acacia (McCreedy *in prep*). However, compared to other North American tree species, a great deal less is known about the propagation of these species for restoration efforts. Agencies should develop nursery sources and silvicultural techniques to ensure successful propagation of these species to minimize costs and maximize benefit to restoration effort. Agencies can partner with urban xeriscaping technicians and landscape architects to take advantage of their significant silvicultural experience with similar arboreal species.

3.5 Actively remove exotic invasives from restoration sites, particularly exotic grasses that can increase fire frequency and ultimately result in catastrophic loss of ongoing restoration. Due to disturbed soils, restoration sites are susceptible to invasion by weedy invasive species such as brome, buffelgrass, and other exotic annuals. These annuals provide fuel for potentially catastrophic fires which would erase restoration progress and potentially burn nearby, high-quality habitat.

Cultivated Restoration Recommendations

Restoration and improved management are the best means by which to increase the amount and quality of desert habitat in the state, thereby increasing the reproductive success and population sizes of desert-associated birds.

OBJECTIVE 4

Design and implement cultivated restoration projects that mimic the diversity and structure of a natural desert plant community.

Recommendations

4.1. Increase our understanding of desert plant succession to increase restoration success.

4.2. Plant a minimum of two or more species of native shrubs or trees (i.e., avoid monotypic plantings).

Several vegetation features have broad positive effects on bird species diversity, abundance and nesting success (Table 8-1, 8-2). Many non-avian species also respond positively to these vegetation components in riparian habitats. Microhabitat characteristics can also influence nest-site selection by breeding birds. The availability of appropriate nest sites may have a direct effect on the ability of birds to reproduce and maintain a viable population (Martin 1993, Nur et al. 1996, Small et al. 1998).

Table 8-1. The following plant species and cover types have been found to positively influence breeding bird diversity or breeding species richness in desert habitats, by California bioregion.

	Mojave Desert	Colorado Desert
Canopy Layer	Joshua Tree, Honey Mesquite, Screwbean Mesquite	Blue Palo Verde, Ironwood, Saguaro, Organ Pipe Cactus
Shrub Layer	Quailbush, Mojave Yucca	Cholla Cactus Species, Jojoba, Snakebush, Quailbush, Saltbush

Table 8-2. The following plant species and cover types have been found to positively influence presence and abundance of the following Desert Plan focal species.

	Mojave Desert	Colorado Desert
Burrowing Owl		Irrigation canals
Costa's Hummingbird	Goodding's Willow	Chuparosa, Goodding's Willow, Palo Verde, Ironwood
Gila Woodpecker		Blue Palo Verde
Ladder-backed Woodpecker	Goodding's Willow, Yucca, Joshua Tree	Blue Palo Verde, Ironwood, Goodding's Willow
Ash-throated Flycatcher	Goodding's Willow, Fremont Cottonwood	Blue Palo Verde, Ironwood, Goodding's Willow, Fremont Cottonwood
Common Raven	Urban Development, Roadside Habitats	Urban Development, Roadside Habitats
Verdin	Honey Mesquite, Screwbean Mesquite, Desert Mistletoe	Honey Mesquite, Blue Palo Verde, Ironwood, Desert Mistletoe
Black-tailed Gnatcatcher	Big Saltbush, Smoketree	Wolfberry, Blue Palo Verde, Catclaw Acacia, Desert Mistletoe, Smoketree
Bendire's Thrasher	Joshua Tree	Blue Palo Verde
Crissal Thrasher	Big Saltbush, Screwbean Mesquite, Honey Mesquite, Goodding's Willow	Blue Palo Verde, Honey Mesquite, Screwbean Mesquite, Ironwood
LeConte's Thrasher	Saltbush	Saltbush
Phainopepla	Desert Mistletoe, Honey Mesquite, Catclaw Acacia	Desert Mistletoe, Honey Mesquite, Catclaw Acacia, Blue Palo Verde, Wolfberry
Lucy's Warbler	Tamarisk, Fremont Cottonwood, Goodding's Willow	Ironwood, Blue Palo Verde, Fremont Cottonwood, Goodding's Willow
Black-throated Sparrow	Saltbush	Jojoba, Cholla Cactus
Scott's Oriole	Joshua Tree, Mojave Yucca	

4.3. Plant native trees and shrubs that are highly correlated to avian abundance and diversity.

McCreedy et al. (2006) reported that Ironwood, and in particular, Blue Palo Verde are widely used by nesting desert birds for foraging opportunities, song perches, and nesting substrates. At desert wash sites in the Lower Colorado River Valley, Blue Palo Verde habitats typically held greater species richness and breeding abundances than Foothills Palo Verde habitats, due to greater use of Blue Palo Verde by cavity nesting species, and due to greater mistletoe parasitism of Blue Palo Verde trees over Foothills Palo Verde. On the Milpitas Wash (Imperial County, CA), 100% of detected Gila Woodpecker nests have been found in Blue Palo Verdes, despite the presence of Ironwood trees in equitable number and girth (McCreedy et al. 2006).

4.4. Increase shrub richness, shrub density, and the rate of natural reestablishment by including plantings of understory species in restoration design.

Understory vegetation is critical as nesting substrate for many desert bird species, especially in newly restored habitats (Germain et al. 1998, Emlen 1974). Avian density may increase in a habitat with increased foliage density because of a higher number of potential nest sites (Martin 1988). The greater the number of potential nest sites within a given habitat patch, the greater the effort required for predators to locate prey (nest sites). Thus, nests may possess a higher probability of fledging young.

4.5. Plant native forb and sedge species.

Increasing presence of exotic annuals such as Red Brome, Medditerranean grasses, and Sahara Mustard place pressure on native annuals competing for limited water resources. In addition, exotic annuals quickly exploit disturbed soils, gaining additional advantage over native annuals.

4.6. Plant vegetation in a mosaic design modeled after the spatial design of an existing healthy site with similar abiotic characteristics.

Plantings that are concentrated into clumps will create more productive patches of habitat for nesting birds than plantings uniformly spaced over a large area.

4.7. Connect patches of existing desert habitat.
The connection of habitat patches is an important restoration consideration. Relatively sedentary species, such as (LeConte's and Crissal Thrashers), may be affected most by patch isolation. These birds may disperse more widely and effectively if existing source populations were well connected with unoccupied habitats.

Management Recommendations

Effective management of desert areas is as crucial as habitat restoration to the survival and recovery of desert birds. Proper management increases habitat value to wildlife, arrests species declines, and contributes to the recovery of declining bird populations. Landscape-scale patterns of land use are of critical importance, influencing whether desert bird populations remain stable over the long term.

OBJECTIVE 5

Implement and time land management activities to increase avian reproductive success and enhance populations.

Recommendations

5.1. Prevent and eradicate populations of African Buffelgrass, Red Brome, and Mediterranean grasses spreading throughout the Colorado and Mojave Desert.

Exotic grasses have been shown to alter desert fire regimes, resulting in conversion from native desert thornscrub habitats to annual grasslands. It will be crucial for our management agencies to prevent the spread of these grasses into undisturbed areas of the Colorado and Mojave Desert, to avoid the elimination of fire-sensitive habitats that our desert birds rely upon for survival. In addition, land management agencies must adopt mixes of control strategies (e.g. mechanical, and biochemical) to handle populations of exotic grasses already present in desert habitats.

5.2. Avoid the construction or use of facilities and pastures that attract and provide foraging habitat for Brown-headed Cowbirds.

Management should avoid aggregations of livestock and associated livestock facilities (e.g., corrals, pack stations, salting areas and feedlots) during the breeding season whenever possible. Livestock, livestock facilities and human habitation provide foraging areas for cowbirds (Mathews and Goguen 1997, Tewksbury et al. 1998), who feed in short stature vegetation within "commuting distance" of their laying areas. Desert bird species are poorly adapted to parasitism pressure and introduction of livestock into desert systems greatly increases the amount of desert habitats accessible to cowbirds.

