The Riparian Bird Conservation Plan

A strategy for reversing the decline of riparian associated birds in California

A project of California Partners in Flight and the Riparian Habitat Joint Venture

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Version 2.0

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Executive Summary

This Riparian Bird Conservation Plan is a collaborative effort of the Riparian Habitat Joint Venture (RHJV, all acronyms are defined in Appendix C on page 144 and California Partners in Flight (CalPIF) and has been developed to guide conservation policy and action on behalf of California's riparian habitats and wildlife. The Conservation Plan focuses on data concerning bird species associated with riparian habitat, but conservation recommendations, if implemented, should benefit many riparian associated species. The plan, which includes both this written document and an associated web site, is intended to provide a source of information on riparian bird conservation for managers, agencies, landowners, academic institutions and non-governmental organizations. This Conservation Plan "takes a heroic step forward in tightening the link between science and on-the-ground management" (Golet 2001). This is not a regulatory document, nor does it represent the policies of any agency or organization.

This Conservation Plan, along with the associated Geographic Information System (GIS) database of riparian monitoring projects maintained by PRBO Conservation Science (PRBO), is the second iteration of a continuing process of updating habitat conservation recommendations based on the latest scientific data. This Conservation Plan, combined with the associated RHJV Strategic Plan, provides the foundation for adaptive conservation planning in California's riparian habitats (RHJV 2003[a]). The plan applies broadly to many of the conservation efforts now underway in the state, including, but not limited to: the California Bay-Delta Program (CALFED); the California Biodiversity Council; California Legacy Project, all habitat-based Joint Ventures (i.e., Central Valley, Intermountain West, Pacific Coast, San Francisco Bay, and Sonoran); the Sacramento and San Joaquin River Basins Comprehensive Study of the U.S. Army Corps of Engineers (Corps); the SB 1086 Program; programs of the Natural Resources Conservation Service; US Fish and Wildlife Service refuges and 'Partners for Wildlife' program; The Nature Conservancy Ecoregion Plans; the California Wildlands Project; and updates to resource management plans (RMPs) and environmental assessments of the USDA Forest Service and Bureau of Land Management.

An important extension of this Conservation Plan is the on-line GIS database of riparian monitoring projects and focal species breeding status available through the CalPIF section of PRBO's website at http://www.prbo.org/calpif/htmldocs/riparian.html (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 website, periodically updated, and made available for use by the public. Therefore, this Conservation Plan is a "living" document.

Biological Need

More than 225 species of birds, mammals, reptiles, and amphibians depend on California's riparian habitats. Riparian ecosystems harbor the most diverse bird communities in the arid and semiarid portions of the western United States (Knopf et al. 1988, Dobkin 1994, Saab et al. 1995). Riparian vegetation is critical to the quality of in-stream habitat and aids significantly in maintaining aquatic life by providing shade, food, and nutrients that form the basis of the food chain (Jensen et al. 1993). Riparian vegetation also supplies in-stream habitat when downed trees and willow mats scour pools and form logjams important for fish, amphibians, and aquatic insects. The National Research Council (2002) concluded that riparian areas perform a disproportionate number of biological and physical functions on a unit area basis and that the restoration of riparian function along America's waterbodies should be a national goal.

Riparian vegetation in California makes up less than 0.5% of the total land area, an estimated 145,000 hectares (CDF 2002). Yet, studies of riparian habitats indicate that they are important to ecosystem integrity and function across landscapes (Sands 1977, Johnson and McCormick 1979, Katibah 1984, Johnson et al. 1985, Faber 2003). Consequently, they may also be the most important habitat for landbird species in California (Manley and Davidson 1993). Despite its importance, riparian habitat has been decimated over the past 150 years. Today, depending on bioregion, riparian habitat covers 2% to 15% of its historic range in California (Katibah 1984, Dawdy 1989).

Due to their biological wealth and severe degradation, riparian areas are the most critical habitat for conservation of Neotropical migrants and resident birds in the West (Miller 1951, Gaines 1974, Manley and Davidson 1993, Rich 1998, Donovan et al. 2002). California's riparian habitat provides important breeding and over wintering grounds, migration stopover areas, and corridors for dispersal (Cogswell 1962, Gaines 1977, Ralph 1998, Humple and Geupel 2002, Flannery et al. 2004). The loss of riparian habitats may be the most important cause of population decline among landbird species in western North America (DeSante and George 1994).

Photo by Eric Preston, ericapreston.com

Riparian areas provide habitat for numerous birds, including Song Sparrows.

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 Riparian 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 Riparian Bird Conservation Plan are:

- 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 riparian habitats.

- Provide recommendations for habitat protection, restoration, management, monitoring, and policy to ensure the long-term persistence of birds and other wildlife dependent on riparian ecosystems.

- Support and inform efforts to increase the overall acreage and effectiveness of riparian habitat conservation efforts in California by funding, and promoting on-the-ground conservation projects.

This Conservation Plan concentrates on a subset of riparian bird species, with the aim of contributing to the conservation of riparian ecosystems as a whole. By focusing appropriate conservation efforts on well-chosen "focal" riparian 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;" those whose protection will result in the protection of many other species (Noss 1990).

The RHJV and CalPIF recognize that the subject of land managment and land use, whether on private or public lands, can be contentious. Because many California riparian areas are on private lands, the RHJV and 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 riparian 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 the leading bird researchers in California through a process designed to:

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

At more than 520 monitoring sites throughout California, researchers have been collecting data on riparian 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 17 bird species chosen because of their conservation interest and as focal species representative of riparian habitats in the state. Preliminary analyses of the 17 focal species habitat requirements reveal:

- Eleven of these species have suffered reductions in a significant portion of their former breeding range and eight of 17 continue to decline. Extirpation appears to have resulted primarily from historical loss and fragmentation of riparian habitat throughout the state.

- Loss of appropriate habitat condition also often contributes to the decline or extirpation of a population. Ten of the focal species depend upon shrub cover and early successional habitat for successful nesting. These species particularly rely upon willow/alder shrub habitats with dense understory cover, which in turn require natural hydrological processes for establishment. Four of the focal species depend on late successional high canopy tree species. Cottonwood and willow tree regeneration is often compromised in riparian systems with altered hydrological processes such as peaks and timing of flows. The extensive alteration of California's streams and hydrological processes by humans contributes significantly to this habitat loss and degradation.

- Current restoration and rehabilitation efforts throughout the state need to be assessed with sound research and monitoring techniques (see Appendix B for more information). Many projects aim to increase riparian habitat by restoring natural hydrological processes or by managing dam releases. While these are excellent first steps in riparian restoration, success can only be gauged by observing their effects on wildlife.

- Riparian restoration and protection sites should be prioritized by:

    1. The ability to restore the natural hydrology of the area.

    2. Location of sites within potential dispersal range of existing "source" populations, which will maximize the potential for range expansion.

    3. The ability to protect and manage adjacent upland habitats for foraging, flood refugia, and/or nesting habitat.

    4. The extent to which land use within 7-12 kilometers from the riparian corridor (or even better, throughout the watershed) can be protected, influenced or is likely to remain under management that is beneficial to birds.

- High levels of brood parasitism by Brown-headed Cowbirds and high predation rates by native and nonnative predators significantly reduce the reproductive success of many species of birds. The structure and diversity of riparian vegetation heavily influence both factors. The size and isolation of remnant riparian patches, coupled with landscape-scale factors such as the type and configuration of surrounding land use, further influence avian productivity. Conservation efforts must initiate protection, management, and development of riparian and surrounding upland areas from a landscape-scale perspective. This will include promoting compatible types of agriculture, grazing, and recreation management, as well as comprehensive land use planning by local governments.

- Seven specific recommendations to increase the benefits of cultivated riparian restoration for landbirds are offered. Most of these recommendations will add little to the cost of restoration, but will significantly enhance benefits to songbirds in riparian habitats.

- Numerous specific recommendations concerning land management practices are offered that will benefit birds. Many recommendations can be implemented on farms and rangelands in California either to protect and enhance riparian habitats or to provide a beneficial buffer to riparian zones and reduce the impacts that negatively affect bird populations.

- The cost-effectiveness of many habitat restoration, management, and mitigation projects can be maximized by incorporating elements from this Conservation Plan, even if the project does not expressly aim to restore bird populations.

California Partners in Flight and Riparian Habitat Joint Venture Partners

California Department of Fish and Game
California Department of Water Resources
California State Lands Commission
Ducks Unlimited
Kern River Research Group (now defunct)
Klamath Bird Observatory
National Audubon Society
National Fish and Wildlife Foundation
National Park Service
Natural Resources Conservation Service
PRBO Conservation Science
River Partners
The Nature Conservancy
The Trust for Public Land
The Resources Agency State of California
U.S. Bureau of Land Management
U.S. Bureau of Reclamation
U.S. Fish and Wildlife Service
U.S. Geological Survey
U.S.D.A. Forest Service
Wildlife Conservation Board

Photo by Peter Knapp.

Common Yellowthroat, a riparian focal species.

Chapter 1. Introduction

Updates to Version 2.0

This document represents the second iteration of the Riparian Bird Conservation Plan. A review of the original focal species list revealed the need to add three new species to better capture the diversity of habitat niches found in California riparian systems and to account for species which are experiencing range reductions in the state. Following the same criteria established in the selection of the original 14 focal species, Spotted Sandpiper, Tree Swallow, and Tricolored Blackbird were added. Species accounts for these new additions are currently in preparation and will be available at http://www.prbo.org/calpif/htmldocs/riparian.html. Their summary information has been added to this document. Static range maps of all 17 focal species, with 2004 data incorporated, are included in this version of the Plan (Figures 5-2 through 5-18). As always, the most recent updates for these maps can be viewed on the web site.

Photo by James Gallagher, Sea and Sage Audubon

Tree Swallow, a new focal species to Version 2.0.

In spring of 2001, the RHJV, the Wildlife Society and sponsors and supporters from numerous state, federal, and private entities hosted the Riparian Habitat and Floodplains Conference in Sacramento, California. This meeting was the largest one-time gathering of wildlife biologists and managers in the western United States in several years. Approximately 400 scientific papers were presented and more than 1,500 people attended. The proceedings derived from this conference were published in 2003 and present results from several projects that have been implemented since Version 1.0 of the Riparian Bird Conservation Plan (Faber 2003). References from these proceedings and other recent scientific publications have been incorporated into this revision of the Plan and added to the already extensive Literature Cited section.

Also new to this version is a description of a process for setting population objectives for select focal species using current monitoring data and GIS data layers (Chapter 6). In this version, examples from Central Valley Basins are used to estimate current and potential population size. Potential populations or "targets" are estimated using GIS data layers based on the historical extent of riparian forests, corrected for permanent habitat loss (urbanization). Densities estimated (using the values for the top 25% of surveyed sites currently available) are extrapolated to provide a target population. Target values for key demographic parameters (primarily nest success and survival) also are provided to evaluate and project a population's viability ('health'). In Chapter 7, we refined the definition of a Portfolio Site, and invited experts from each bioregion to supplement the existing list with new sites. In Chapter 8, we incorporated the most current riparian songbird data from several California bioregions into the Conservation Recommendations section and included the latest topical references from the scientific literature. Tables reflecting bird and habitat associations, estimates of nest success, and riparian songbird nesting seasons by bioregions have been added to better assist land managers with data pertaining to their specific area. In Chapter 9, we provided updates on the North American all-bird initiatives and the recent activities of the RHJV. In Chapter 10, we identified more opportunities for private citizens to be involved in bird

conservation and to help enhance bird populations. Finally, we added a new chapter (Chapter 3) with information pertaining to landscape-scale factors that affect riparian birds.

As always, this Plan is a "living document" which will constantly be revised to best fit the needs of the land management, research, education, policy and conservation communities. Perhaps one of the most essential uses of this document is to demonstrate where information gaps exist, or where existing information has been overlooked. For this reason, and with the spirit of the RHJV in mind, we encourage you, the reader, to provide us with your feedback, data, and experiences. Version 3.0 is planned for release in September of 2006.

Riparian Habitat Joint Venture

Following a series of strategic meetings with members of the CalPIF Management Committee in 1993, the Riparian Habitat Joint Venture project was launched in a public ceremony along the American River in Sacramento in September 1994. The RHJV, modeled after the successful Central Valley Habitat Joint Venture project of the North American Waterfowl Management Plan, reinforces other collaborative efforts currently underway that protect biodiversity and enhance natural resources and the human population they support. The RHJV seeks to restore, enhance, and protect a network of functioning riparian habitat across California to support the long-term viability of birds and other species. The RHJV will provide leadership and guidance to promote effective riparian conservation from the local to state level. This will be accomplished by the following goals:

- **Identify and develop technical information for a strategic approach to riparian conservation in California.** To develop a strategic statewide approach to riparian conservation, the initial step is to assess the extent and condition of riparian habitat in California. In addition, the latest riparian management and scientific information must be continually assessed to refine and update RHJV conservation goals.

- **Promote and support riparian conservation on the ground by providing guidance, technical assistance and a forum for collaboration**. Through meetings, workshops, and technical assistance the RHJV provides a forum where members, as well as other organizations, can develop new collaborative opportunities for planning, funding and implementing riparian conservation projects.

- **Guide and promote riparian conservation policy through outreach and education.** The RHJV can raise the awareness of local constituents and state policy makers to the critical importance of riparian habitat for wildlife and plants as well as to the many benefits and services it provides to human society.

Partners in Flight

This Conservation Plan is one of many to be created under the aegis of the national 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.

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 several 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.

Photo by James Gallagher, Sea and Sage Audubon

The international initiative Partners in Flight strives to keep common birds common, such as this Black-headed Grosbeak.

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 riparian systems. A large number of bird species breed in riparian habitat in California; many others use riparian areas during some portion of their life cycle. 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 the riparian ecosystem (e.g., Bank Swallows depend upon regular high-water events to create exposed riverbank sites that they use for nesting). 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 "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.

Objective of the Riparian Bird Conservation Plan

The Riparian Bird Conservation Plan seeks to synthesize and summarize the current state of scientific knowledge concerning the requirements of birds in riparian habitats. It provides recommendations for habitat protection, restoration, management, research, monitoring, and policy to ensure the long-term persistence of birds dependent on riparian ecosystems. This Conservation Plan is complemented by the RHJV Strategic Plan and the RHJV Annual Operating Plan (RHJV 2003a, 2003b) that will guide the RHJV in accomplishing its objectives. Both the Conservation and Strategic plans are "living" documents; new information and data analysis will be incorporated into the recommendations and conservation targets regularly.

Photo by Steve Zack, WCS

Yellow-breasted Chats nest in early successional riparian habitats.

Chapter 2. Riparian Vegetation in California

Riparian vegetation in California makes up less than 0.5% of the total land area, an estimated 145,000 hectares (CDF 2002, Table 2-1, Figure 2-1). Yet, riparian habitats have long been recognized as important to ecosystem integrity and function across landscapes, and have received much attention at scientific conferences and symposia (Sands 1977, Johnson and McCormick 1979, Warner and Hendrix 1984, Johnson et al. 1985, Faber 2003).

Riparian habitats have been identified as the most important habitats to landbird species in California (Manley and Davidson 1993, Davidson 1995), yet they have been decimated over the past 150 years. Reservoir construction, levee and channelization projects, livestock grazing, timber harvest, water pollution, introduction of non-native species, gravel and gold mining, and clearing for agricultural and domestic uses have all contributed to riparian destruction (see Knopf et al. 1988 for review). While no estimates exist for the total historical extent of riparian habitat in California, there were at least 600,000 miles of streams in the state that were capable of supporting this type of vegetation (Warner and Hendrix 1984). Current estimates of remaining riparian habitat in the state range from 2% to 7% for the Central Valley and desert areas and approximately 15% for the northern coastal streams (Katibah 1984, Dawdy 1989).

Table 2-1. Approximate extant hectares of riparian habitat in each California bioregion. Derived from composite 100-m pixel landcover GIS data compiled by the California Department of Forestry's Fire and Resource Assessment Program, 2002 (CDF 2002). CWHR codes are given in parentheses.

Bioregion	Aspen (ASP)	Montane Riparian (MRI)	Valley Foothill Riparian (VRI)	Desert Riparian (DRI)	Palm Oasis (POS)	Wetland Meadow (WTM)	Freshwater Emergent Wetland (FEW)
North Coast / Klamath	6	15,230	552	0	0	5,162	374
Modoc	1,345	1,609	12	0	0	22,570	93
Sacramento Valley	0	112	8,015	0	0	43	12,585
Bay Area / Delta	0	568	3,102	0	0	20	6,626
San Joaquin Valley	0	2	2,596	0	0	12	11,627
South Central Coast	0	3,454	2,925	0	0	3	83
South Coast	0	2,874	6,496	12	0	1,116	461
Sierra	5,252	10,620	68	0	0	14,884	794
Colorado Desert	0	46	220	826	15	47	55
Mojave	0	210	187	2,827	0	109	5
Total in California	**6,603**	**34,725**	**24,173**	**3,665**	**15**	**43,966**	**32,703**

Riparian Habitat

NRCS photo

The word *riparian* is derived from the Latin word *ripa*, meaning bank or shore (as of a stream), and this meaning remains intact today. Warner and Hendrix (1984) define *riparian* as pertaining to the banks and other adjacent terrestrial environs of freshwater bodies, watercourses, estuaries, and surface emergent aquifers (springs, seeps, and oases). These areas can be perennial, intermittent, or ephemeral, and include estuarine-marine shorelines. Riparian areas are transitional between terrestrial and aquatic ecosystems, providing linkages between waterbodies and adjacent uplands and include portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems (NRC 2002). The available water provides soil moisture in excess of that typically available through local precipitation and potentially supports the growth of mesic vegetation. Here, *vegetation* refers to all the plant species in a region and the way they are arranged (i.e., plant assemblages Sawyer and Keeler-Wolf 1995).

The terms *riparian habitat* and *riparian vegetation* represent broad physiographic units and may include areas with few or no plant species in common. This is especially true in California, where differences in species diversity, topography, biogeography, climate, and geology are great. The California Wildlife Habitat Relationships (CWHR) system of classification provides general descriptions of wildlife habitats in California. The following brief descriptions of the major riparian habitats in California offer a window into the diversity of riparian vegetation. CWHR codes are given in parentheses. 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 D.

Montane Riparian (MRI)

Montane riparian habitats (elevation = sea level to 2,440 m) are found in the Klamath, Cascade, Coast, Transverse, and Peninsular ranges and in the Sierra Nevada south to Kern and Northern Santa Barbara counties. Associated with lakes, ponds, seeps, bogs, meadows, rivers, streams, and springs, they are structurally diverse with variable vegetation. The composition of montane riparian zones varies widely by region. In northwestern California, west of the Klamath mountains, black cottonwood is the dominant species, sometimes codominant with bigleaf maple, and often associated with dogwood and boxelder. In northeastern California, black cottonwood, white alder and thinleaf alder are dominant, with Oregon ash and willow associates. Characteristic species of Sierra Nevada montane riparian zones include thinleaf alder, aspen, black cottonwood, dogwood, wild azalea, willow and water birch, white alder, and dogwood. Bigleaf maple and California bay are dominant in the southern Coast Ranges, the Transverse Ranges, and the Peninsular Range. Along the immediate coast, from San Luis Obispo to Del Norte counties, red alder is the dominant species in the coastal subtype of montane riparian.

Valley Foothill Riparian (VRI)

Valley foothill riparian habitats (elevation = sea level to 1,000 m) occur in the Central Valley and the lower foothills of the Cascade, Sierra Nevada, and Coast ranges. These habitats are associated with variable flow velocities and topographies, ranging from swift rapids and waterfalls of steep canyons to slow moving water in floodplains of gentle topography. They comprise a complex structure with a canopy, subcanopy, and understory shrub layer (usually impenetrable). Wild grape festoons trees and shrubs and constitutes a high percent of the groundcover. Dominant trees include valley oak, cottonwood, California sycamore, white alder, box elder, and Oregon ash, and California bay. Shrub layer plants include wild grape, wild rose, California blackberry, blue elderberry, poison oak, buttonbush, and willows. The herbaceous layer is diverse.

Desert Riparian (DRI)

Desert riparian habitats (elevation < 900 m) are found in scattered locations throughout the 1.4 million hectares of the Mojave, Colorado, and Great Basin deserts and in the desert canyons of the Peninsular ranges along permanent streams, seeps, and springs. They are often characterized by dense groves of low trees and tall shrubs; other patches are sparser, with medium-sized trees. The dominant canopy species vary but often include velvet ash, mesquite, Fremont cottonwood, willows and tamarisk (an invasive non-native species also known as Salt Cedar). The shrub layer comprises smaller individuals of canopy species as well as quailbush, Mojave seablight, desert lavender, seep willow, and arrowweed. Cattail and common reed are also important components of the understory.

Palm Oasis (POS)

Palm oasis habitats (elevation < 1,066 m) are found around the Salton Sea basin, especially along the San Andreas Fault zone, and are restricted to areas with permanent water of seeps, springs, and streams. Density of vegetation varies from sparse, scattered trees to dense, closely packed vegetation. The California fan palm frequently dominates the vegetation, but the habitat may also include coyote willow, velvet ash, California sycamore, naturalized date palms, Fremont cottonwood, mesquite, and tamarisk. Alkali sacaton and wiregrass dominate the herb layer. The understory also includes young individuals of canopy species and arrowweed, squaw waterweed, and alkali goldenbush.

Freshwater Emergent Wetland (FEW)

Fresh emergent wetland is found throughout California (most prevalent at elevation < 2,270 m) with the bulk of acreage in the Klamath Basin, Sacramento Valley, San Joaquin Valley, Delta, and Imperial Valley/Salton Sea. It primarily occurs at the edges of rivers and lakes. All emergent wetlands are flooded frequently. Dominant plant species include common cattail, tule bulrush, sedge, river bulrush, and baltic rush. Fresh emergent wetlands are an extension of many riparian areas, often grading into land with nonhydric soils.

Wetland Meadow (WTM)

Wet meadows (elevation = 1200-2400 m) usually occur in ecotones between fresh emergent wetlands and perennial grasslands. Where wet meadows merge with fresh emergent wetlands, slight differences in water depth significantly contribute to the animal species composition of the area. At all elevations, wet meadows generally have a simple structure consisting mainly of a layer of herbaceous plants. Trees and shrubs are an important part of the meadow, usually occurring around the edges. Wet meadows occur with a great variety of plant species, but several genera, including bent grass, oat grass, and rushes, occur commonly throughout the state.

Aspen (ASP)

Most aspen habitats (elevation = 2,000-3,000 m) in California are found within 80 km of the Nevada border from Mono County to Modoc County. Aspen habitats are found near seeps and streams on both the eastern and western slopes of the Sierra Nevada and eastern slope of the Cascade Range. East of the Sierra crest, aspens are found in the Carson and Monitor ranges and the Sweetwater and White mountains. Aspen stands tend to become more extensive in the north and east of their range. They comprise relatively open canopies associated with willows, alders, black cottonwoods, lodgepole pines, Jeffrey pine, ponderosa pine, red fir, and white fir. Important understory shrubs include sagebrush, roses, snowberry, chokecherry, and serviceberry with an extremely rich herbaceous layer. Additional aspen habitats are found on upland sites with increased associations with sagebrush and western juniper.

Photo by Eric Preston, ericxpreston.com

Aspens in Mono County, California.

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. Appendix E contains descriptions of riparian and semi-riparian alliances identified by the 2004 California Vegetation classification by Sawyer and Keeler-Wolf.

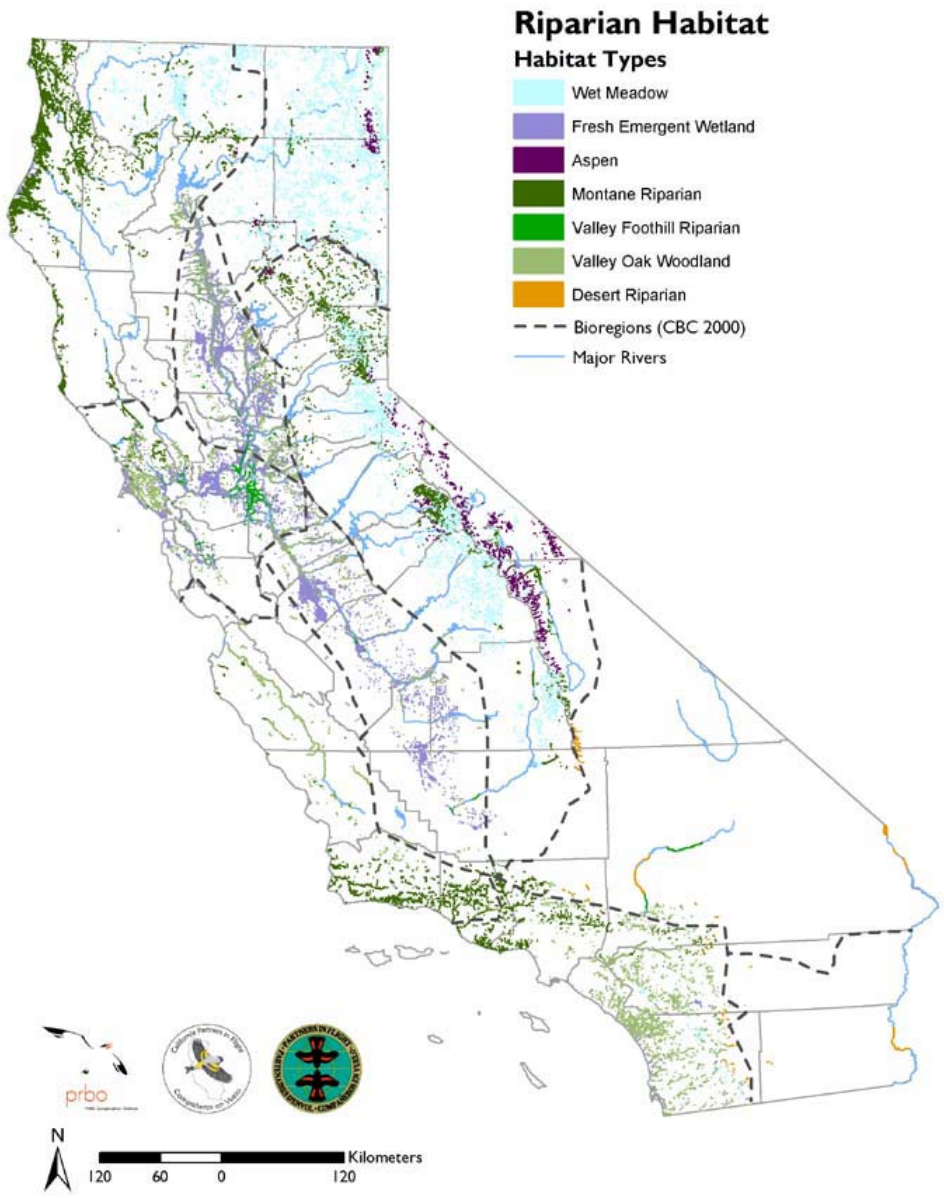

Figure 2-1. Approximate current coverage of riparian habitats throughout California.

Chapter 3. Riparian 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.

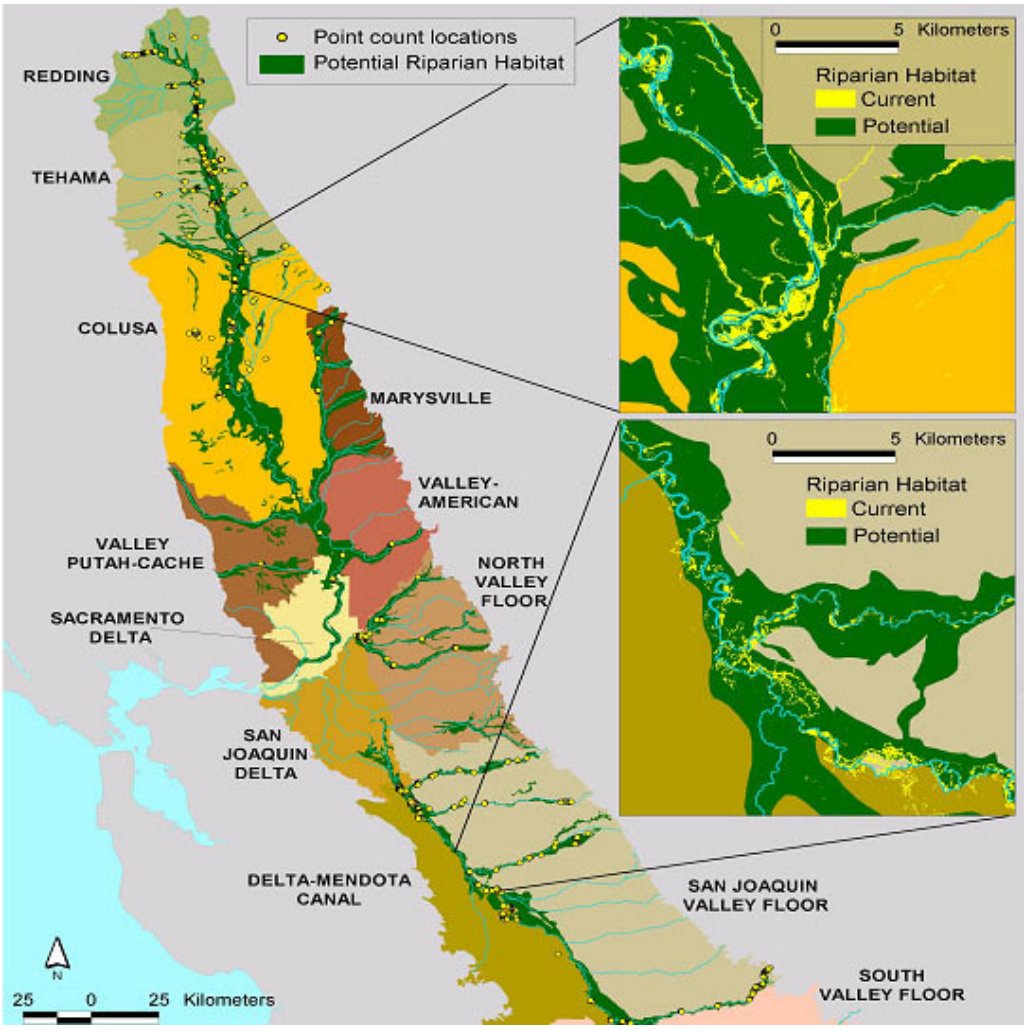

Figure 3-1. Point count locations and riparian data layers of the Central Valley basins.

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 riparian birds

Many environmental factors can affect riparian 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). 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 riparian forests have been converted to agricultural fields, for example, remnant undeveloped habitat has been left as a disconnected series of fragments of varying size and shape. 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 habitats, which are more naturally fragmented than eastern deciduous forests, densities of both nest predators and nest parasites (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.

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).

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.

Wcavilhead.org photo.

Female Brown-headed Cowbird.

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, 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, surrounding areas for 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).

Chapter 4. Problems Affecting Riparian Birds

Riparian areas are the most critical habitat for conservation of Neotropical migrant and resident birds in California (Miller 1951, Gaines 1974, Manley and Davidson 1993) and throughout the west (Rich 1998). Riparian ecosystems harbor the highest number of bird species found in the arid and semiarid portions of the western United States (Knopf et al. 1988, Dobkin 1994, Saab et al. 1995). Consequently, the loss of riparian habitats may be the most important cause of population decline among landbird species in western North America (DeSante and George 1994). In addition to providing important breeding grounds, riparian habitat offers vital overwintering and migration stopover areas and corridors for dispersal (Gaines 1977, Ralph 1998, Humple and Geupel 2002).