5.3. Manage or influence management at the landscape level.

Landscape scale land use patterns significantly affect the population levels of Brown-headed Cowbirds and avian predators in an area. With increases in cowbird and predator populations, species often suffer poor reproductive success and, possibly, population declines. Eventually, local extirpation of the species may occur. Managers should discourage certain adjacent land uses that subsidize cowbirds and avian predators, including intensive grazing, golf courses, human habitation and recreation areas, and pack stations.

5.4. Limit restoration activities and disturbance events such as grazing, disking, raking, herbicide application, and high-water events to the non-breeding season. When such actions are absolutely necessary during the breeding season, time disturbance to minimize its impacts on nesting birds.

The nesting season is a critical period for the maintenance of bird populations (Martin 1993). Some management activities, such as ground preparation for planting or water impoundment, can have serious consequences for breeding songbirds by destroying nests and nesting habitat or causing nest abandonment. Managers often have a degree of flexibility, allowing them to schedule these activities outside the breeding season while still achieving their management objectives. In general, the breeding season in the Mojave and Sonoran Deserts may begin as early as January and continue through August, depending on region, habitat type and elevation (Table 8-3).

5.5. Coordinate with management and restoration projects targeted at non-avian taxa to maximize the benefits of conservation of desert habitats.

Restoration and management activities such as removal of tamarisk and exotic grasses, feral horse or burro removal, or replanting should be conducted with bird monitoring components to assess outcomes and impacts of the restoration or management on bird populations. Exotic species removal can displace some breeding bird populations (e.g. Lucy's Warblers and Crissal Thrashers) while promoting others. Incorporating bird monitoring programs in these efforts allows managers to gauge and advertise restoration and management successes.

Table 8-3. Dates of earliest egg, latest first egg, peak of egg initiation and timing of breeding season for desert-breeding bird species by study site and bioregion. Derived from nests monitored every four days, all nests for all species combined.

Bioregion and study site	Earliest first egg	Latest first egg	Peak of egg initiation	Breeding Season
Mojave Desert				
Amargosa Canyon	March 5	July 5	n/a	February 15 – July 30
Colorado Desert				
Chemehuevi Wash	February 3	May 23	April 8	January 15 – July 15

OBJECTIVE 6

Protect, enhance or recreate natural desert processes.

Recommendations

6.1. Control and eradicate non-native animal species.

Non-native animals can have a severely negative impact on birds (Table 8-4). Invasive bird species such as European Starlings and House Sparrows often out-compete native birds for nest sites and have been known to destroy active nests and even kill nesting adults. Introduced animals, such as domestic cats, kill millions of birds every year, while feral horses and burros can overgraze habitats crucial for breeding desert birds. To reduce the effects of non-native animals on native birds:

- Avoid establishing human habitat near riparian and dry wash zones.
- Do not feed or otherwise encourage populations of feral animals.
- Keep cats indoors.
- Do not put bird feeders in a yard where a cat might ambush feeding birds.
- Humanely control non-native species when necessary.

6.2 Limit fragmentation of pristine desert environments by controlling off-highway vehicle use through fencing, signing, and lining trails in problem areas with logs, boulders, or debris. One of the greatest threats to desert ecosystem function is the increasing pressure of off-highway vehicle (OHV) use, both legal and illegal, that is widely distributed across the Mojave and Sonoran Deserts. The number of miles of trails created by off-highway vehicles in the Mojave and Sonoran Deserts has increased exponentially in recent decades, causing erosion, spread of exotic plants, increased fire threat, destruction of vegetative cover, and disruption of cryptobiotic crusts which fix nitrogen and enrich soil. Off-highway vehicle users often use illegal trails due to a lack of signs or other obstructions to the use of legal trails. Agencies and non-profits can do much to prevent this fragmentation by actively signing, vertically mulching, and placing materials or debris along legal trails to steer users in the right direction. Furthermore, adequate support for existing California State Park and U.S. Forest Service OHV riding areas may help concentrate OHV's in areas designated for such uses.

Table 8-4. Non-native animal species and their effects in desert habitat.

Introduced Species	Scientific Name	Effects/Bird Species Affected [1]
European Starling	*Sturnus vulgaris*	Evicts cavity-nesting species such as Gila Woodpecker and Gilded Flicker from nest sites (Kerpez and Smith 1990).
Brown-headed Cowbird	*Molothrus ater*	A species native to North America but which would be unable to survive in desert habitats without human subsidization. Can cause nearly complete breeding failure in ill-adapted desert species such as Black-tailed Gnatcatcher and Black-throated Sparrow.
Feral Burro	*Equus asinus*	Severely overgraze slow-growing, xeric riparian canopy species such as palo verde and ironwood, resulting in zero regeneration and unhealthy population structure of xeric riparian woodland. As the majority of desert breeders are strongly associated with these woodland species, burros can negatively impact the entire desert bird community.
Feral Cat	*Felis catus*	Populations flourish in and around urban areas of warm desert climes. Severe negative impacts on several low-nesting desert bird species, and extermination of several lizard species as well.

1 Unless otherwise noted, sources for the information provided in this table came from the species accounts developed as the first step in producing this conservation guide. Visit http://www.prbo.org/calpif/ .

6.3 Improve zoning and draft local ordinances to preserve a clean urban/wild interface in desert habitats. Urban areas in the desert Southwest have some of the most lax zoning regulations in the country – when urban planning strategies exist at all. Edges of urban areas typically expand far beyond actual housing areas due to absence of fencing and/or regulations limiting off-highway vehicle use on public lands adjacent private lands.

6.4 Minimize or eliminate desert livestock grazing whenever possible. Livestock grazing in the Mojave and Sonoran Desert is detrimental for many reasons-- it causes erosion, soil compaction, destruction of cryptobiotic crusts, spread of exotic annuals, and elimination of vegetation. Mojave and Sonoran Desert environments cannot support high numbers of livestock and are easily overgrazed. Agencies have ended grazing leases across much of the Mojave and Sonoran Desert, but high grazing pressures still exist, particularly in areas of Arizona and Sonora.

Monitoring and Research Recommendations

OBJECTIVE 7

Provide data on pressing conservation issues affecting birds.

In order to successfully protect and expand native bird populations, managers must have the most recent data available on populations and their habitat needs. Standardized scientific monitoring of populations will provide decision-makers with these essential tools. Desert land managers in particular lack basic density and trend data for many desert species, including several Desert Plan focal species. Thus Partners in Flight has listed desert monitoring as one of the primary objectives for the Southwest Avifaunal Biome (Rich et al. 2004).

Recommendations

7.1. Consider reproductive success and survival rates when monitoring populations, assessing habitat value, and developing conservation plans.

The number of young produced in a bird population (reproductive success) critically influences a population's presence, health and sustainability in an area. Reproductive success is a primary demographic parameter that provides critical information for understanding patterns of population change. Hence, these data can be used to understand trends, focus conservation action and funds, and identify hypotheses for further evaluation. When fewer than 20% of nestlings survive to fledge young, nest success is considered poor and probably indicates a nonviable population. Nur et al. (2004) and Shaffer (2004) describe feasible analytical techniques for monitoring nest survival as a function of covariates such as environmental and/or temporal variables. These variables may be quantitative (e.g., vegetation measurements, nest height, date, nest age) or qualitative (e.g., habitat type, management practice). However, to adequately measure annual productivity, investigators should not stop at calculating nest success alone (Thompson et al. 2001, Anders and Marshall 2005); instead we should also strive to accurately 1) count re-nesting attempts after nest failure, 2) count number of young fledged per successful nest, 3) measure double brooding frequency by following color-marked birds throughout the breeding season.

Monitoring annual adult survival is important in the same way as discussed for reproductive success; population trends can thus be better understood from monitoring the interaction of these demographic parameters. Survival can only be confidently calculated for adults after at least four years of mark/recapture data (such as mist-netting) have been obtained (Nur et al. 1999). Research seeking to determine productivity for a breeding population should include at least four years of nest-searching and/or mist-netting.

7.2. Conduct intensive, long-term monitoring at selected sites. In order to analyze trends, long-term monitoring should continue for more than five years.

Long-term data are vital to deciphering the difference between a true population decline and a natural fluctuation in population size. The Breeding Bird Survey lacks trend data for ten of fifteen Desert Plan focal species in both Mojave and Sonoran Desert habitats (Sauer et al. 2007). Because conservation dollars are limited, the best possible data on population trends are needed so as not to squander scarce resources on a species that is not truly in decline. Long-term monitoring should be conducted at reference sites that embody the characteristics restoration efforts strive to recreate. Additionally, long-term monitoring at key experimental sites can test the assumptions that currently drive restoration and management practices. Intensive monitoring includes collecting data on primary demographic processes and associated habitat characteristics and seeks to identify causal connections between habitat variables and species viability. Biologists collect data on reproductive success, breeding densities, parasitism, survival, vegetation data, suitable habitat requirements, and general life-history information. Managers can employ these data to make well-informed, adaptable management plans.

In addition, due to great fluctuation in annual precipitation (on both regional and local levels) and differential response to precipitation between breeding species and migrant species (McCreedy *in prep*), it is critical to obtain several consecutive years of demographic data in the Mojave and Sonoran Deserts. Without multiple years of data, collected in the context of annual precipitation (winter and spring precipitation, in particular), by-site and by-treatment comparisons can be confounded by dramatic swings in population abundance, diversity, and productivity.

7.3. Develop a series of monitoring and research projects that:

1) Determine the habitat attributes that affect migratory stopover use.
2) Assess how migratory stopover habitat may affect species survival.
3) Define conservation priorities and recommendations for stopover habitat.

While vital as breeding grounds, desert wash corridors also provide essential stopover habitat for migrating birds. However, little information exists regarding which habitat factors attract and affect migrants. Events at migratory stopover areas may significantly affect certain populations and contribute to declines (Moore et al. 1995, Yong et al. 1998). Monitoring programs should attempt to cover a broad geographic scope and seek to collect data on a wide variety of variables, including avian diversity, abundance, stopover duration, fat deposition/physical condition, and vegetation characteristics.

7.4. Develop monitoring programs with replicates spread over a wide area:

Due to the ephemeral nature of desert breeding bird populations, patchy breeding distributions, and widely variable precipitation patterns, it is crucial to design desert monitoring programs that cover study areas large enough to assess annual geographic shifts in breeding populations that relate to patchy seasonal rainfall. Black-throated Sparrows, Bendire's Thrashers, Northern Mockingbirds, and Phainopeplas are all highly vagile species that will temporally inhabit or abandon study sites in response to favorable or harsh breeding conditions. Monitoring programs that are too small in geographic scope or duration may incorrectly assess desert population trends as site-based and not climate-based. Thus desert monitoring programs should not only be wide in geographic scope, but should be linked to other ongoing monitoring efforts to correctly read population shifts in vagile desert species.

7.5. Conduct selective monitoring at critical sites to determine the effects of cowbird parasitism on Black-tailed Gnatcatchers, Black-throated Sparrows, and Lucy's Warblers.

Brown-headed Cowbird parasitism has potentially devastating effects on the populations of these and many other species. Over a forty-year period (1966-2007) the BBS has found Black-throated Sparrow populations to be in significant decline (-3.0% annual decline, p=0.00), along with Black-tailed Gnatcatchers (-2.7% annual decline, p=0.11) and Lucy's Warblers (-0.5% annual decline, p=0.37). Habitat size, vegetation structure, and adjacent land use all influence the rates of cowbird parasitism. By studying the variables involved, conservationists can better formulate landscape-level management plans to enhance bird populations.

7.6. Conduct selective monitoring at key sites to determine the factors influencing nest success of the Bendire's Thrasher, Crissal Thrasher, LeConte's Thrasher, Gila Woodpecker, Burrowing Owl, Elf Owl, and Cactus Ferruginous Pygmy-Owl.

Relatively recent, local extirpation and declines of these and other western species from their historical breeding ranges appear to be caused by low productivity (Latta et al. 1999, Laudenslayer et al. 1992, Rosenberg et al. 1991). Local extirpation may signal the early stages of a process of severe population decline. By determining the factors associated with low reproductive success, research may identify which management and restoration actions will help reverse these population declines. Land managers, owners and regulatory agencies gain greater freedom in their decision-making if they conserve bird species before special-status listing becomes necessary. Monitoring the reproductive success of key species provides gauges that allow management changes before it is too late.

7.7. Encourage citizen-science monitoring efforts that increase coverage of desert habitats to better handle vagile desert bird species.

7.8. Employ radar to monitor migration.

Utilizing radar at select migration sites (e.g. Salton Sea, Lower Colorado River Valley) will provide information on migration timing, flyway locations, and critical stopover areas.

7.9. Institute fall migration monitoring at high elevations.

Little is known on fall migration patterns through Mojave and Sonoran Desert habitats, though it is known that significant numbers of Neotropical migrants depend on high-elevation meadow habitats in the Sierra Nevada. Autumn mist-netting and surveys at high elevation "sky island" habitats will shed light on the importance of desert montane habitats during fall migration, which may be particularly important in the survival of first-year migrant birds.

OBJECTIVE 8

Maximize the effectiveness of ongoing monitoring and management efforts.

Recommendations

8.1. Increase communication and coordination between land managers and specialists hired to implement specific projects or conduct monitoring.

Experts, such as those conducting endangered species or biodiversity inventories, should be consulted and included as part of project implementation teams. By doing so, managers can quickly and easily access a wealth of detailed information on local birds and their response to management activities.

8.2. Use standardized monitoring protocols.

By standardizing monitoring techniques, researchers ensure that results can be compared across space and time. It is especially imperative to standardize monitoring protocols in desert habitats to ensure proper coverage of vagile desert species. The USDA Forest Service has published guidelines for standardized monitoring techniques for monitoring birds (Ralph et al. 1993).

8.3. Maximize the cost effectiveness and value of existing specialized monitoring programs for listed species (e.g., those oriented toward Southwestern Willow Flycatchers, Least Bell's Vireos, Western Yellow-billed Cuckoos, Elf Owls, and Cactus Ferruginous Pygmy-Owls) by collecting standardized data on multiple species (such as point counts) in addition to any specialized protocols aimed at one species.

Many state and federally-sponsored surveys only monitor special-status species. By adding a standard protocol that provides information on multiple species while conducting special-status species surveys, researchers will rapidly expand their knowledge of California's birds. Such data could be shared and analyzed and results would be added to conservation plans and incorporated into management regimes. Even if resources are not immediately available for analysis, the information will provide a baseline or historical perspective on bird distribution and abundance.

8.4. Coordinate with monitoring and research projects targeted at non-avian taxa to maximize the benefits of the protection, management and restoration of desert habitats.

Significant effort is placed on monitoring populations of Desert Tortoises, and numerous opportunities exist in coordinating study sites and surveys with tortoise surveys and other desert taxa such as plants, bats, and lizards. Due to logistical difficulties in assessing hard-to-reach and often remote desert surveys, integrating bird monitoring with monitoring of other taxa will save agencies and researchers significant funds due to costs of scale.

OBJECTIVE 9

Expand research and monitoring of selected special-status species to address pressing conservation issues.

Recommendations

9.1. Identify and implement research relevant to management of Gila Woodpeckers, Elf Owls, LeConte's, Crissal, and Bendire's Thrashers, and Lucy's Warblers, whose population trends are declining or are of unknown status in California.

9.2. Identify winter range, habitat, and possible over-wintering conservation issues for as many Neotropical migrants as possible, including Lucy's Warblers, Phainopeplas, Sage Sparrows, Brewer's Sparrows, Green-tailed Towhees, Sage Thrashers, and Bendire's Thrashers.

Wintering grounds play a significant role in the life cycles of Neotropical migratory birds. If a population is declining primarily due to low over-winter survival, no amount of effort to restore or protect breeding grounds will suffice to conserve the species. Additionally, recent research implies that declines in habitat quality on wintering or migratory stopover grounds may lead to lower productivity on breeding grounds (Marra 1998).