Habitat loss and degradation are probably the most important factors causing the decline of riparian bird populations. Alteration of riparian landscapes narrows or destroys important population dispersal corridors. Disruption of natural hydrological conditions by dams, levees and diversions, clearing associated with farming and development, overgrazing, and invasion by exotic species have all contributed to degradation of riparian zones. Nest predation and parasitism by the Brown-headed Cowbird may reduce the reproductive success of many riparian birds in California (Gaines 1977, Harris 1991, Geupel et al. 1997b, Laymon and Williams 1997, Gardali et al. 1998, USFWS 1998). Long-term studies of migrant landbirds in California suggest that reproductive success on the breeding grounds is the primary factor limiting populations (Johnson and Geupel 1996, Chase et al. 1997, Gardali et al. 2000). However, the situation is complex and it is likely that many factors, in and across all stages in the annual cycle, are operating to influence population dynamics (Martin 1993, Rappole and McDonald 1994, Sherry and Holmes 1995, Faaborg 2002, Ballard et al. 2003b).

Nest Parasitism

Local habitat features around the nest, such as vegetation composition and structure, as well as habitat configuration and landscape context, have been shown to affect levels of nest parasitism and predation (Freemark et al. 1995, Larison et al. 1998, Hochachka et al. 1999, Tewksbury et al. 2002, Chapter 3). As a result of the conversion of native habitats to farms and pastures, the Brown-headed Cowbird has undergone a population explosion and range expansion during the twentieth century (Rothstein et al. 1980, Laymon 1987, Lowther 1993). Agriculture and livestock grazing near riparian zones provide Brown-headed Cowbirds with ample foraging habitat close to songbird breeding grounds (Mathews and Goguen 1997, Tewksbury et al. 1998). Cowbird parasitism contributes to lowered productivity in host species through direct destruction of host eggs; through competition between cowbird and host chicks, resulting in increased mortality; and through nest abandonment in some species, thus lowering overall fecundity within a season.

Nest Predation

In addition, the expansion of agricultural and urban land conversion tends to enhance favorable conditions for native and non-native predators that can decimate bird communities. The elimination of top predators, such as mountain lions and wolves, often results in an increased population of midlevel predators (Soule et al. 1988, Crooks et al. 1999). Raccoons, skunk and domestic cats, for example, are well-documented avian predators (Winter 1999, Pietz and Granfors 2000, Thompson and Burhans 2003, Sawin et al. 2003). Land conversion can also favor nest predators such as jays, crows and magpies (Andren 1992).

The identification and protection of source populations (production of young exceeds adult mortality) is vital to bird conservation. By recognizing those habitat and landscape factors that exist in these healthy (i.e., source) populations, conservation efforts can increase and enhance favorable conditions for birds (Martin 1995). To identify source populations, scientists must gather specific demographic information on the productivity, survivorship and dispersal rates of the bird community. Determination of these variables for every species breeding in riparian habitat is not currently feasible; however, recent advances in the monitoring demographic parameters of bird populations (Martin and Geupel 1993, DeSante 1995, DeSante and Rosenberg 1998) have allowed biologists to model a population's potential health at specific sites (e.g., Robinson et al. 1995, Tewksbury et al. 1998). In general, nest success rates of 20% or less, for most species, indicate unsustainable or "sink" populations (Martin 1992, Robinson et al. 1995, Trine 1998, Budnik et al. 2000). The number of young produced in a bird community is probably the most important factor influencing many species' occurrence and persistence (Martin 1992, Martin and Geupel 1993) and may be the easiest way to identify a healthy population. Table 4-1 provides an example of how productivity can vary among riparian sites among California's bioregions.

Photo by Ian Tait

Western Scrub-Jay, a common nest predator.

However, nest success alone cannot entirely substitute for an actual measure of annual productivity that takes into account re-nesting attempts after nest failure, double brooding, and the number of young fledged per successful nest (Thompson et al. 2001). Several recent studies have demonstrated that the Mayfield method underestimates population productivity (summarized in Anders and Marshal *in press*). Intensive studies that follow color-marked birds throughout the breeding season are feasible, and yield the most accurate productivity data. Powell et al. (1999) describe a model that may be used to predict breeding-season productivity as a function of adult survival, juvenile survival, nesting success, season length, re-nesting interval, and juvenile care intervals. For species with nests that are difficult to find or monitor, or when logistical constraints prohibit locating every nest on a study plot, nest monitoring may be supplemented by color-marking breeding adults and counting fledglings on breeding territories to measure annual productivity (Porneluzi and Faaborg 1999).

Many of California's riparian birds face potential population declines and local extirpations. Of these, Least Bell's Vireo, Yellow-billed Cuckoo, and Willow Flycatcher have suffered the most drastic reductions in their overall populations and breeding ranges (Laymon and Halterman 1985, USFWS 1998), resulting in state or federal listing for each. Habitat loss, in concert with brood parasitism and nest predation, affects most open cup nesting species throughout the state. Events in California may be illustrated by the demise of Yellow Warbler populations along the Colorado River. There, a combination of massive habitat loss, breeding failure in "replacement" habitats and, finally, high cowbird pressure in remaining habitat patches resulted in near extirpation of the species (Rosenberg et al. 1991).

Table 4-1. Mayfield (1975) estimates of nest success for select species among riparian songbird monitoring sites by California bioregion, using same data collection and analysis methods.

Species	Sacramento Valley	Bay-Delta	Modoc	Sierra Nevada
Black-chinned Hummingbird	0.44[3]	--	--	0.39[6]
Western Wood-Peewee	--	0.64[4]	0.17[5]	0.63[6]
Warbling Vireo	--	0.06[1]	--	0.09[6]
Bushtit	--	0.44[4]	--	0.44[6]
Swainson's Thrush	--	0.29[1]	--	--
American Robin	--	0.21[1]	--	0.49[6]
Yellow Warbler	0.32[2]	--	0.89[5]	0.30[7]
Wilson's Warbler	--	0.05[1]	--	--
Common Yellowthroat	--	0.63[4]	--	--
Spotted Towhee	0.28[3],0.05[2]	0.43[4]	--	0.24[6]
Song Sparrow	0.28[8]	0.58[4],0.24[1]	0.59[5]	0.29[7]
Black-headed Grosbeak	0.27[3], 0.33[2]	0.27[1]	--	0.57[6]

[1] Gardali et al. 1999, [2] Wood et al. 2001, [3] Small et al. 1999, [4] Haff et al. 2001, [5] King et al. 2001, [6] Heath et al. 2001, [7] Heath et al. 2002b, [8] Hammond and Geupel 2000

Least Bell's Vireo: An Example of Conservation Need and Action

The Least Bell's Vireo provides an excellent example of the problems facing riparian birds in California and how adaptive management and restoration efforts can reverse population declines. Historically, the Least Bell's Vireo was one of the most common breeding birds in riparian habitat in California (Grinnell and Miller 1944). In 1973, extensive searches of their former breeding grounds between Tehama and San Joaquin counties failed to detect any Least Bell's Vireos (Gaines 1974). By 1980, the species was extirpated from the entire Central Valley (USFWS 1998). Once characterized as abundant (for review see USFWS 1998), there remained only about 300 pairs of breeding birds when the species received federal listing as endangered in 1986 (RECON 1989). Today, the Least Bell's Vireo remains absent from the bulk of its historical range and is restricted to eight southern counties, with the majority of birds occurring in San Diego County (Figure 5-7).

Habitat destruction and degradation have severely reduced the range of Least Bell's Vireo in California. Agricultural land uses and water projects have not only actively destroyed riparian habitat, but have reduced water tables to levels that inhibit the growth of the dense vegetation the vireos prefer. The remaining vireo populations cling to small, increasingly isolated patches of habitats; as such, populations are more vulnerable to catastrophic events, demographic failure and loss of dispersal corridors. Dams, levees and other flood control structures hinder riparian reestablishment, creating more "old-growth" conditions (dense canopy and open understory) that are unfavorable to breeding vireos. Finally, habitat degradation encourages nest predation and parasitism.

Photo by Big Sur Ornithology Lab

Cowbird parasitism of Least Bell's Vireo nests further encourages their decline. Livestock grazing has reduced and degraded the lower riparian vegetation favored by the Least Bell's Vireo (Overmire 1962) and provided foraging areas for the Brown-headed Cowbird. Row crops and orchards also provide feeding grounds for the parasite. By as early as 1930, nearly every Least Bell's Vireo nest found in California hosted at least one cowbird egg (USFWS 1998). Since a parasitized nest rarely fledges any vireo young, nest parasitism of Least Bell's Vireo results in drastically reduced nest success (Goldwasser 1978, Goldwasser et al. 1980, Franzreb 1989, Kus 1999, Kus 2002).

Since federal listing and concordant restoration and management activities, the population increased dramatically up until 1998 (USFWS 1998). The Camp Pendelton population increased from 15 males in 1980 (Salata 1980) to 1011 in 1998 (Griffith 1999). In addition to population growth, observations indicate that the species is expanding its range northward. Currently, Least Bell's Vireos are recolonizing areas unoccupied for decades and may potentially reestablish breeding populations in the central and northern portions of their historic range (USFWS 1998). Since the peak in 1998, however, the Camp Pendelton population has declined to 757 in 2002 (W. Berry pers. comm.).

Chapter 5. The Conservation Planning Process

The national Partners in Flight program requested that state working groups define and prioritize the most threatened habitat types in each region, weighted by their importance to birds. In California, riparian habitats were unanimously chosen as the top priority because they provide the richest habitats for both breeding and wintering birds (Miller 1951, Cogswell 1962, Gaines 1977, Manley and Davidson 1993). Thus, California Partners in Flight formed the Riparian Habitat Joint Venture to spearhead the conservation planning process.

Prioritization schemes developed for the state's Neotropical migrants consistently ranked riparian as the most important habitat type (Davidson 1995). California's riparian habitats have many endemic species and subspecies that are known as riparian-obligate species. In addition to high species richness, riparian areas during the breeding season can harbor individuals at densities up to ten times greater than surrounding upland habitats. Although riparian habitat is recognized as extremely important, the magnitude of its destruction and degradation has been greater than for any other habitat in California, with the possible exception of perennial grassland.

The Riparian 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 riparian habitat types throughout the state.
- Develop, by consensus, biological conservation objectives for selected riparian bird species.

Photo by Kevin McKeeghan

Song Sparrow, a riparian focal species.

Criteria for Selecting Riparian 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. The RHJV elected against this method for the Riparian 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 riparian 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 the RHJV preferred. Instead, the RHJV chose to emphasize the ecological associations of individual species *as well as* those of conservation concern (Chase and Geupel *in press*). In doing so, the RHJV included a suite of focal species whose requirements define different spatial attributes, habitat characteristics, and management regimes representative of a "healthy" system (Table 5-2). Additionally, the RHJV 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.

The RHJV included species in the conservation planning process based on five factors (although not all species meeting these criteria were selected, and species selected did not necessarily meet all criteria, note: most are not special management species; see Table 5-1). The species considered:

- Use riparian 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 riparian 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 riparian ecosystems—to assess the success of restoration efforts.

Because birds occupy a wide diversity of ecological niches in riparian habitat (Figure 5-1), 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 riparian system (Chase and Geupel *in press* for review of CalPIF's strategy of choice and use of focal species). 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).

Figure 5-1. A healthy system needs diverse vegetative structure to best support birds. Illustration by Zac Denning.

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 D. New for this version are: Spotted Sandpiper, Tree Swallow, and Tricolored Blackbird.

Swainson's Hawk: California listed as threatened. Brian Woodbridge, U.S. Fish and Wildlife Service

Spotted Sandpiper: Chris McCreedy and Nils Warnock, PRBO Conservation Science

Western Yellow-billed Cuckoo: California listed as endangered. Steve Laymon, Bureau of Land Management

Willow Flycatcher: California listed as endangered, USFS Region 5 sensitive species; the Southwestern Willow Flycatcher subspecies is federally listed as endangered. Mary Whitfield, Southern Sierra Research Station; Diana Craig, USDA Forest Service and Pamela Williams, Kern National Wildlife Refuge

Warbling Vireo: Tom Gardali, PRBO Conservation Science

Least Bell's Vireo: Federally listed as endangered. Barbara Kus, San Diego State University

Bank Swallow: California listed as threatened. Barry Garrison, California Department of Fish & Game

Tree Swallow: David Winkler, Cornell University

Swainson's Thrush: Jennifer White and Stacy Small, University of Missouri, Columbia

Yellow Warbler: California species of special concern for species and Sonoran subspecies. Sacha Heath, PRBO Conservation Science

Common Yellowthroat: California listed as species of special concern for San Francisco subspecies. Tina Menges, U.S. Fish and Wildlife Service

Wilson's Warbler: Chris Otahal, U.S. Fish and Wildlife Service

Yellow-breasted Chat: California species of special concern. Matt Ricketts, LSA Associates and Barbara Kus, San Diego State University

Song Sparrow: Diana Humple and Geoff Geupel, PRBO Conservation Science

Black-headed Grosbeak: Stacy Small, University of Missouri, Columbia and Mike Lynes, Hastings University

Blue Grosbeak: Jeanne Hammond, Humboldt State University

Tricolored Blackbird: Bill Hamilton, UC Davis

Key findings from the species accounts are available at http://www.prbo.org/calpif/htmldocs/riparian.html. 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.

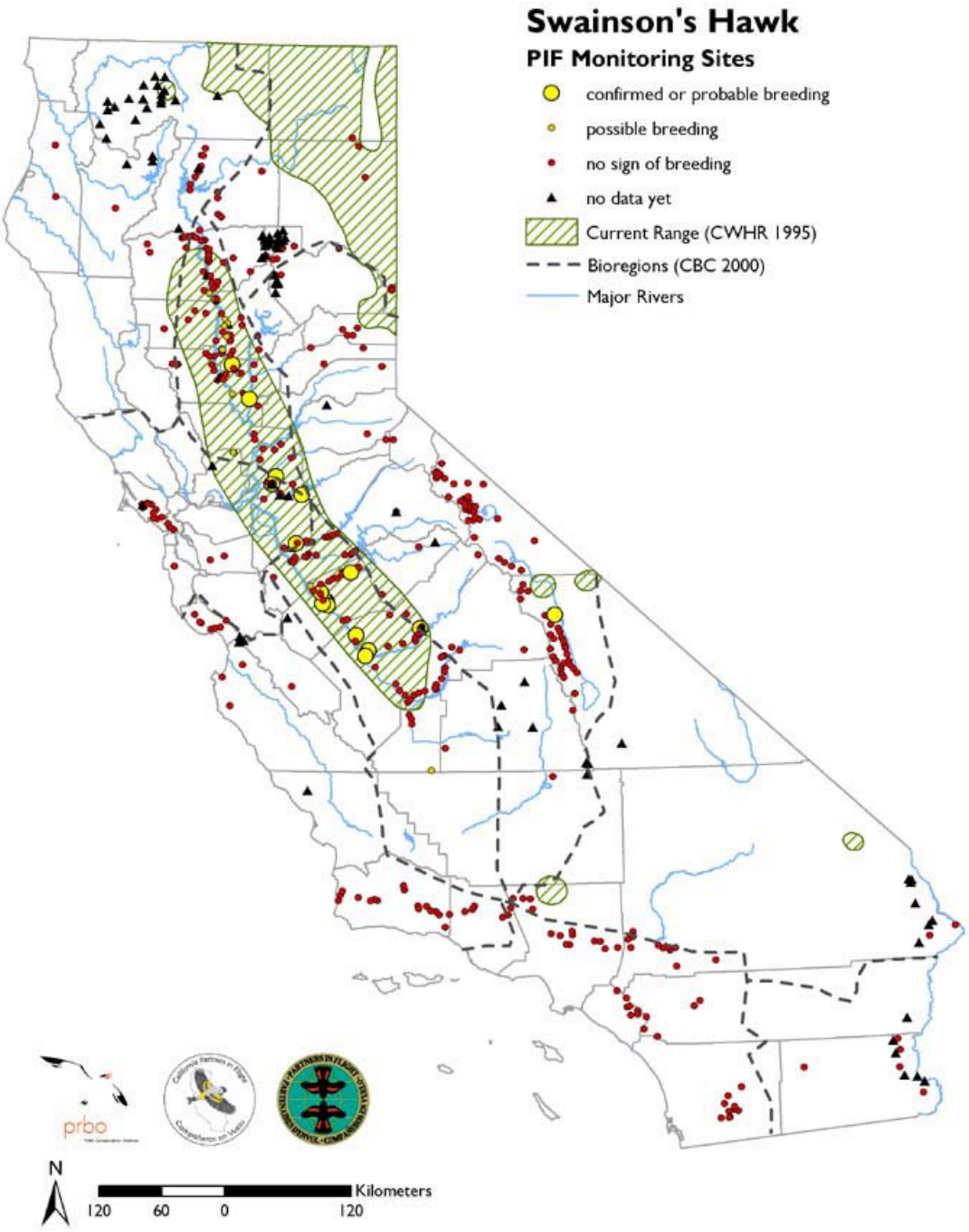

Figure 5-2. CalPIF monitoring sites, breeding status, and current range for the Swainson's Hawk in California.

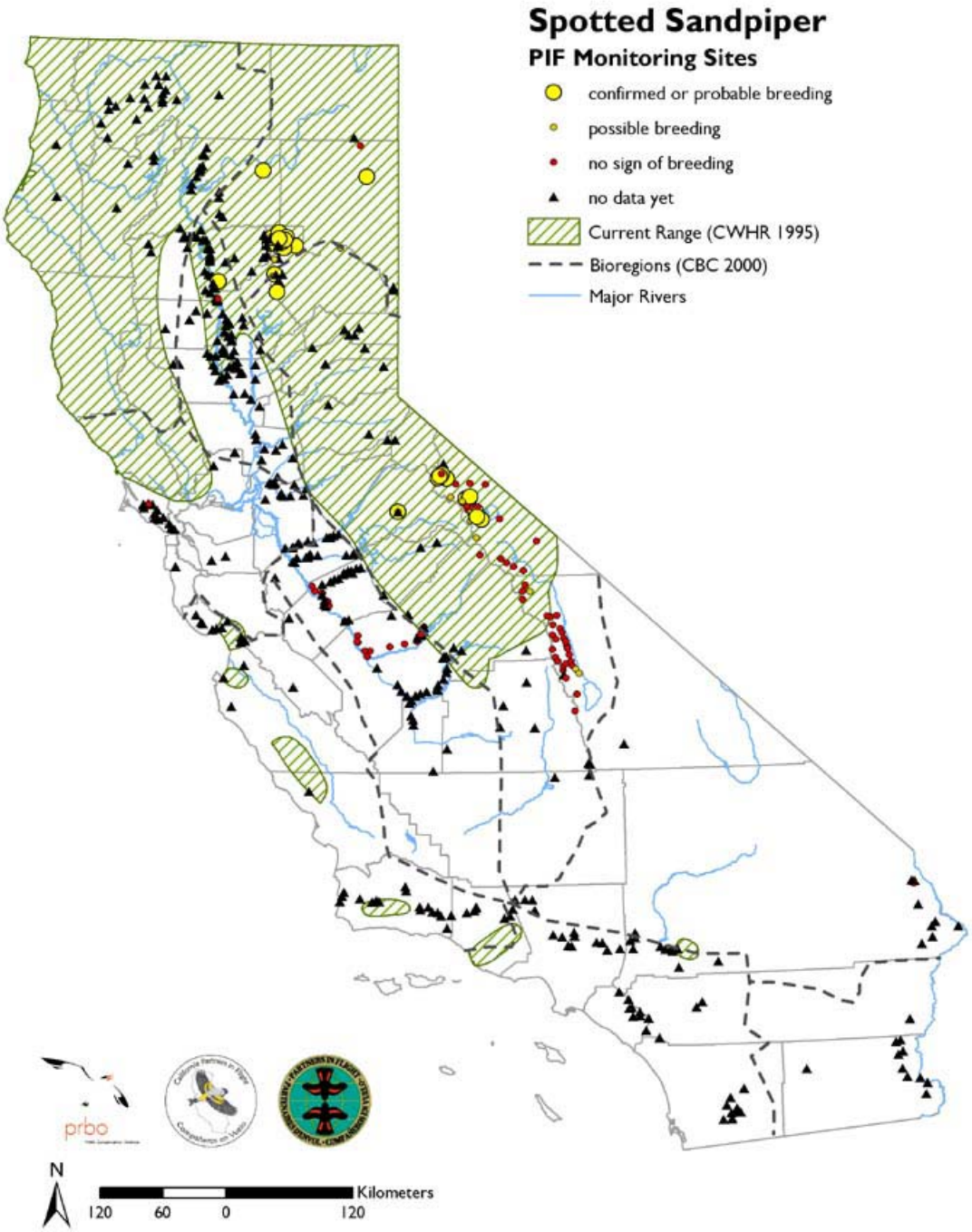

Figure 5-3. CalPIF monitoring sites, breeding status, and current range for the Spotted Sandpiper in California.

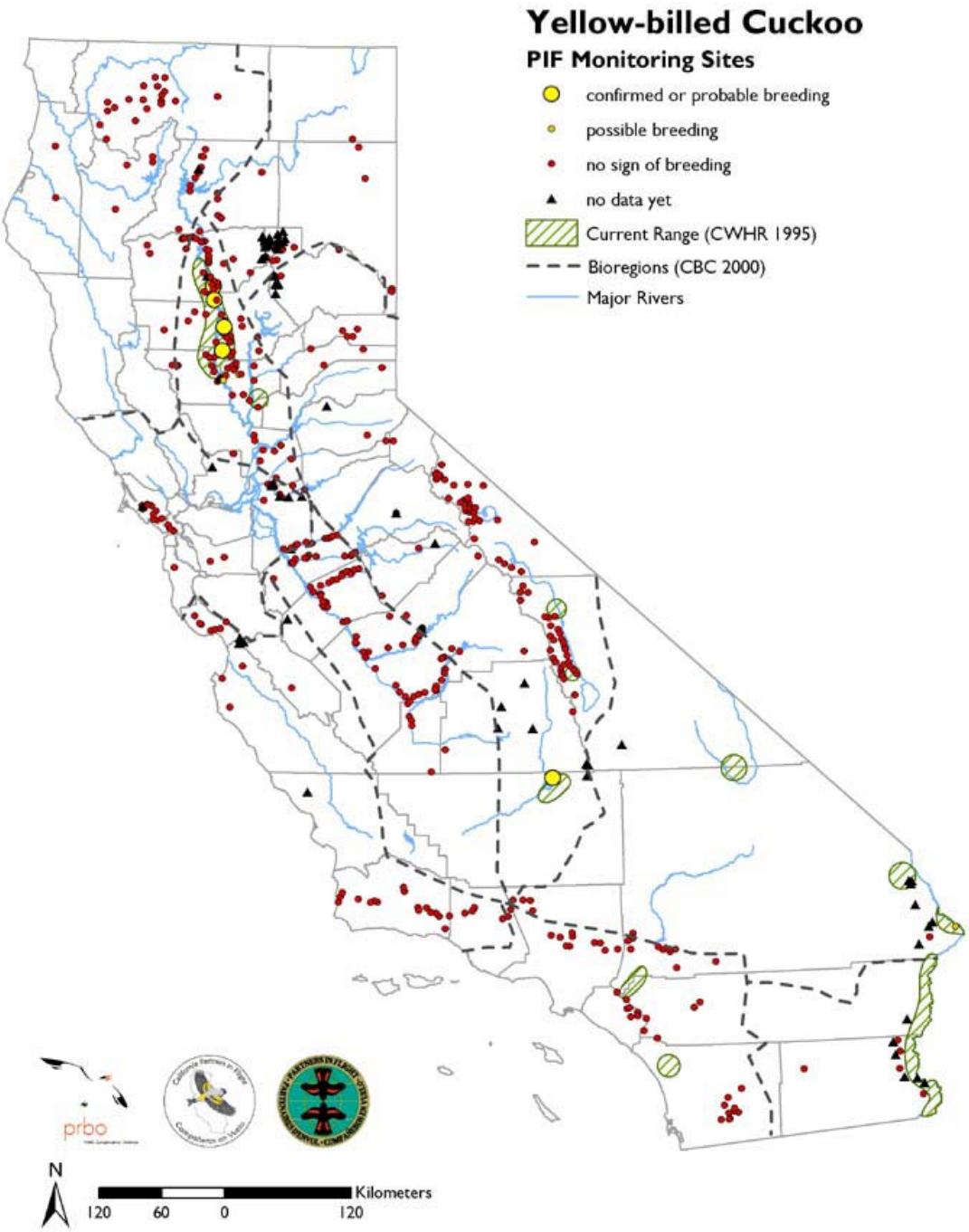

Figure 5-4. CalPIF monitoring sites, breeding status, and current range for the Western Yellow-billed Cuckoo in California.

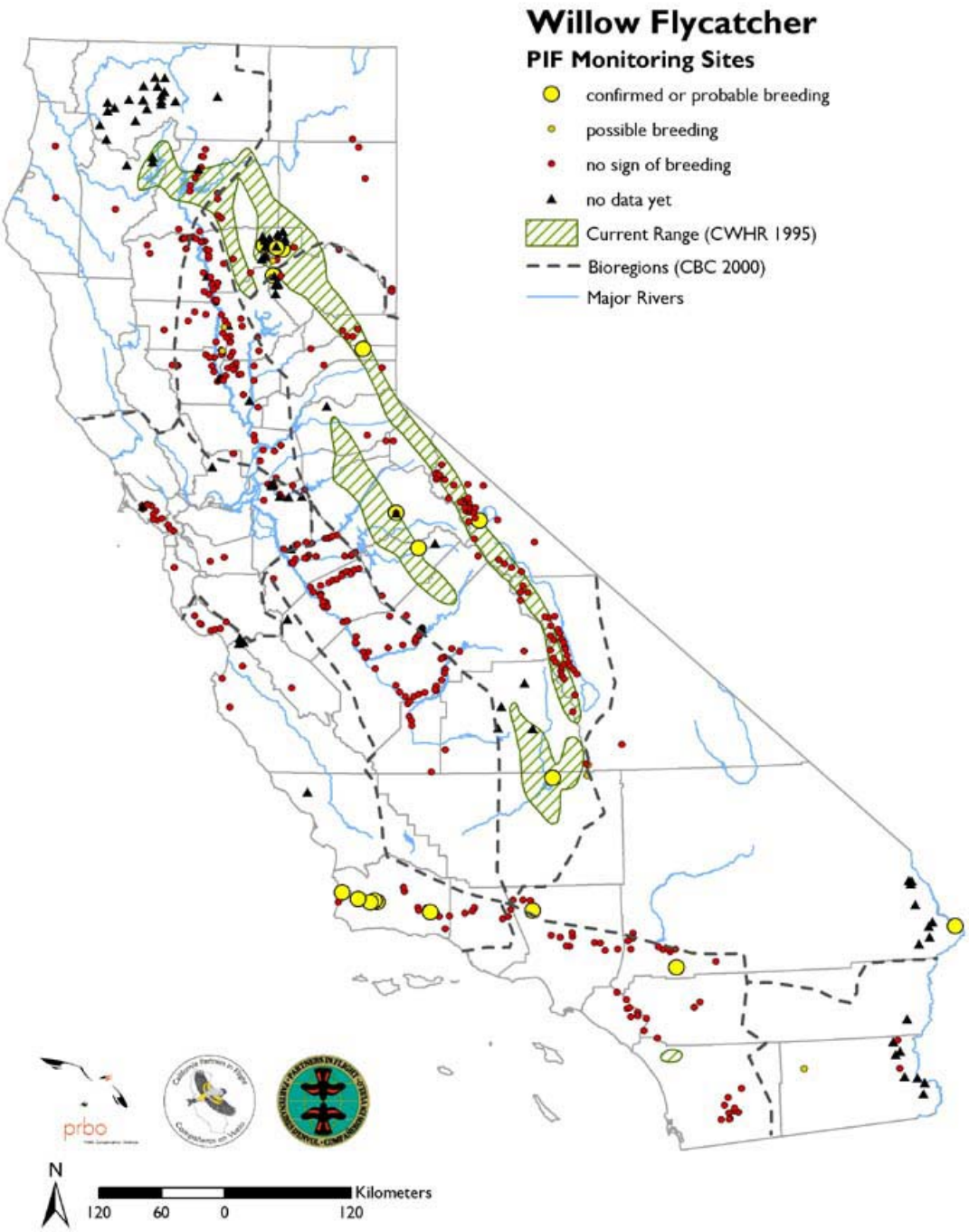

Figure 5-5. CalPIF monitoring sites, breeding status, and current range for the Willow Flycatcher in California.

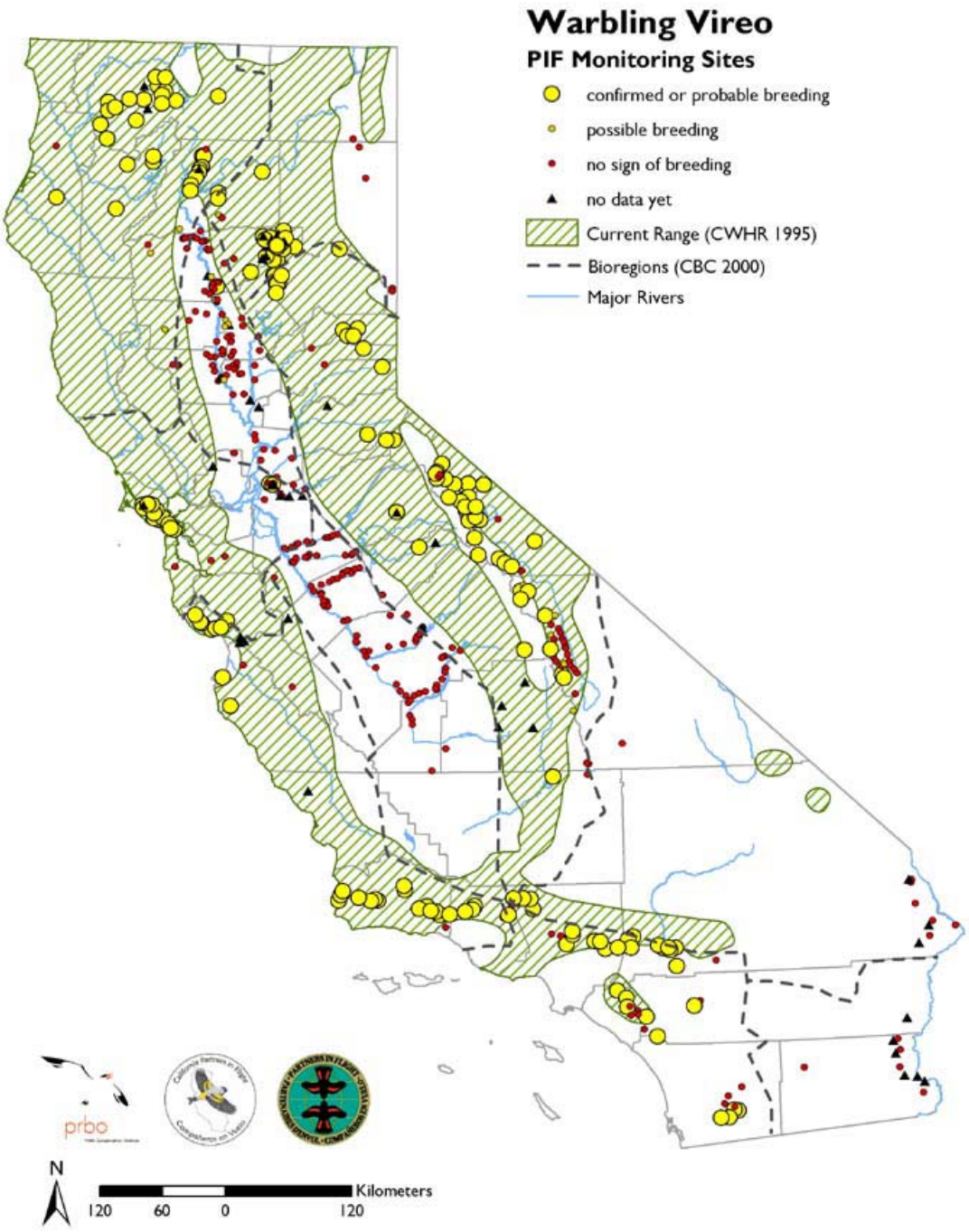

Figure 5-6. CalPIF monitoring sites, breeding status, and current range for the Warbling Vireo in California.