For many species, including Mojave and Sonoran Desert breeding species (e.g. Phainopepla and Lucy's Warblers), and several Great Basin Desert breeding species that utilize Sonoran Deserts in the winter, little information is available on over-wintering habitat requirements.

Policy Recommendations

Conservation efforts will make little headway without effective policy development. The future of habitat conservation in the West lies not only in the activity of scientists and restoration experts in the field, but also within the walls of statehouses and the pages of law. Policy makers need to examine and appropriately amend statutory and regulatory programs that endanger native habitats or that unnecessarily impede restoration actions. Whenever possible, policy should encourage governmental support of innovative local conservation and sustainable-growth projects.

To achieve conservation and management goals, diverse interests must effectively combine their skills and financial resources. Partners in Flight embodies this kind of cooperative effort. In these groups, scientists, governmental agencies, nonprofit organizations and private citizens share information and concerns and collaborate on solutions. The biological recommendations in this Conservation Plan are readily available to policy-makers, public land managers and private landowners. Furthermore, the findings described here will be relevant to the Partners in Flight North American Landbird Conservation Plan, enhancing conservation efforts throughout the country.

Funding from the National Fish and Wildlife Foundation, derived from the Neotropical Migratory Bird Conservation Initiative, and the USDA Forest Service Partners in Flight awards continue to catalyze conservation activity across the country. Government agencies participating in CalPIF intend to use this Conservation Plan to guide their desert conservation projects. These agencies include the California Wildlife

Conservation Board, the California Department of Fish and Game, the U.S. Fish & Wildlife Service, and the Bureau of Land Management.

The following recommendations seek to assist policy advocates and decision-makers as they shape the regulations and procedures that affect avian conservation in the West.

OBJECTIVE 10

Encourage regulatory and land management agencies to recognize that avian productivity is a prime criterion for determining protected status of specific habitats, mitigation requirements for environmental impacts, and preferred land management practices.

Recommendations

10.1. Land managers should consider avian population parameters, such as reproductive success, as important criteria when designating priority or special-status sites, such as Areas of Critical Environmental Concern (BLM), Research Natural Areas (BLM, USFS) and other publicly owned areas specially managed for biodiversity.

Until recently, few data regarding avian reproductive success at many important riparian sites have been available. Similar data for non-riparian desert sites are generally not available. Government land managers should consider reproductive success data when designating and managing areas in support of biodiversity, including state wildlife areas and ecological reserves. This information complements ongoing efforts by agencies to evaluate and restore riparian areas, such as efforts by the BLM, USFS, and NRCS to assess proper functioning condition of riparian areas on public lands throughout the West.

10.2. When developing management practices for natural areas, government agencies, such as the USFWS and CDFG, should consider environmental impacts on local bird populations. Such evaluations should also occur when developing plans for habitat mitigation, habitat conservation, multi-species conservation, and natural community conservation.

The California Department of Fish & Game estimates that more than 89 habitat conservation plans, natural community conservation plans, and resource management plans were ongoing in California in 1998. Of these, 33 addressed the needs of one or more bird species. Additionally, the U.S. Fish & Wildlife Service constantly makes decisions regarding mitigation requirements for private and federally sponsored projects that affect the habitats of threatened or endangered species. By incorporating the conservation, restoration, management and monitoring recommendations of this Conservation Plan into their regulatory plans, agencies can implement the most effective conservation actions.

10.3. Incorporate the costs of limited-term (two–five years) or long-term bird monitoring into management endowments prescribed for conservation projects, including mitigation banks, habitat conservation plans and natural community conservation reserves.

The size of management endowments for preserves in Southern California, for example, varies substantially with management needs and staffing levels. In 1998, they varied from $70,000 at Dos Palmas (covering coordination meetings and management support to the BLM) to $2.5-$3 million at the Coachella Preserve (providing for 1.5 to 2 staff positions, buildings, vehicles, management activities and monitoring). Most endowments for unstaffed preserves are less than $1 million (usually less than $500,000). Most endowments for staffed preserves are greater than $2 million, depending upon the level of management, staffing, and partnerships at the site. Endowments of up to $510 million are common for sites requiring several staff, building maintenance, and active management, and that lack partners with whom to share costs.

Incorporating the long-term cost of bird monitoring into the management endowments of large-scale reserves is an efficient way to ensure that monitoring occurs. In 2000, a monitoring program costing $35,000 per year could provide extensive data from point count routes, mist-netting and two nest monitoring plots (see Appendix C for more information regarding methods). Using progressive investment strategies and a 5% capitalization rate, an endowment of approximately $700,000 would support this level of monitoring. Under these assumptions, one can calculate the cost for endowing monitoring at a site. A good rule of thumb is to add $150,000 to an endowment for every additional $7,500.00/year cost added to the long-term management (i.e., take the additional annual cost, e.g., $7,500, and divide by 5%) (Teresa, pers. comm. 1998).

OBJECTIVE 11

Increase protection and management actions to benefit severely declining or locally extirpated bird species in California.

Recommendations

11.1 Promote awareness, restoration and recovery of desert riparian gallery forest and mesquite woodlands.

California State Endangered Bell's Vireos, Gila Woodpeckers and Elf Owls populations once common in riparian forest and mesquite woodland transitions of the Lower Colorado River Valley have declined precipitously during the twentieth century. It is likely that Elf Owls have become extirpated from California (Rosenberg et al. 1991). The loss of these habitats has also factored in the demise of the federally-endangered Southwestern Willow Flycatcher, and has encouraged declines in other Desert Plan focal species such as Phainopepla, Lucy's Warbler, and Crissal Thrasher. These productive habitats are prime locations for urban development, conversion to agriculture, and large-scale water impoundments. Due to severely altered hydrology, these sites have largely converted to non-native tamarisk that, while beneficial to some species, is inhospitable to several others. In some cases on the Colorado River, habitat alteration is so complete that the local public often does not know what has been lost. Without appreciation for these diminishing habitat types, policy makers will not have the political will to further conserve these habitats.

OBJECTIVE 12

Foster policy initiatives that unite various land-use interests and extol the value of desert habitats.

12.1 Develop political partnerships to diffuse land-use differences.

While difficult, political leaders must find a way to unite land-use interests in the desert. Off-highway vehicle use will continue to increase in desert habitats, and even low-level use may have insidious effects, significantly altering fragile desert ecosystems into critical situations. Expensive policy disputes and legal action has resulted in the battle to preserve endangered endemic species of the Algodones Dunes in Imperial County, CA in the face of heavy recreation use of dune habitats. Intensive efforts at developing political partnerships, through mechanisms such as the California State Parks Off-Highway Motor Vehicle Recreation Commission, can help keep declining desert species from becoming threatened or endangered, saving time and resources for all parties.

Chapter 9. Implementation of Conservation Plan Recommendations

The implementation of the Desert Bird Conservation Plan is in development. It will be used to engage with local, bioregional conservation efforts and to better define bioregional priorities for acquisition, restoration, and conservation-focused efforts. Ideally, the implementation process would eventually include a series of local workshops to:

- Familiarize local organizations with the Conservation Plan and the Implementation Plan.
- Identify local initiatives, projects, and organizations capable of working as local partners to achieve habitat, restoration, and population targets.
- Develop conservation and restoration acreage objectives based on inventory, assessment and biological need.

The North American Bird Conservation Initiative

In 1998, participants at a meeting of the International Association of Fish and Wildlife Agencies developed a vision to link all of the major bird conservation initiatives in Canada, the U.S. and Mexico (CEC 1998). The participants represented each of the four major bird conservation initiatives already underway on the continent: The North American Waterfowl Management Plan (the oldest and most successful of bird conservation initiatives), Partners in Flight, the U.S. Shorebird Conservation Plan, and the Colonial Waterbird Conservation Plan. This new overarching program, known as the North American Bird Conservation Initiative (NABCI), seeks to synthesize the efforts of all these groups by creating "regionally based, biologically driven, landscape-oriented partnerships delivering the full spectrum of bird conservation across the entirety of the North American continent, including simultaneous, on-the-ground delivery of conservation for both game and nongame birds." See www.nabci.org for more information.