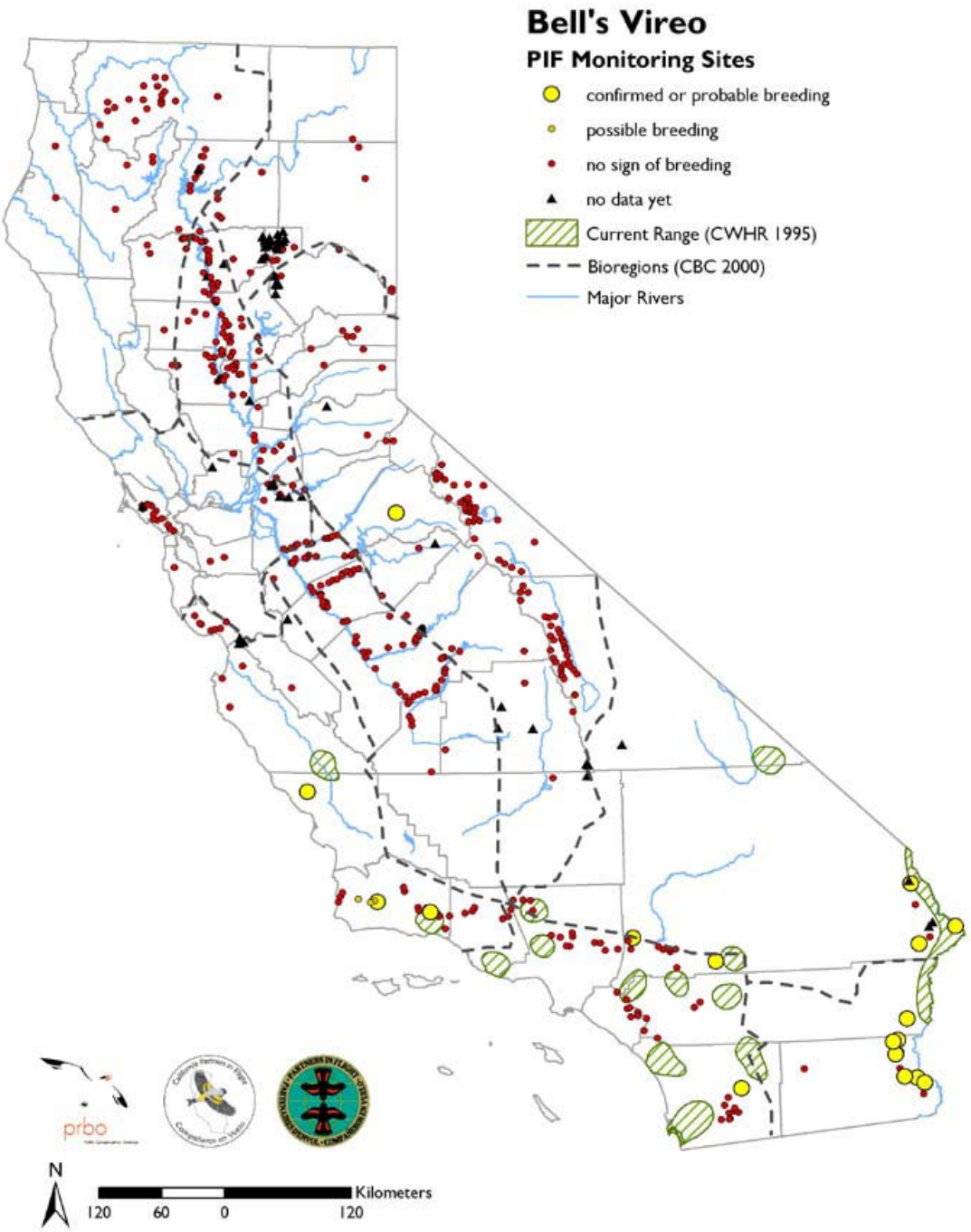

Figure 5-7. CalPIF monitoring sites, breeding status, and current range for the Least Bell's Vireo in California.

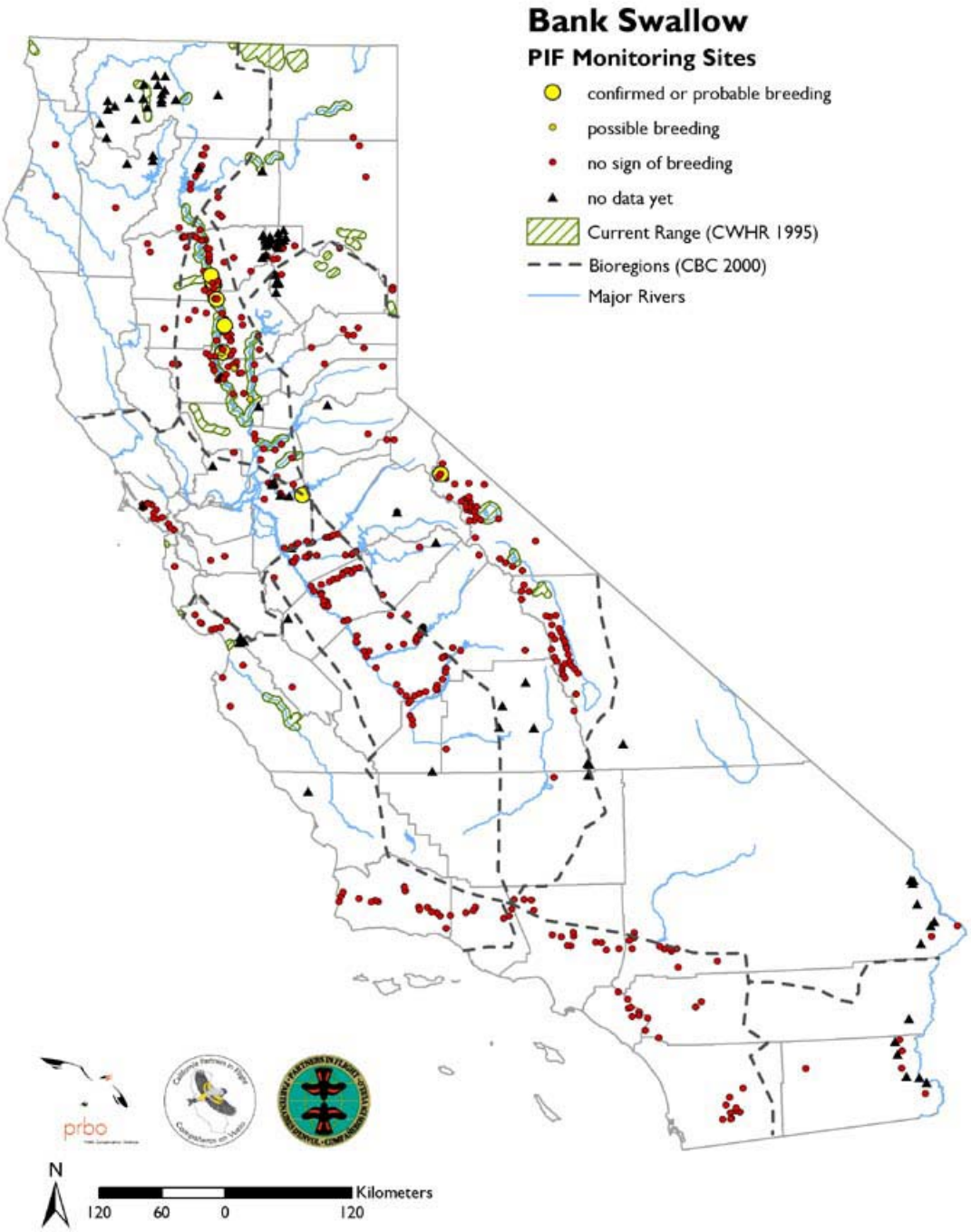

Figure 5-8. CalPIF monitoring sites, breeding status, and current range for the Bank Swallow in California.

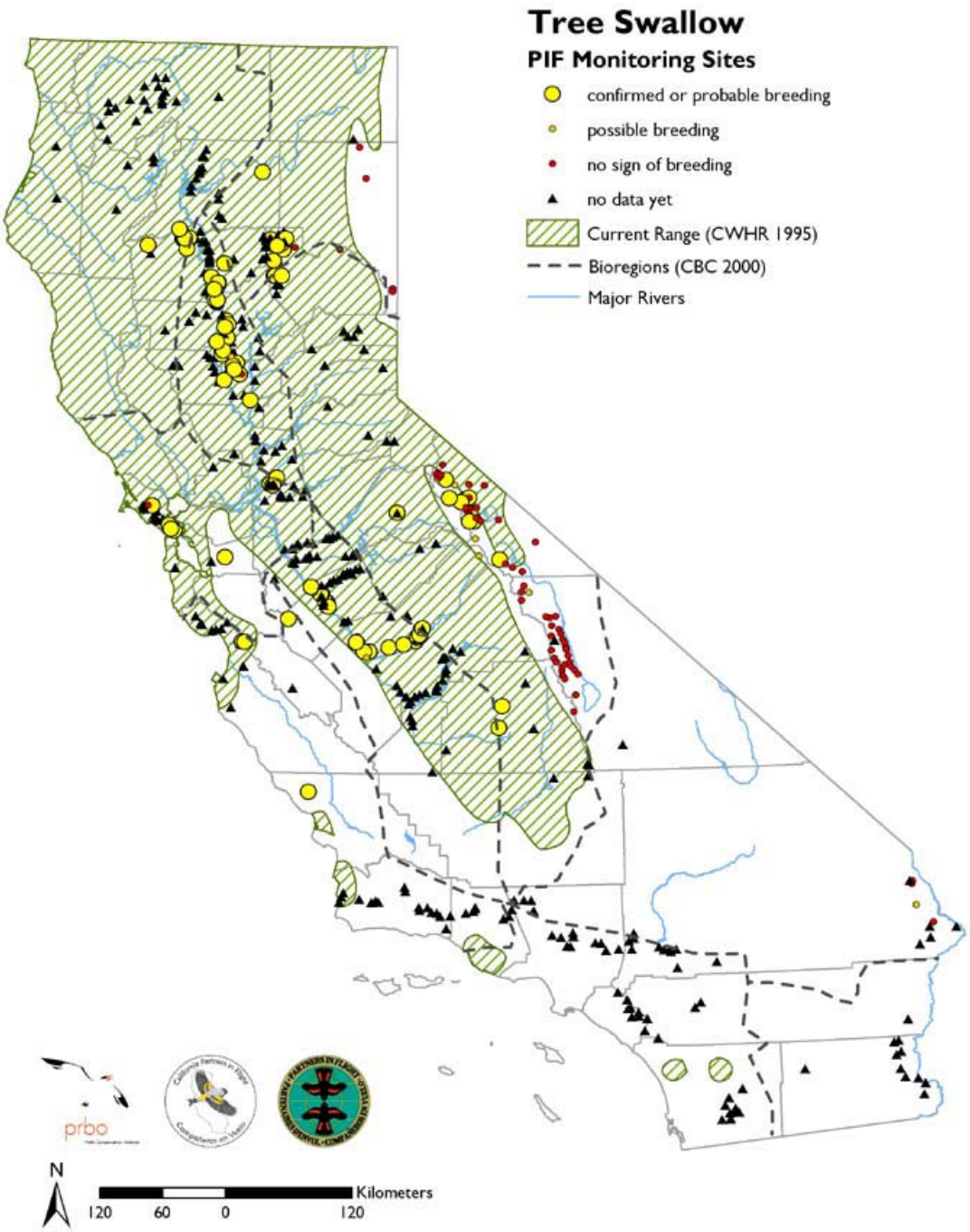

Figure 5-9. CalPIF monitoring sites, breeding status, and current range for the Tree Swallow in California.

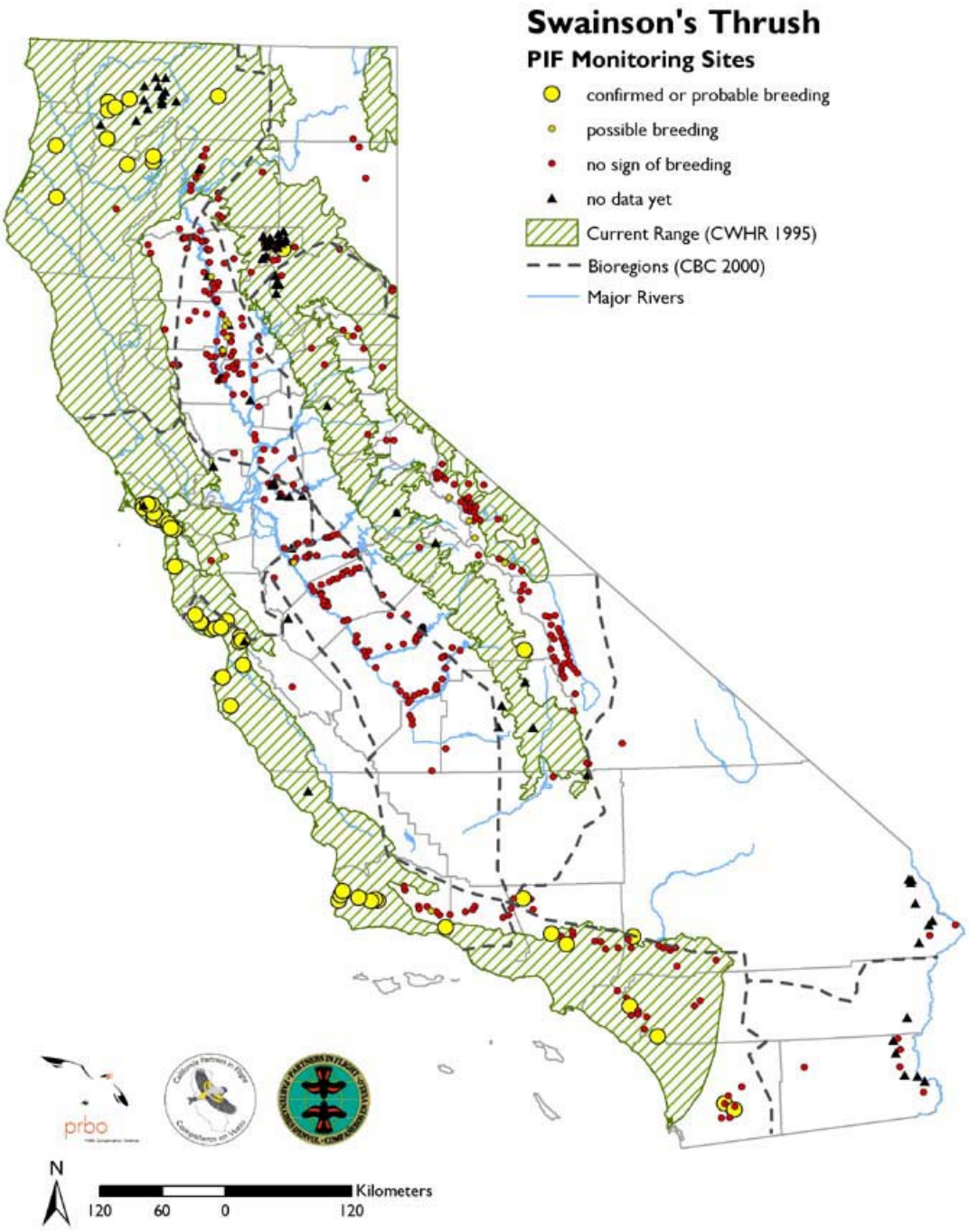

Figure 5-10. CalPIF monitoring sites, breeding status, and current range for the Swainson's Thrush in California.

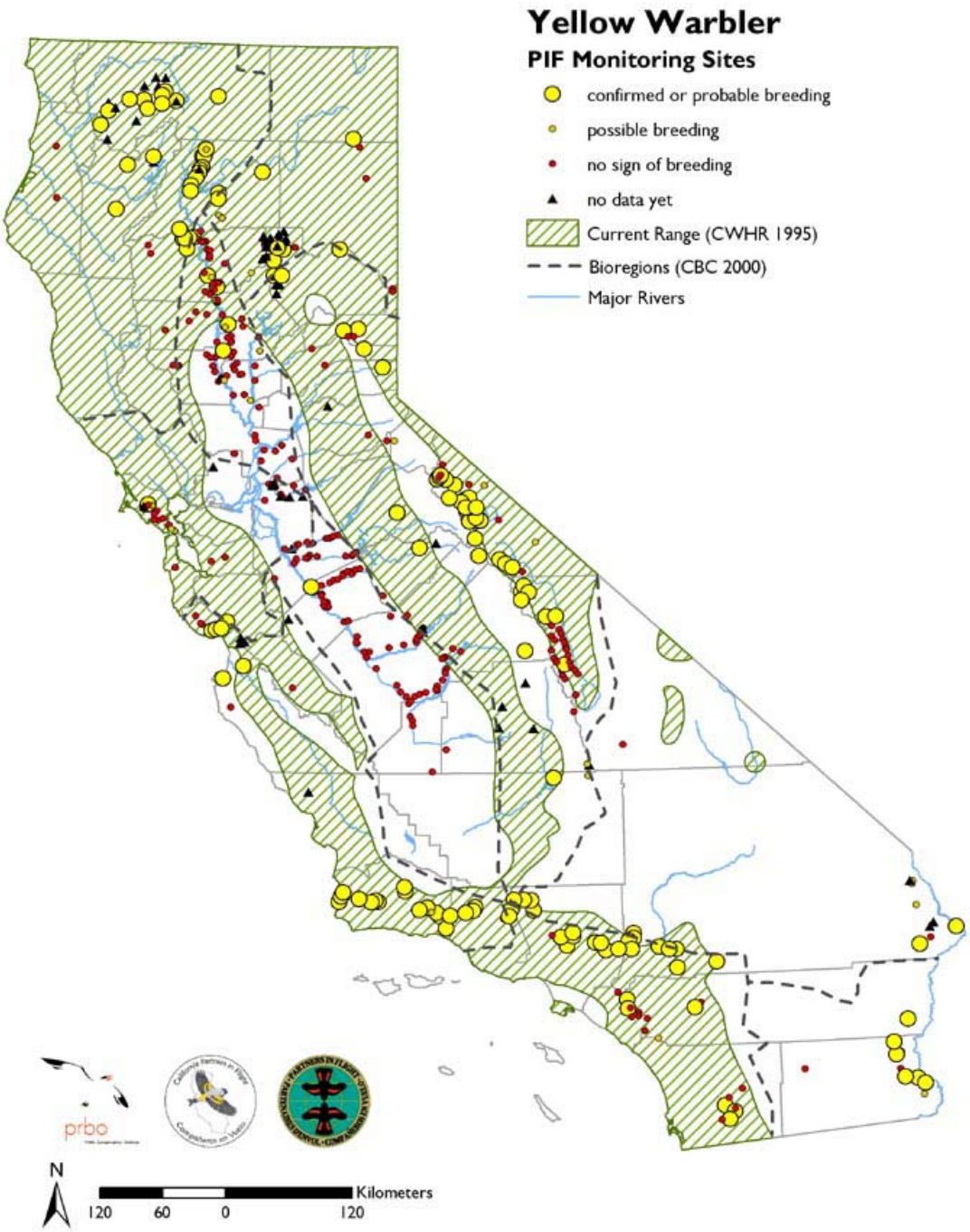

Figure 5-11. CalPIF monitoring sites, breeding status, and current range for the Yellow Warbler in California.

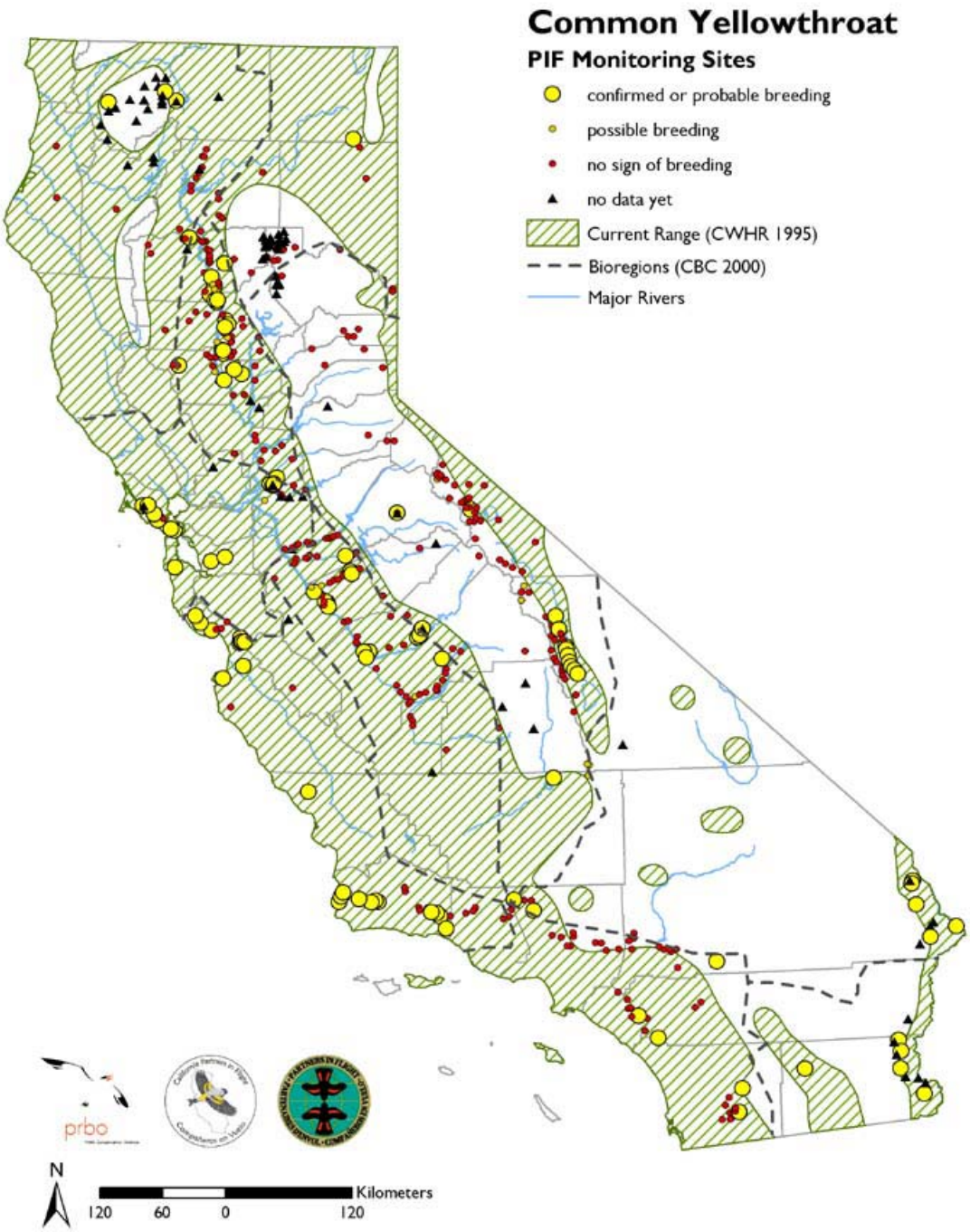

Figure 5-12. CalPIF monitoring sites, breeding status, and current range for the Common Yellowthroat in California.

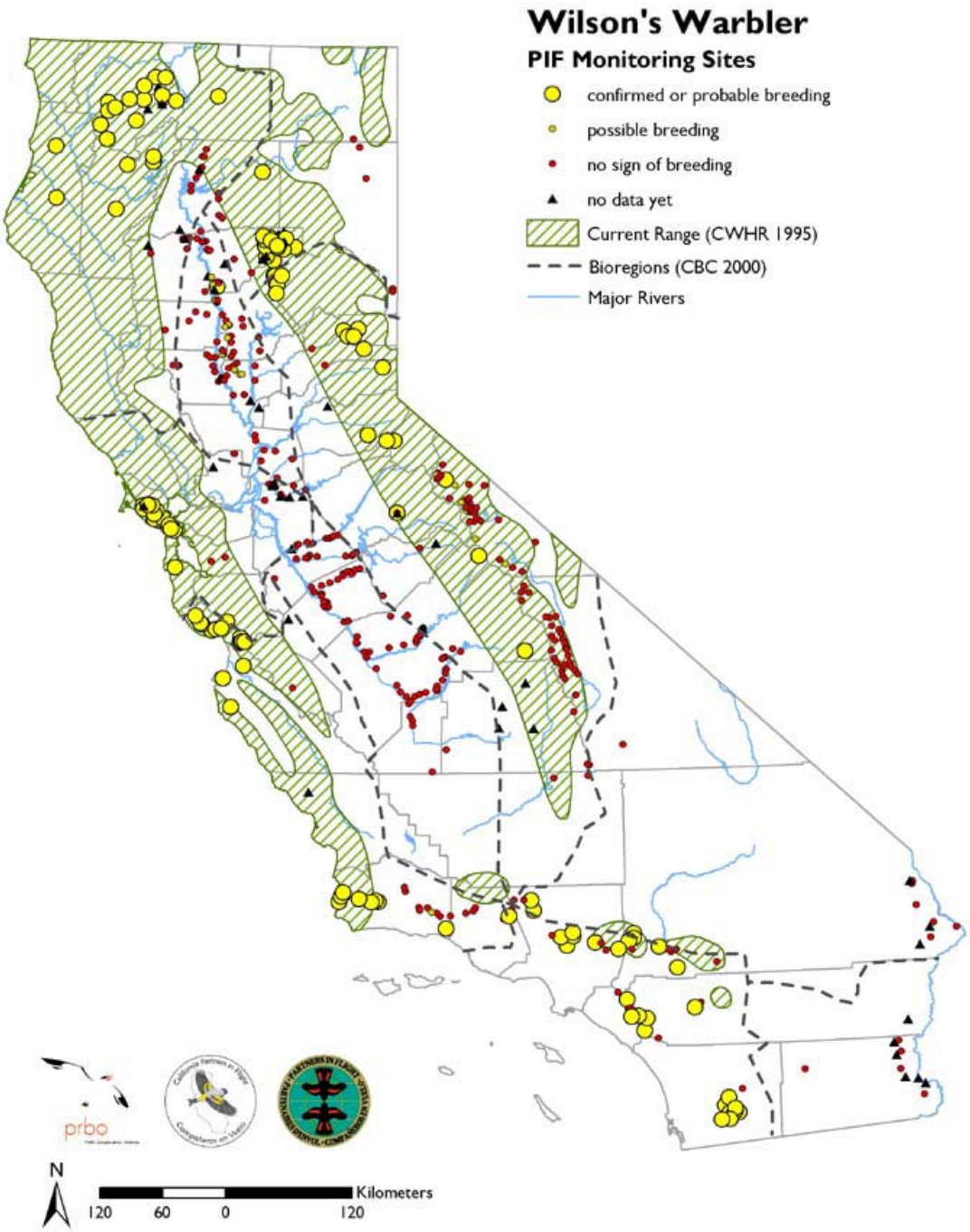

Figure 5-13. CalPIF monitoring sites, breeding status, and current range for the Wilson's Warbler in California.

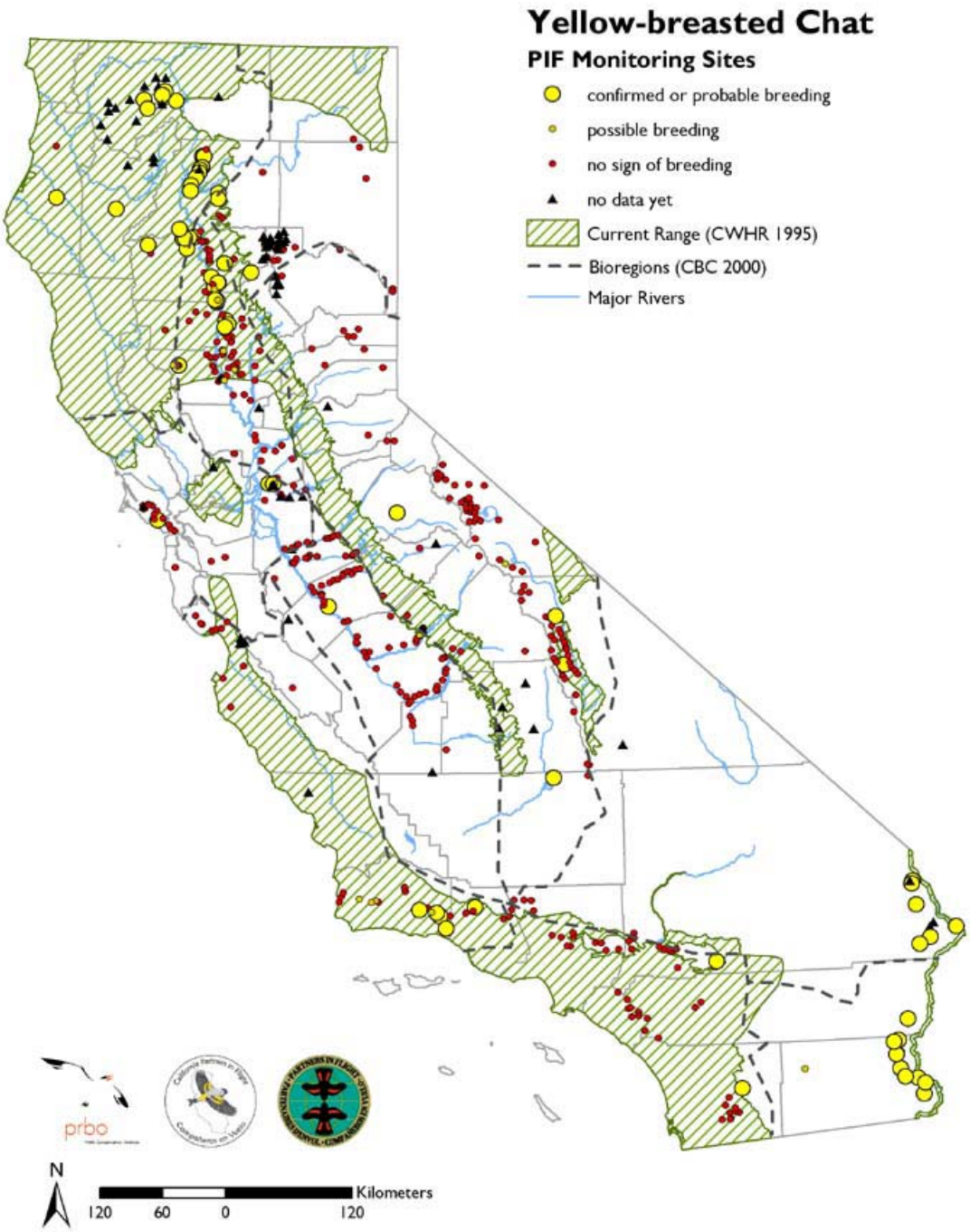

Figure 5-14. CalPIF monitoring sites, breeding status, and current range for the Yellow-breasted Chat in California.