State, provincial, federal and non-governmental representatives from Canada, Mexico, and the U.S. adopted an ecological framework that facilitates coordinated conservation planning, implementation, and evaluation among major bird initiatives. These Bird Conservation Regions (BCRs) were defined by adopting the hierarchical framework of nested ecological units delineated by the Commission for Environmental Cooperation (CEC). Existing joint ventures as formed under the North American Waterfowl Management Plan (NAWMP) are recognized as important vehicles for local and regional delivery of bird conservation goals. Joint venture focus areas do not always correspond with BCR boundaries, but joint ventures are coordinating with the BCRs encompassed within their boundaries. Many joint ventures in North America have moved beyond waterfowl-only conservation and embrace the concept of "all-bird" conservation.

California is encompassed within five BCRs: the Northwestern Pacific Rainforest region, the Sierra Nevada region, the Coastal California region (which includes the Central Valley), the Great Basin region, and the Sonoran and Mohave Deserts region (see http://www.nabci-us.org/map.html for BCR boundaries). The state currently hosts five Joint Ventures: the Central Valley Habitat Joint Venture, the San Francisco Bay Joint Venture, and the Riparian Habitat Joint Venture (all located entirely within the state), and the Intermountain West Joint Venture and the Pacific Coast Joint Venture (both located partially within the state). Future bird conservation in priority habitats of California will be achieved by encouraging adoption of the all-bird conservation concept within existing joint ventures of the North American Waterfowl Management Plan and/or by expansion of the Riparian Habitat Joint Venture to include other habitat types.

Photo by Eric Preston, ericpreston.com

Joint Ventures, originally created to protect North America's waterfowl like this Ring-necked Duck, are now embracing the conservation of all birds.

The following is only a partial list of programs and agencies with which CalPIF intends to interface in implementing this plan:

Non-governmental Organizations:
California Native Grass Association
California Native Plant Society
California Cattleman's Association
PRBO Conservation Science
Wildlife Conservation Society
National Audubon Society
National Fish and Wildlife Foundation
The Nature Conservancy

University Organizations:
University of California Cooperative Extension
(UC-Berkeley, UC-Davis, UC-Riverside)

State of California Organizations:
California Department of Fish and Game
California Department of Forestry and Fire Protection
California Department of Parks and Recreation
Resource Conservation Districts
Wildlife Conservation Board

Federal Organizations:
USDA Forest Service
US Fish and Wildlife Service
Bureau of Land Management
Natural Resource Conservation Service
Bureau of Reclamation
US Geological Survey - Biological Resource Div.

Private Organizations:
Certified Rangeland Managers

Chapter 10. Outreach and Education

Outreach and education are critical components of any effort to conserve desert birds and habitats. This chapter targets scientists, managers, communicators, and others seeking ideas for communicating desert bird conservation needs and actions to a variety of audiences. We hope that scientists, managers, and outreach practitioners from conservation groups, government agencies, Joint Ventures, nature centers, Audubon chapters, and private lands programs will reference this plan, and especially the tables within this chapter. This information will help guide the development and delivery of outreach and education programs that reflect the needs outlined in the Desert Bird Conservation Plan. As new programs and products are developed, they will be made available through future versions of the Plan and online through the CPIF resource directory at www.prbo.org/cpif.

The five key conservation threats for desert birds, as identified in this plan, are habitat loss and degradation, off highway vehicle use, and livestock grazing. For the purposes of communication, we have broken the broad category of habitat loss and degradation into three categories: urbanization, habitat fragmentation, and exotic/invasive vegetation. Using these threats to guide our education and outreach programs will ensure our programs address the needs of desert birds. Many times outreach and education programs miss the opportunity to directly contribute to bird conservation efforts at various levels. Outreach and education programs can address these threats by changing people's attitudes, behavior, and perceptions and increasing knowledge about desert bird conservation issues. Information in this chapter will help you tailor existing or new bird education and outreach programs to support desert bird conservation needs. It will also help you create outreach and education programs and products that directly support regional conservation objectives, making your program part of a larger effort to protect birds and bird habitat.

Chapter Highlights:

- ***A series of tables summarizing the five key conservation threats for desert birds and corresponding key concepts and target audiences.***
- ***A list of general concepts every person should understand for desert bird conservation.***
- ***A resource table listing existing groups and resources that promote desert conservation.***
- ***Guidelines for creating effective, targeted outreach and education messages for target audiences.***

Conservation Threat and Key Concept Tables

The following five tables present a summary of the primary threats to desert bird and desert ecosystem conservation. They key concepts provide the background needed to understand the core issues for desert birds. Further detail is contained in Chapter four.

Conservation Threat: Habitat fragmentation through suburban development, habitat conversion, catastrophic fire, or other means.
Key Concepts
In order to survive, birds require different sizes of territories that need to be intact and free from fragmentation.
Habitat fragmentation can lead to increased predation and nest parasitism.
Suburban/urban areas can provide important native habitat for migratory and resident birds.
Agriculture practices such as planting hedge rows and no-till agriculture can provide important habitat for migratory and resident birds.
Networks of green spaces within communities, towns, cities, etc. may help connect habitat patches.
Native plants require less water and are more tolerant of fire.
Native desert plants can be incorporated into landscaping for all new developments.
Altered fire cycles in desert scrub habitats from the introduction of non-native bufflegrass threaten habitat for Costa's Hummingbird.
Audiences to target:
Agencies
Agricultural producers
City planners
Farmers
Future Farmers of America, 4-H-type groups
Media

Conservation Threat: Off Highway Vehicle Use
Key Concepts
OHV use in the Sonoran Desert region is particularly destructive to **xeric riparian woodland habitat**.
Xeric riparian woodland accounts for only 5% of the area of the Lower Colorado River Valley section of the Sonoran Desert, yet it hosts 90% of its birds.
Xeric riparian habitats contain the highest breeding songbird diversity and abundance of any desert habitat except desert riparian. They are also critical stopover points during spring migration for songbirds to refuel.
OHV use may result in the abandonment and failure of songbird nests because vehicles deter birds from nesting.
OHV use degrades habitat through soil compaction, erosion, fragmentation by roads, spread of exotic vegetation, and direct disturbance to nesting birds.
OHV use conducted prior to March 1st has less of an effect on nesting desert birds because it is prior to the nesting season.
OHV use should be confined to designated areas only.
Closing certain areas to OHV use during the bird nesting season (March through mid-June) will help desert songbirds produce young, essential to maintaining healthy desert bird populations.
Audiences to target:
Agencies
Conservation Organizations
Legislatures
Media
OHV groups
Sonoran Joint Venture Partners

Conservation Threat: Urbanization
Key Concepts
Urban vegetation is tree and lawn dominated while natural desert vegetation is dominated by shrubs and forbs.
Desert birds nest largely in low growing shrubby vegetation, not trees and mowed areas.
Urbanization replaces desert scrubland communities, reducing foraging and nesting habitat for birds.
Urbanization results in increased predation to birds nesting in or near urban areas (e.g., cats, rats, raccoons, etc.)
Urbanization results in increased disturbance from human activities such as vegetation clearing, mowing, pets, roads, etc.
Gila Woodpeckers are threatened by habitat loss from development.
Gambel's Quail, Greater Roadrunner, and Black-throated Sparrows nest on the ground and are especially vulnerable to urban predation and human disturbance.
In areas where urban or agricultural development is imminent, working with developers to retain native Sonoran vegetation patches of greater than 1-ha, especially along washes and arroyos, is critical. These patches must be interspersed throughout the urban or agricultural matrix at a distance of less than 0.5 kilometers.
Audiences to target:
Developers
Land use planners
Landscaping companies and groups
Neighborhood associations
Urban residents

Conservation Threat: Domestic and Feral Livestock Grazing
Key Concepts
Grazing by feral burros significantly reduces palo verde and other understory vegetation in desert washes and decreases nesting habitat for desert birds.
Unsustainable cattle grazing practices have a wide range of negative impacts on desert ecosystems, including increased erosion, decreased water retention/infiltration, increase in exotic species, woody shrub encroachment, changes in fire regimes, and soil impaction.
Audiences to target:
Agencies
Future Farmers of America, 4-H- groups
Legislators
Media
Private Landowners: Farmers /Ranchers