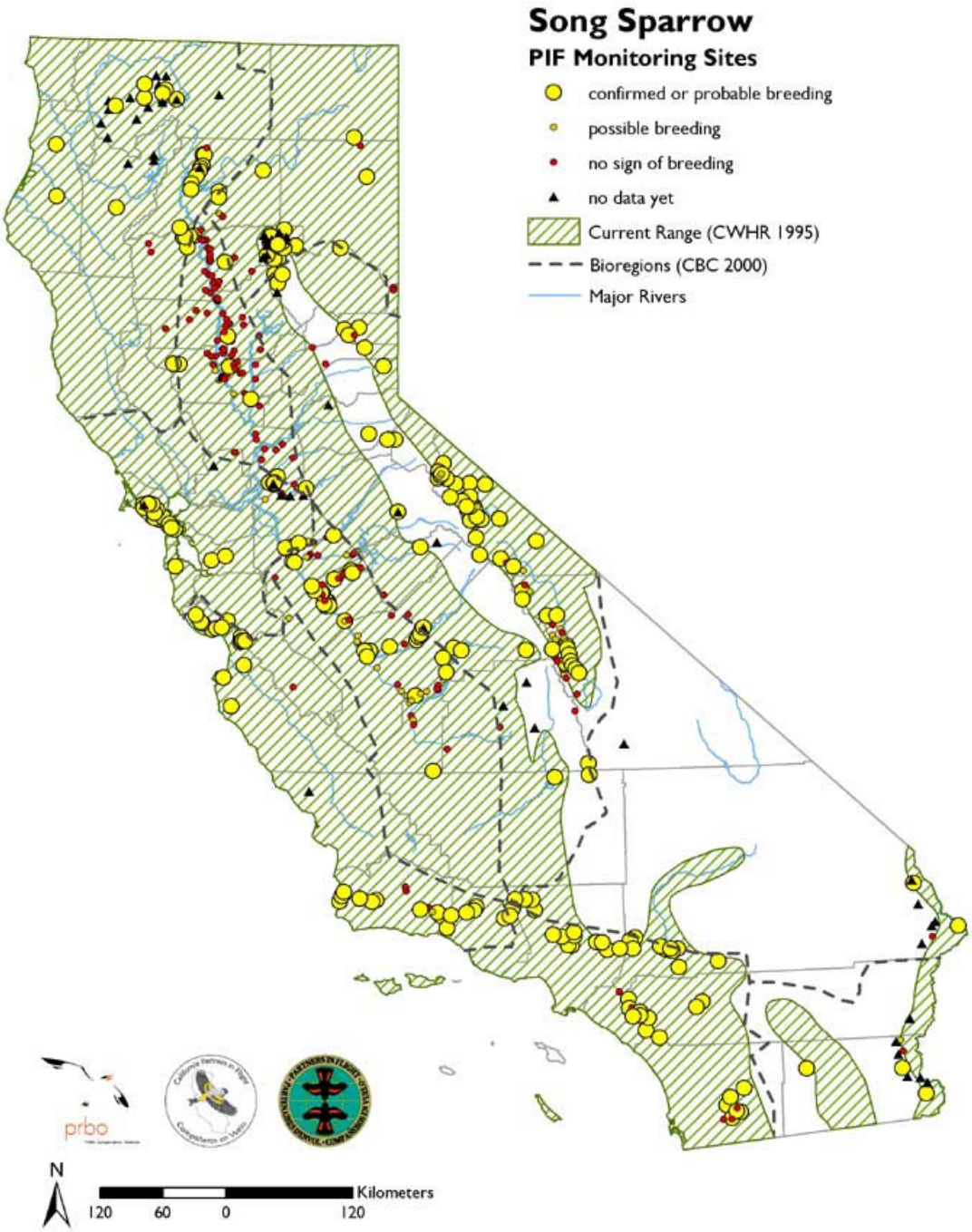

Figure 5-15. CalPIF monitoring sites, breeding status, and current range for the Song Sparrow in California.

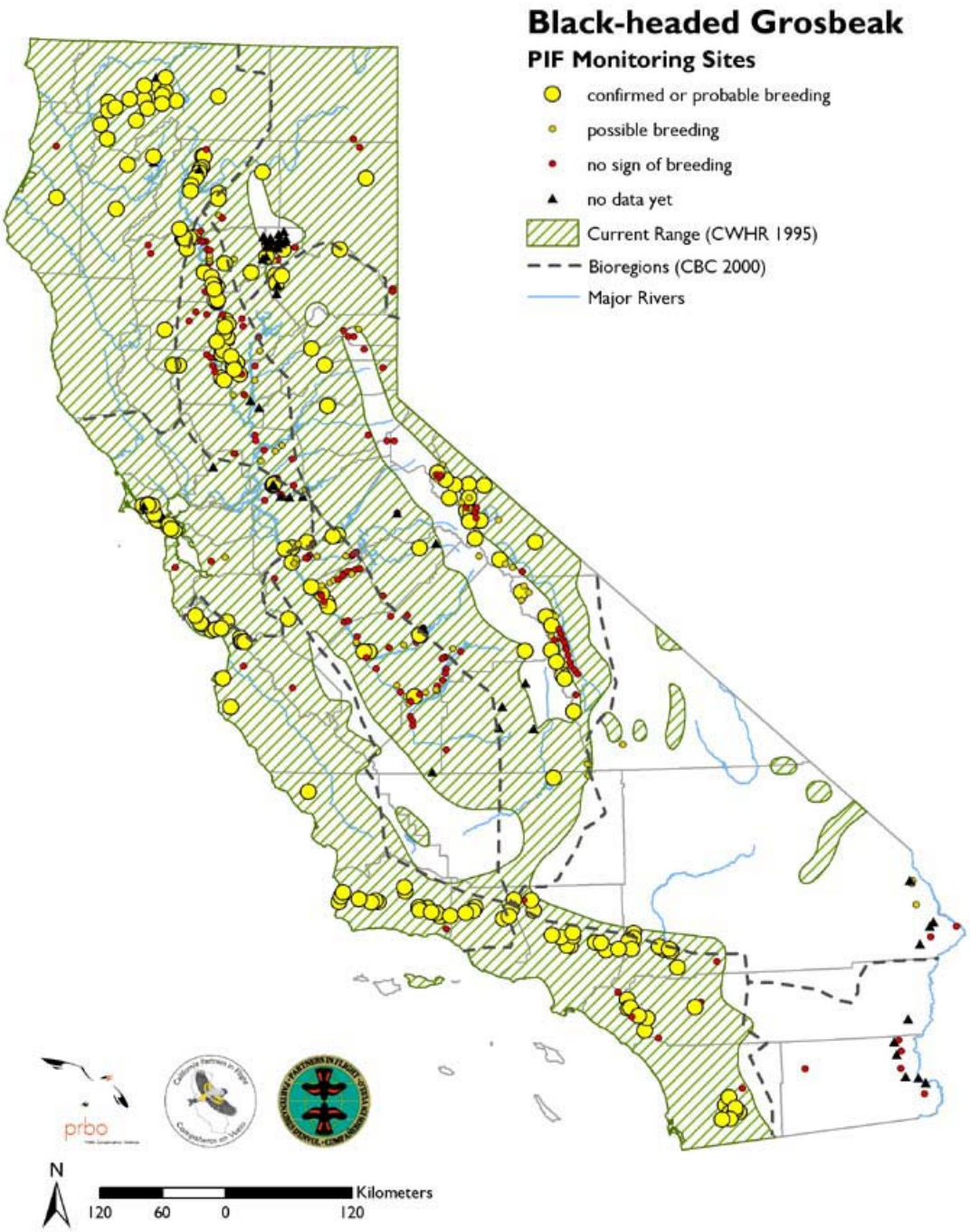

Figure 5-16. CalPIF monitoring sites, breeding status, and current range for the Black-headed Grosbeak in California.

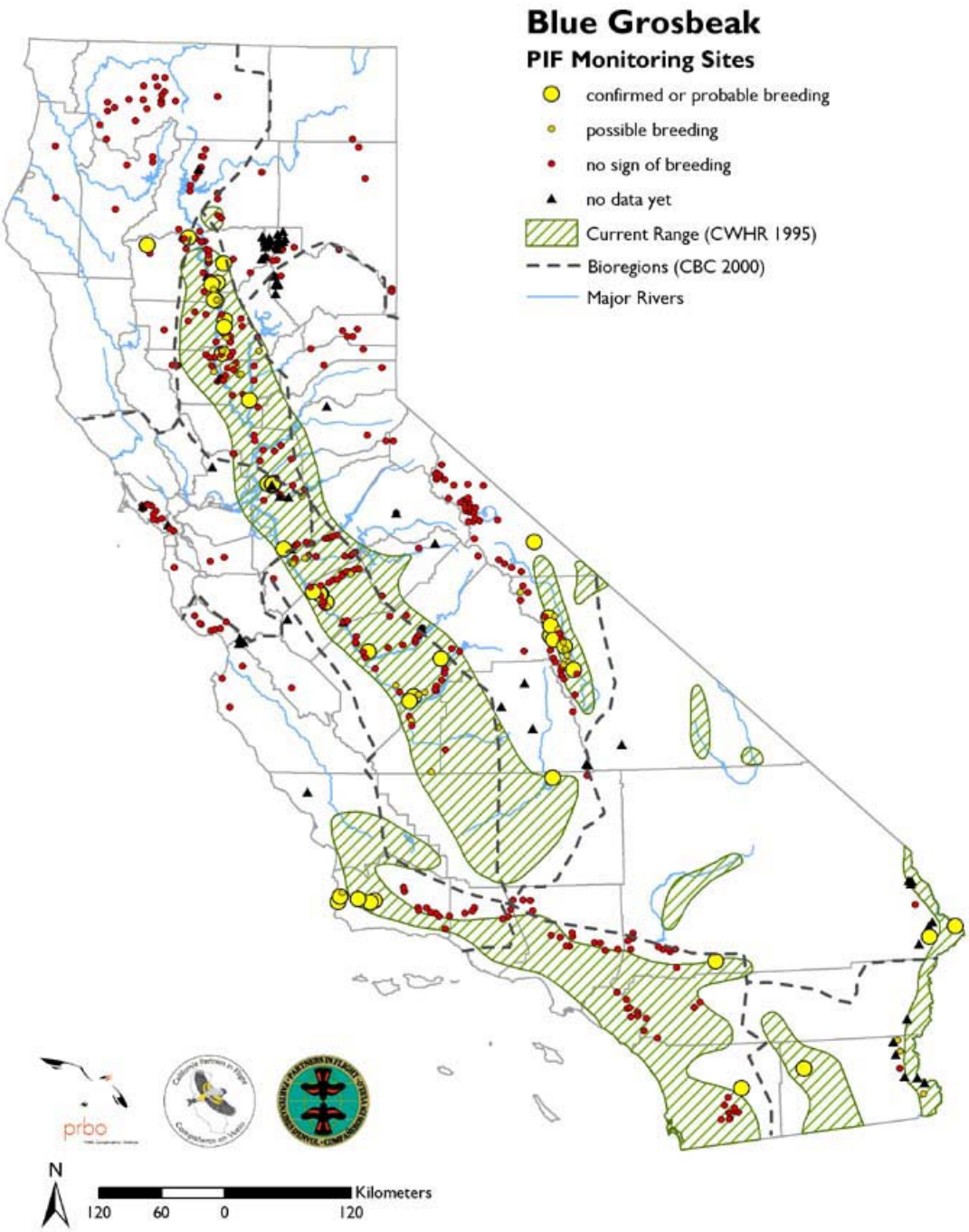

Figure 5-17. CalPIF monitoring sites, breeding status, and current range for the Blue Grosbeak in California.

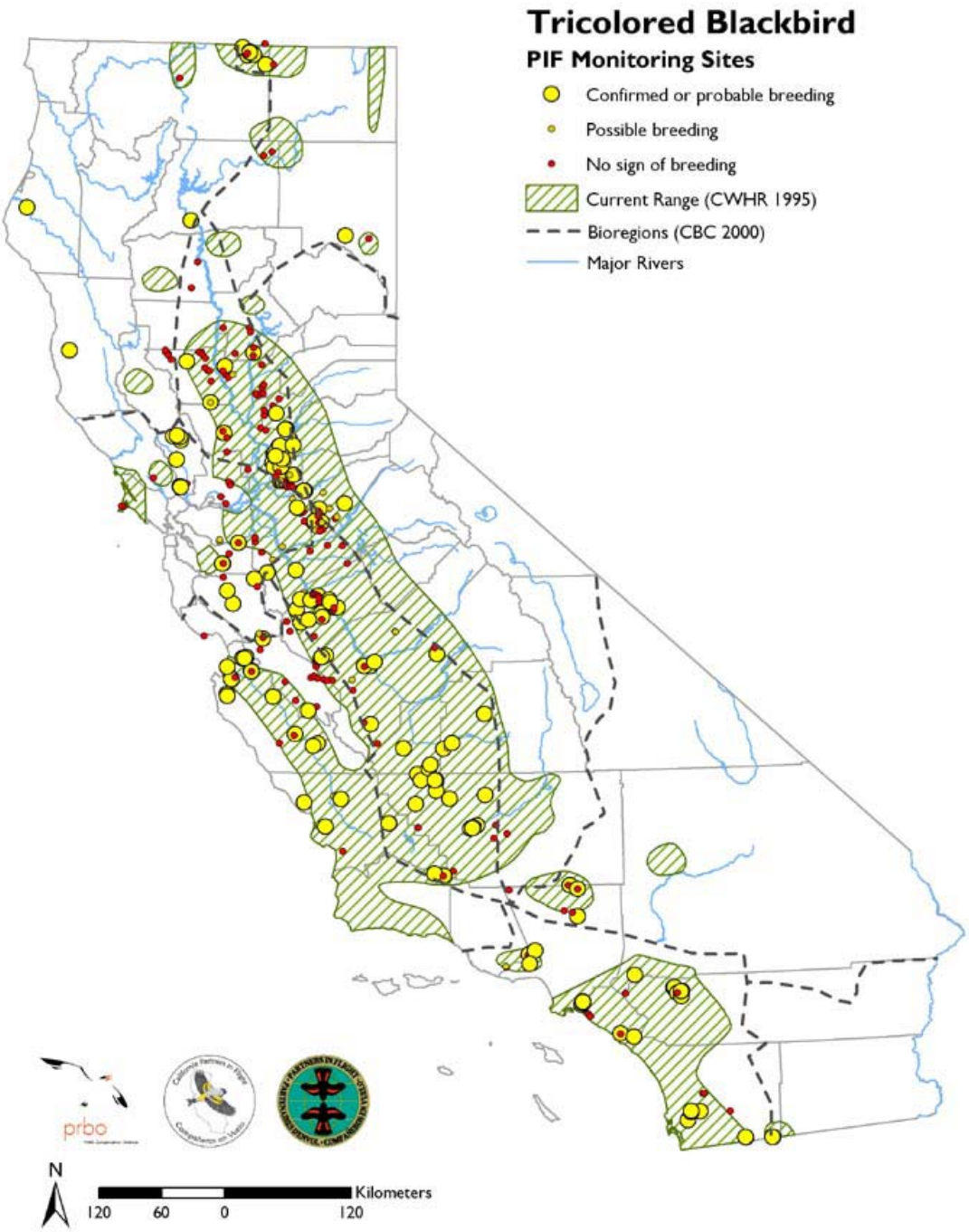

Figure 5-18. CalPIF monitoring sites, breeding status, and current range for the Tricolored Blackbird in California.

Table 5-1. Criteria for selecting the Riparian Bird Conservation Plan focal species.

Focal Species	Riparian Breeder	Special status	Reduction in breeding range	Abundant breeder in CA	Nest Site Location
Swainson's Hawk	X	X	X		Canopy
Spotted Sandpiper	X			X	Gravel Bar
Yellow-billed Cuckoo	X	X	X		Midstory to Canopy
Willow Flycatcher	X	X	X		Understory
Warbling Vireo	X		X	X	Canopy
Bell's Vireo	X	X	X		Understory
Bank Swallow	X	X	X		Sandy banks
Tree Swallow	X			X	2º Cavity
Swainson's Thrush	X		X	X	Understory
Yellow Warbler	X	X	X	X	Midstory
Common Yellowthroat	X	X	X	X	Understory
Wilson's Warbler	X			X	Understory
Yellow-breasted Chat	X	X	X		Understory
Song Sparrow	X		X	X	Understory
Black-headed Grosbeak	X			X	Midstory
Blue Grosbeak	X	X	X		Understory
Tricolored Blackbird	X	X	X		Understory

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 (see Appendix A for a summary, 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 2003). 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). In the West, Breeding Bird Surveys cover riparian habitat poorly because most survey routes occur on public lands and along roads, whereas riparian habitat tends to occur on private lands and/or away from roads. Furthermore, the inability of BBS data to detect trends within certain habitats, particularly patchily distributed habitats such as riparian, 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 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 5-19 provides a map of riparian bird data showing biodiversity "hotspots" in California riparian habitats as defined by the richness of 16 of the 17 focal species.