Conservation Threat: Exotic Vegetation
Key Concepts
Exotic vegetation compromises the value of desert habitat for birds.
Disturbed soils without intact soil crusts are vulnerable to exotic plants.
Altered hydrological regimes facilitate the establishment of salt cedar and other invasive riparian species.
Invasive plants have been introduced as a byproduct of agriculture and recreation.
Invasive grasses, such as red brome and buffelgrass, increase fire by filling open spaces in desert scrub habitat and providing a vector for the spread of fire.
Desert birds cannot survive as well in an introduced plant community because it does not provide the same nutrition, host sites for insects, or nest sites.
Introduced plants spread quickly, reducing the diversity of vegetation and wildlife that inhabit the area.
Native desert ecosystems can be restored on public and private lands and there are existing programs, incentives, and resources available.
Native plants require less water and are more tolerant to fire than exotic plants.
Audiences to target:
Agencies
Conservation Organizations
Landscaping companies and groups
Land use planners
Private landowners
Recreation groups
School groups

These additional key concepts apply to desert bird conservation regardless of a particular threat.

Key Concepts for Desert Bird Conservation
Programs that communicate these general concepts about desert bird ecology will help to improve the knowledge and perception of a variety of audiences.
Desert birds and their habitats are unique, fascinating and inspiring to people.
Desert birds indicate a healthy desert ecosystem that provides ecosystem services such as water storage, water filtration, erosion control, and refugia during droughts.
Avoid conducting vegetation clearing activities during February - August, the bird nesting season of desert birds.
Eliminate outdoor sources of food (open compost piles, pet food, etc.) that might attract nest predators. Keep cats indoors. Pursue neighborhood ordinances calling for cats as indoor pets. Never feed feral cats.
People can give birds the food and shelter they need to survive by landscaping with native plants. Use native desert plants in landscaping for new developments. Native desert plants are drought tolerant and low maintenance.
Rare and threatened birds that live in natural desert habitat include the Burrowing Owl, Gila Woodpecker, Bendire's, Crissal, and LeConte's Thrasher, and Lucy's Warbler. See http://www.prbo.org/calpif/htmldocs/desert.htm for species profiles on all of the desert focal species.
Desert birds depend largely on shrub and forb dominated vegetation (scrubland).

Key Concepts for Desert Bird Conservation
A healthy native desert plant community supports many common and rare birds.
Different bird species place their nests in different locations, from directly on the ground to the tops of trees.
The breeding season is a vital period in birds' lives. Birds nest during the spring and early summer of each year, from February-August in the desert.
Natural predator-prey relationships are balanced, but human disturbance creates an imbalanced system.
Natural processes, such as flood and fire, are integral to a healthy ecosystem**.** They provide the natural disturbance needed in an area to keep the vegetative diversity high, an important factor for birds.
Reproductive success may be the most important factor influencing bird population health. If birds cannot reproduce the population will not sustain itself.

Designing Education and Outreach Programs

Guidelines for creating effective, targeted outreach and education messages for target audiences, adapted from: *Jacobsen et al, 2006 Conservation Education and Outreach Techniques. Oxford University Press Inc. New York.*

Answering these questions will help you plan an outreach program or tool that is truly effective.

Planning-
1. What is the conservation problem or issue being addressed?
2. What is the goal and objectives of the program/product/website?
3. Who is your targeted audience(s)?
4. What are the backgrounds, needs, interests, and knowledge level of the intended audience?
5. For each audience, what are the desired actions, changes, knowledge gains, etc.?
6. What are the key messages for each audience?
7. What communication tool(s) will best serve your audiences?

Implementation- Pilot and Final product
1. What subset of your target audience will be your pilot group?
2. What modifications are indicated by the results of pilot tests of programs/products/websites?
3. Is scheduling, funding, and staffing adequate to complete the final product?

Evaluation
1. How will you know if you met your goal and completed desired actions?
   - Choose one or more evaluation tools: feedback forms, surveys, interviews, observations, etc.

Example Communication Tools

(modified from Jacobsen et al, 2006)

Below is a list of commonly used education and outreach tools with some tips for maximizing their use:

Communication Tool/Program	Notes
Sign, poster, billboard	Raise awareness of an issue. Keep message short.
Brochures/Fact Sheets	Raise awareness, convey a needed action. Keep simple, catchy titles, pictures, color. Write for 8th grade level.
Web Pages	A good place to post resources, more information, or copies of brochures/fact sheets.
Press Release	Include Who, What, Where, When, Why
Press Interview	Present an issue to a large audience, provide reporter with background information as well as short sound bites
Letters to the Editor/Opinion Piece	Read by many people, good for presenting controversial issues. Keep short.
Advertisement	Raise awareness of an issue, provide testimonials. Can reach a large number of people.
Presentation	Raise awareness of an issue; good for reaching an existing group of people, especially if they meet regularly. Can be delivered by others.
Newsletter Articles	Raise awareness of an issue; convey a specific message. Articles in partner or audience group newsletters can be an effective way to reach a target audience.
Field Program/Bird Walk	Get people interacting with nature; excellent for building appreciation for birds and their habitats.
School Program	Increase knowledge of students; can also be an indirect way to reach parents in a community.
Festival/Community Event	Gets people out doing things, especially good for families. Can involve other conservation partners.

Existing Resources for Desert Bird Conservation Education and Outreach

Conservation Issue	Existing Resources
Urbanization	• American Bird Conservancy Cat's Indoors campaign materials www.abcbirds.org
Off Highway Vehicle Use/Recreation	• Poster on effects of OHV use on bird populations www.prbo.org/desertbirds • Arizona Game and Fish website for wildlife friendly tips for OHV use: http://www.azgfd.gov/outdoor_recreation/ohv_habitat_areas.shtml
Exotic/Invasive Species	• Arizona-Sonora Desert Museum *INVADERS* program (http://www.desertmuseum.org/invaders/) • Arizona Native Plant Society (http://www.aznps.org/invasives.html) • USGS/UA Desert Laboratory Buffelgrass Eradication and Outreach (http://wwwpaztcn.wr.usgs.gov/buffelgrass/) • Arizona Invasive Species Advisory Council (http://azgovernor.gov/AIS/) • Arizona Native Plant Society (http://aznps.org/invasives.html) • Buffelgrass Action Center (http://www.buffelgrass.org/) • California Native Plant Society (http://www.cnpssd.org/) • Center for Invasive Plant Management (http://www.weedcenter.org/) • Grow Native (http://aznps.org/invasives/GrowNative/invasives.html) • National Park Service Weeds Gone Wild (http://www.nps.gov/plants/alien/factmain.htm) • Sonoran Desert Weedwackers (http://aznps.org/invasives/weedwackers.html) • The Invasive Species Initiative (http://tncweeds.ucdavis.edu/methods.html) • USDA Invasive Species Initiative (http://www.invasivespeciesinfo.gov/) • U.S. Fish and Wildlife Service Invasive Species (http://www.fws.gov/invasives/)

Conservation Issue	Existing Resources
Exotic/Invasive Species (continued)	• USFWS National Wildlife Refuge: Volunteers and Invasive Plants (http://www.fws.gov/invasives/volunteersTrainingModule/index.html) • Sonoran Institute and Environmental Education Exchange have a bilingual (Spanish/English) book about exotic and invasive plants suitable for landowners, agencies, ranchers, land use planners, and developers. • The Master Watershed Steward program educates and trains citizens across the state of Arizona to serve as volunteers in the protection, restoration, monitoring, and conservation of their water and watersheds. (http://cals.arizona.edu/watershedsteward/)
Domestic and Feral Livestock Grazing	• Arizona Ranchers' Management Guide (http://cals.arizona.edu/AREC/pubs/rmg/ranchers.html • An Introduction to Erosion Control, by Bill Zeedyk and Jan-Willem Jansens (http://quiviracoalition.org/images/pdfs/73-Erosion_Control_Field_Guide.pdf) • An Introduction to Induced Meandering, by Bill Zeedyk (http://quiviracoalition.org/images/pdfs/75-Induced_Meandering_Field_Guide.pdf) • Rangeland Health and Planned Grazing, by Kirk Gadzia and Nathan Sayre (http://quiviracoalition.org/images/pdfs/77-Planned_Grazing_Field_Guide.pdf) • The Quivira Coalition (http://quiviracoalition.org) • The New Ranch Network (http://newranch.net/) • New Ranch Network Small Grants program (http://newranch.net/NRN_Small_Grants/index.html)
Habitat fragmentation and connectivity	• Science and Collaboration for connected Wildlands http://www.scwildlands.org
Groups/Programs that promote Desert Conservation	Sonoran Joint Venture www.sonoranjv.org Anza-Borrego Natural History http://www.abdnha.org/02bookstore_main.html Tuscon Audubon Society http://www.tucsonaudubon.org/education/index.htm CREEC RIM area: http://creec.edgateway.net/cs/creec9ap/query/q/3 (region 9a and 10) Bureau of Land Management Nevada – Environmental Education (http://www.blm.gov/nv/st/en/fo/lvfo/blm_programs/blm_special_areas/red_rock_nca/environmental_education0.html)

Conservation Issue	Existing Resources
Private land Incentive Programs:	• The Farm Security and Rural Investment Act of 2002 (Farm Bill) is landmark legislation for conservation funding and for focusing on environmental issues. The conservation provisions help farmers and ranchers meet environmental challenges on their land. This legislation simplifies existing programs and creates new programs to address high priority environmental and production goals. The 2002 Farm Bill enhances the long-term quality of our environment and conservation of our natural resources. • The Conservation Reserve Program reduces soil erosion, protects the Nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filterstrips, or riparian buffers.

Photo by Laura Hughes

Ash-throated Flycatcher, a desert focal species

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Appendix A. Acronyms and Abbreviations

BBS:	Breeding Bird Survey
BLM:	U.S. Bureau of Land Management
Conservation Plan:	The California Partners in Flight Riparian Bird Conservation Plan
CalPIF:	California Partners in Flight
CDFG:	California Department of Fish and Game
GIS:	Geographic Information Systems
km:	kilometers
m:	meters
NRCS:	Natural Resource Conservation Service
PIF:	Partners in Flight
PRBO:	Point Reyes Bird Observatory
USFS:	U.S. Forest Service
USFWS:	U.S. Fish and Wildlife Service
USGS:	U.S. Geological Service
WHR:	Wildlife Habitat Relationships

Appendix B. Scientific and Common Names

Plants

Common Name	***Latin Name***
Acacia	*Acacia* spp
African buffelgrass	*Pennisetum ciliare*
Alkali goldenbush	*Isocoma acradenia*
Alkali rubber rabbitbrush	*Ericameria nauseosa*
Alkali sacaton	*Sporobolus airoides*
Allscale	*Atriplex polycarpa*
Anderson wolfberry	*Lycium andersonii*
Arrowweed	*Pluchea sericea*
Barrel cactus	*Ferocactus* spp
Beavertail cactus	*Opuntia basilaris*
Big galleta	*Pleuraphis rigida*
Big saltbush	*Atriplex lentiformis*
Blackbrush	*Coleogyne ramosissima*
Black greasewood	*Sarcobatus vermiculatus*
Bladdersage	*Salazaria mexicana*
Blue palo verde	*Parkinsonia florida*
Buckthorn	*Frangula* spp.
Bud sagebrush	*Picrothamnus desertorum*
Burrobush	*Ambrosia dumosa*
California buckwheat	*Eriogonum fasciculatum*
California juniper	*Juniperus californica*
Catclaw acacia	*Acacia greggii*
Cheesebush	*Hymenoclea salsola*
Cooper's goldenbush	*Ericameria cooperi*
Cooper's wolfberry	*Lycium cooperi*

Common Name	***Latin Name***
Cottontop cactus	*Echinocactus polycephalus*
Creosote bush	*Larrea tridentata*
Crucillo	*Randia rhagocarpa*
Desert agave	*Agave deserti*
Desert broom	*Baccharis sarothroides*
Desert globemallow	*Sphaeralcea ambigua*
Desert-holly	*Atriplex hymenelytra*
Desert lavender	*Hyptis emoryi*
Desert needle-grass	*Achnatherum speciosum*
Desert senna	*Senna armata*
Desert-willow	*Chilopsis linearis*
Fishhook cactus	*Sclerocactus* spp.
Foothills palo verde	*Parkinonia microphyllua*
Fourwing saltbush	*Atriplex canescens*
Fremont dalea	*Psorothamnus fremontii*
Goldenbush	*Ericameria* spp
Grizzlybear pricklypear	*Opuntia erinacea*
Red brome	*Bromus rubens*
Hedgehog barrel cactus	*Echinocactus* spp.
Hedgehog cactus	*Echinocactus* spp.
Honey mesquite	*Prosopis glandulosa*
Iodine bush	*Allenrolfea occidentalis*
Ironwood	*Olneya tesota*
Jojoba	*Simmondsia chinensis*
Joshua trees	*Yucca brevifolia*
Kochia	*Kochia* spp.
Littleleaf krameria	*Krameria* spp.
Longspine horsebrush	*Tetradymia axillaris*
Mediterranean grasses	*Schismus* spp.
Mesquite	*Prosopis* spp
Mojave yucca	*Yucca schidigera*
Nevada ephedra	*Ephedra nevadensis*
Nolina	*Nolina* spp.
Nuttall's saltbush	*Atriplex nuttallii*
Ocotillo	*Fouquieria splendens*
Organ pipe cactus	*Stenocereus thurberi*
Palmer's coldenia	*Tiquilia palmeri*
Palo verde	*Parkinsonia* spp.
Parry's saltbush	*Atriplex parryi*
Pencil cholla	*Opuntia arbuscula*
Pickleweed	*Salicornia* spp.
Rabbitbrush	*Chrysothamnus* spp.
Rabbit-thorn	*Lycium pallidum*
Red-spined sclerocactus	*Sclerocactus polyancistrus*
Saguaro	*Carnegia gigantean*
Sahara mustard	*Brassica tournefortii*
Saltcedar	*Tamarix* spp.
Saltgrass	*Distichlis spicata*
Sand verbena	*Abronia* spp.
Screwbean mesquite	*Prosopis pubescens*

Common Name	***Latin Name***
Seablite	*Suaeda esteroa*
Shadscale	*Atriplex confertifolia*
Singleleaf pinyon	*Pinus minophylla*
Smoketree	*Psorothamnus spinosus*
Snakeweed	*Gutierrezia* spp.
Spanish bayonet	*Yucca harrimaniea*
Spinescale	*Atriplex spinifera*
Spiny hopsage	*Grayia spinosa*
Spiny menodora	*Menodora spinescens*
Squawthorn	*Lycium torreyi*
Staghorn cholla	*Opuntia acanthocarpa*
Teddy-bear cholla	*Opuntia bigelovii*
Thurber sandpaper-plant	*Petalonyx thurberi*
Torrey's saltbush	*Atriplex torreyi*
Utah juniper	*Juniperus osteosperma*
White brittlebush	*Encelia farinosa*
White bursage	*Ambrosia dumosa*
Wiggins croton	*Croton wigginsii*
Winterfat	*Ceratoides arborescens*
Wire-lettuce	*Stephanomeria*
Birds	
American Crow	*Corvus brachyrhynchos*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Bendire's Thrasher	*Toxostoma bendirei*
Bewick's Wren	*Thryomanes bewickii*
Black-tailed Gnatcatcher	*Polioptila melanura*
Black-throated Gray Warbler	*Dendroica nigrescens*
Black-throated Sparrow	*Amphispiza bilineata*
Brewer's Sparrow	*Spizella breweri*
Bronzed Cowbird	*Molothrus aeneus*
Brown-headed Cowbird	*Molothrus ater*
Burrowing Owl	*Athene cunicularia*
Cactus Wren	*Campylorhynchus brunneicapillus*
California Thrasher	*Toxostoma redivivum*
Common Raven	*Corvus corax*
Costa's Hummingbird	*Calypte costae*
Crissal Thrasher	*Toxostoma crissale*
Elf owl	*Micrathene whitneyi*
European Starling	*Sturnus vulgaris*
Ferruginous Pygmy-Owl	*Glaucidium brasilianum*
Gambel's Quail	*Callipepla gambelii*
Gila Woodpecker	*Melanerpes uropygialis*
Greater Roadrunner	*Geococcyx californianus*
Green-tailed Towhee	*Pipilo chlorurus*
Hooded Oriole	*Icterus cucullatus*
House Finch	*Carpodacus mexicanus*
House Sparrow	*Passer domesticus*
Ladder-backed Woodpecker	*Picoides scalaris*
LeConte's Thrasher	*Toxostoma lecontei*

Common Name	***Latin Name***
Loggerhead Shrike	*Lanius ludovicianus*
Long-eared Owl	*Asio otus*
Lucy's Warbler	*Vermivora luciae*
Mourning Dove	*Zenaida aurita*
Northern Flicker	*Colaptes auratus*
Northern Mockingbird	*Mimus polyglottos*
Phainopepla	*Phainopepla nitens*
Pyrrhuloxia	*Cardinalis sinuatus*
Rufous-crowned Sparrow	*Aimophila ruficeps*
Rufous-winged Sparrow	*Aimophila carpalis*
Sage Sparrow	*Amphispiza belli*
Sage Thrasher	*Oreoscoptes montanus*
Scott's Oriole	*Icterus parisorum*
Verdin	*Auriparus flaviceps*
Western Screech Owl	*Otus kennicottii*
White-winged Dove	*Zenaida asiatica*

Mammals

Fox, Gray	*Urocyon cinereoargenteus*
Fox, Red	*Vulpes vulpes*
Raccoon	*Procyon lotor*
Skunk, Striped	*Mephitis mephitis*
Wild burro	*Equus asinus*

Amphibians and Reptiles

Desert tortoise	*Gopherus agassizii*

Appendix C. How to Monitor Bird Populations

Adaptive management requires the periodical gathering of information to ascertain whether management actions are achieving desired results. The most comprehensive and rigorous way of collecting this information is through a strategic program of monitoring using standardized methods that can be compared between years and between regions. Restoration and land stewardship programs need to build in long-term monitoring programs to assess the effectiveness of their activities. Such data are necessary to determine the need for continued funding.

Research and Monitoring

If habitat restoration or management is undertaken to benefit wildlife species, wildlife monitoring becomes the ultimate measure of success. There are many reasons that bird monitoring should be adopted as a basic component of long term stewardship in preserves with significant shrubland habitats or significant bird populations:

•Birds are highly visible and monitoring is cost effective.

•Birds can show relatively quick response in abundance and diversity to restored habitats (35 years).

•As secondary consumers (i.e., insectivores), birds are sensitive indicators of environmental change.

•By managing for a diversity of birds, most other elements of biodiversity are conserved.

•Bird monitoring can prevent future listing of declining species by identifying problems and solutions early.

•The only way to measure special-status bird species response to management and restoration is by monitoring bird populations.

•Because of the increasing popularity of birdwatching, there is great potential for public participation in bird monitoring.

•Birds are tremendously important culturally and economically and their popularity can help raise awareness of land-stewardship needs.

Monitoring Strategically

Monitoring can be conducted at varying levels of intensity, depending on the objectives to be achieved and the resources available. The standardization of protocols is critical to comparing results across space and time. Many recent programs (Ralph et al. 1995, Martin et al. 1997, DeSante et al. 1999a) and publications (Ralph et al. 1993, Geupel and Warkentin 1995, DeSante et al. 1995, 1998, 1999b, Nur et al. 1999) have summarized methods, objectives, and how to use results. Latta et al. (2005) present strategies and "tiers" for conservation monitoring of birds.

Monitoring programs should always include an analysis plan and identification of issues or site-specific projects to be assessed. The primary purpose of site-specific monitoring is to assess the effects on wildlife of natural and anthropogenic stressors or disturbances in the environment. This knowledge is critical in determining the relative priority of identified conservation problems and in developing effective measures to address those problems. Monitoring is an integral component of the adaptive management feedback loop, allowing land managers, conservation groups, and land owners to assess the effectiveness of their habitat management and restoration programs.

Standardized monitoring across many sites at varying scales can be analyzed to highlight broad changes or trends in species presence, diversity, abundance and productivity. Ideally, a series of reference sites with long-term monitoring, using most if not all protocols below, will be developed for each California bioregion. Other sites will be monitored more opportunistically, depending on the objectives of the landowner.

The following is a list of common monitoring regimes from least to most intensive.

1) Rapid assessment of habitat or designation of Important Bird Areas based on general vegetation characteristics and presence/absence of indicator species.

Method: area search or point count as little as one census per site per year.

2) Determine breeding status, habitat association, restoration evaluation and/or evaluation of changes in management practices.

Method: area search or point count two or more times per year for 3 years. For restoration evaluation every other year, censusing should continue for at least 10 years.

3) Determination of population health or source/sink status.

Method: census combined with demographic monitoring for a minimum of 3 years (4 years preferable).

Long-term Monitoring

Long-term monitoring provides a wealth of useful information about bird populations. In addition to parameters that can be determined by both short- and long-term monitoring (such as annual productivity, abundance, and diversity), patterns of variation in reproductive success and trends in abundance and diversity may also be described. Long-term monitoring is also the only method to monitor natural and human-induced changes in bird populations and adaptively manage in a time of rapid environment changes.

The Palomarin Field Station of PRBO Conservation Science provides an excellent example of the utility of a long-term monitoring program. Biologists have conducted mist-netting at the site for more than twenty years. With the data collected, they have documented a population decline of Warbling Vireos and linked it to reproductive failure on the breeding grounds (Gardali 2000).

Standardized Methods Adopted by the Western Working Group and Monitoring Working Group of Partners in Flight

These are listed from least to most intensity of effort. All are described in detail in Handbook of Field Methods for Monitoring Landbirds (Ralph et al. 1993).

Area Search
The Area Search, adopted from the Australian Bird Count, is a habitat specific, time constraint census method to measure relative abundance and species composition. It may also provide breeding status. While still quantitative, this technique is ideal for volunteers as it mimics the method that a birder would use while searching for birds in a given area, allowing the observer to track down unfamiliar birds.

Point Count
The point count method is used to monitor population changes of breeding landbirds. With this method, it is possible to study the yearly changes of bird populations at fixed points, differences in species composition between habitats, and assess breeding status and abundance patterns of species. The objective of point count vegetation assessment is to relate the changes in bird composition and abundance to differences in vegetation.

Mist Netting
Mist netting provides insight into the health and demographics of the population of birds being studied. Mist nets provide valuable information on productivity, survivorship, and recruitment. With these data, managers will have information on the possible causes of landbird declines or their remedies. This method is currently being used nationwide in the Monitoring Avian Productivity and Survivorship (MAPS) program (DeSante 1992).

Territory Mapping
Also known as "spot mapping," based on the territorial behavior of birds, where locations of birds are marked on a detailed map during several visits (a minimum of eight) in the breeding season. By counting the number of territories in an area, this method estimates the density of birds. Distribution of territories, species richness, and diversity is also documented. This is an excellent method for assessing areas with limited habitat. Standard methods are described by Robbins (1970) and used by The Cornell Laboratory of Ornithology's resident bird counts.

Nest Monitoring
Also called nest searching, this technique measures nesting success in specific habitats and provides information on trends in recruitment; measurement of vegetation associated with nests may identify habitat influences on breeding productivity. Examination of nests also allows collection of life-history data (e.g., clutch size, number of broods, numbers of nesting attempts), which provide important insight into vulnerability of species to decimation or perturbations (Martin and Geupel 1993).