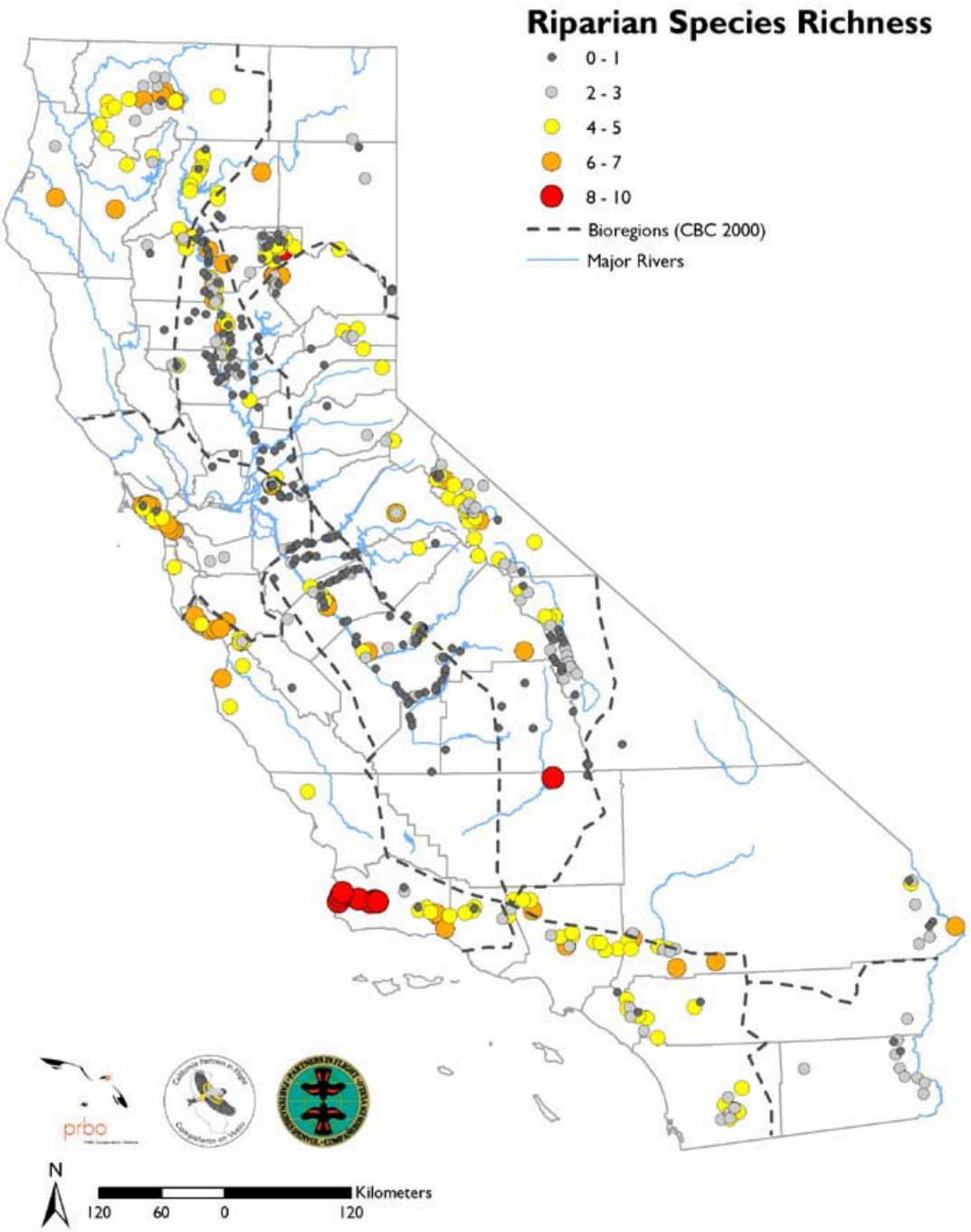

Figure 5-19. Species richness for 16 of the 17 focal riparian species at census sites throughout California. Data were collected and submitted by CalPIF contributors.

Table 5-2. Status, special factors, and nesting requirements of riparian focal species.

Species	Statewide Status	Historical Breeding Range	Special Factors	Nest Site	Breeding Grounds Description	Territory Size and Breeding Density
Swainson's Hawk	• CA Threatened species • CA may have declined by as much as 90%.	SACR, BA/DE[2], SAJO, CECO[2], SINE, MOJA[2], COLD[2]	• Disturbance can lead to nest abandonment. • Poisoned by pesticides during migration and over winter.	Varied. Constructs nests in wide variety of trees.	Occupy a wide variety of open habitats with suitable nest trees, typically riparian forest or remnants.	Variable. Home range varies from 69-8,718 ha. Depends on availability of nest trees.
Spotted Sandpiper	• None	KLAM[2], MODO[2], BA/DE[2], SINE, SOCO[2], CECO[2], MOJA[2]	• Loss of nesting habitat from flood control projects and water diversions. • Abrupt changes in water level from human management or recreation during breeding season can cause nest failure. • Responds quickly to restoration efforts. • Benefits from healthy riparian systems in which flooding, and thus early successional vegetation and exposed gravel are prevalent.	Exposed gravel bars along streams, lakes and reservoirs. Often utilizes slight vegetative cover and litter.	Prefers early successional riparian.	Polyandrous. Sierra Nevada: 0.10 – 0.39 nest/ha found and 0.19 – 0.50 females/ha (PRBO data).

Table 5-2. Status, special factors, and nesting requirements of riparian focal species.

Species	Statewide Status	Historical Breeding Range	Special Factors	Nest Site	Breeding Grounds Description	Territory Size and Breeding Density
Willow Flycatcher	• All three subspecies in CA listed as State Threatened and USFS Region 5 Sensitive Species. *E.t. extimus* is federally listed as Endangered. • Extirpated from much of historical breeding range.	KLAM[2], MODO, BA/DE[2], SAJO[2], SINE, CECO, SOCO, COLD (AZ).	• Negatively affected by livestock grazing, which changes riparian hydrology and vegetation composition, and damages nests. • Common Brown-headed Cowbird host. Trapping at South Fork Kern River reduced parasitism by 30-50%. • Recreational activities in riparian areas can reduce the quality of habitat for WIFL. • Not adequately monitored by many multispecies census	Generally in willows, alders, and cottonwoods or other riparian deciduous vegetation. Will also nest in non-native vegetation, such as tamarisk.	Varies by subspecies. Please refer to species account. Typically prefers dense patches and early successional riparian areas.	Varies by subspecies and region. *E.t. brewsteri* in eastern Fresno Co.; territories averaged 0.18 ha, and in Sierra Co. averaged 0.34 ha. *E.t. extimus* averaged 0.06-1.5 ha in Arizona and 0.6-1.1 ha on South Fork Kern River.
Warbling Vireo	• Declining in CA.	KLAM, MODO, SACR[2], BA/DE, CECO, SAJO[2], SINE, SOCO	• Common Brown-headed Cowbird host; parasitism in Sierra Nevada may be severe enough to depress population • Sensitive to loss of deciduous trees. • Population size likely limited primarily on breeding grounds from Brown-headed Cowbird parasitism and nest predation.	Nests high in deciduous trees. In Marin County, prefers willows and red alders.	Prefers large deciduous trees associated with streams, semi-open canopy. Shrub layer seems unimportant.	1.2 ha according to only reported account. Density: 1.1 pairs/ha in Bay-Delta. In AZ, densities were 0.52-0.63 pairs/ha in unlogged forests although they were 0.88-1.1 pairs/ha in selectively logged areas
Least Bell's Vireo	• Federal Endangered species. • Extirpated from or reduced in much of historical range.	SACR[2], SOJA[2], BA/DE[2], SINE[2], SOCO, MOJA, COLD, CECO	• Common Brown-headed Cowbird host. • Benefits from Brown-headed Cowbird control efforts.	Nests typically within 1 m of the ground in dense vegetation.	Prefers early successional riparian areas.	Territory size ranges from 0.2-3.0 ha; averages 0.6 (SD=0.3) to 1.1 (SD=0.6) ha.

Table 5-2. Status, special factors, and nesting requirements of riparian focal species.

Species	Statewide Status	Historical Breeding Range	Special Factors	Nest Site	Breeding Grounds Description	Territory Size and Breeding Density
Bank Swallow	• California Threatened Species. • Nesting populations appear to be declining.	KLAM, MODO, SACR, CECO, SINE, SOCO[2]	• Loss of nesting habitat from bank protection and flood control projects. • Abrupt changes in water level from human management or recreation during breeding season can cause nest failure.	Burrows in vertical faces of bluffs or banks higher than 1 meter tall. Requires friable soils.	Variable. Requires vertical banks and bluffs, often from flooding and associated erosion events.	NA. Nest burrows are placed 1-59 cm apart. Varies from solitary to 1,500 pairs in a colony.
Tree Swallow	• None	KLAM, MODO, SACR, BA/DE, SAJO[2], SINE, GRBA, CECO, SOCO	• Natural nests require trees of considerable trunk diameter (>13cm), but nest-boxes can provide habitat in the absence of large trees. • Requires open areas for coursing feeding flights. • Eggs are vulnerable in shrubby habitats to puncturing by male House Wrens. • Nests near livestock can be subject to intense nest site competition from House Sparrows, sometimes resulting in the death of the defending swallows.	Uses cavities in the range of heights that are available, but appears to prefer sites 1.5-6.1 meters above the ground. Natural cavities in cis-montane California likely in cottonwoods or sycamore. In mountain and Great Basin habitats, often nests in aspen.	Without nest-boxes, prefers edges of riparian areas with large trees for nesting. Nest-boxes encourage this species to nest in a wide variety of habitats, from upland areas to sewage ponds. All foraging is done in open areas, preferably near water, and not in dense riparian forest.	Territory limited to immediate vicinity of nest-cavity. Fighting over nest-cavities, with own and other species, can be quite intense. Territory is not defended more than a few yards away from the nest. Nest densities depend on availability of nesting cavities, and nearest neighbor distances of 15 meters or less are not uncommon if cavity availability is high.

Table 5-2. Status, special factors, and nesting requirements of riparian focal species.

Species	Statewide Status	Historical Breeding Range	Special Factors	Nest Site	Breeding Grounds Description	Territory Size and Breeding Density
Yellow Warbler	• CA Species of Special Concern (both as species and as subspecies *D. p.sonorana*). • Extirpated or declining in much of historical breeding range.	KLAM, MODO, SACR?, BA/DE, SAJO[2], SINE, GRBA, CECO, MOJA, SOCO, COLD	• Common Brown-headed Cowbird host. • Needs more subspecies-specific information in regards to Brown-headed Cowbird parasitism and habitat needs. • More data on productivity needed in CA. • Grazing reduces quality of nesting habitat. • Species seems to respond quickly to management actions such as restoration and Brown-headed Cowbird control.	Varies by bioregion. Often nests in deciduous riparian plant species, such as willows and cottonwoods, but also breeds locally in wild rose and more xeric plant species and habitats.	Generally found in wet areas with early successional riparian communities, or in remnant or regenerating canopy species stands. Will also breed locally in xeric shrub fields.	In early successional restored habitats in the eastern Sierra Nevadas, density ranged from 0.4 – 2.74 territories/ha. Territory sizes ranged from 0.06 – 0.75 ha.
Wilson's Warbler	• Shows significant decline in CA from 1966-1996 according to BBS data.	KLAM, MODO, BA/DE, SINE, GRBA, CECO, SOCO.	• Common Brown-headed Cowbird host. Abundance negatively correlated with abundance of Brown-headed Cowbird. • Loss of herbaceous cover during breeding season may reduce nest success. • Grazing may result in increased frequency of above points. • Loss of nesting habitat and pressure from Brown-headed Cowbird has resulted in reduction of breeding range.	Nests in riparian deciduous plants as well as grass, nettles, and ferns. Nest height from 0.3-3.0 meters, but mostly below 0.9 meters.	Prefers willows, alders, and shrub thickets and areas with tall trees and moderate to thick canopy cover.	In the Bay-Delta region: 0.57/ha (range 0.2-1.3 ha)

Table 5-2. Status, special factors, and nesting requirements of riparian focal species.

Species	Statewide Status	Historical Breeding Range	Special Factors	Nest Site	Breeding Grounds Description	Territory Size and Breeding Density
Yellow-breasted Chat	• California Species of Special Concern. • Appears to be reduced in much of historical range.	KLAM, MODO, SACR,COLD BA/DE, SAJO?, SINE[2], CECO, MOJA, SOCO .	• Common Brown-headed Cowbird host[5]. • Any activity, such as grazing, that leads to the disappearance of dense, shrubby areas will be detrimental[5].	Nests in low, dense shrubs 0.3-2.4 meters high.	Prefers riparian habitat and marsh margins[5]. Often found in early successional riparian habitat.	In California riparian habitat, densities ranged from 6.5-27 males/100 ha[5].
Black-headed Grosbeak	• Population appears stable.	KLAM, MODO, SACR, BA/DE, CECO, SINE, SOCO	• Vulnerable to loss of riparian habitat for nesting. • Highest quality territory of males are where densities of Western Scrub-jays are low. • Responds quickly to restoration efforts.	Highly variable. In riparian, nests in willow, alder, and ash with fairly high nest cover.	Prefers semi-open canopy with moderate shrub cover and vertical stratification of vegetation layers. Often nests in early to mid-successional riparian areas.	No data for California. 1.9-3.9/ha in n. Utah.
Blue Grosbeak	• Appears to be reduced in much of historical range.	SACR, BA/DE, CECO, SINE, MOJA, COLD, CECO	• Common Brown-headed Cowbird host, but can raise both parasite and own young. • Benefits from a healthy riparian system where herbaceous annuals and early successional plant species are abundant. • Patch size and fragmentation seem unimportant to this species.	Nests in vertical forbs, young willows and cottonwoods, and herbaceous annuals.	Riparian edge species, preferring the annual forbs, young deciduous plants, and low canopy cover found in early successional riparian habitat.	No data for California. 1.2-6.2/ha in southeast U.S.
Song Sparrow	• *M.m.mailliardi* subspecies is a California Species of Special Concern[4].	KLAM, MODO, SACR, SINE, SAJO,COLD CECO, SOCO	• Common Brown-headed Cowbird host. • Responds quickly in many areas to restoration efforts (PRBO data).	Varies by bioregion.	Varies by bioregion. Breeds in early successional riparian, wetlands, coastal scrub, and marshes (PRBO data).	Bay Delta Coastal Scrub: 0.88 terr./ha. Bay Delta Salt Marsh: 14.9 detected per hectare (PRBO data).

Table 5-2. Status, special factors, and nesting requirements of riparian focal species.

Species	Statewide Status	Historical Breeding Range	Special Factors	Nest Site	Breeding Grounds Description	Territory Size and Breeding Density
Tricolored Blackbird	• California Species of Special Concern.	KLAM, MODO, SACR, BA/DE, SAJO, SINE[2], CECO, SOCO	• Loss of nesting and foraging and habitat due to agricultural and urban development[3]. • Significant reproductive losses annually due to crop harvesting activities[3]. • Failure of entire nesting colonies due to pesticides and other contaminants[3].	Dense patches of cattails and/or bulrushes. Blackberry[3].	Prefers freshwater wetlands and weedy, fallow fields[3].	Male territory size ranges from 1.8m^2 to 3.25m^2

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

2. Not recently detected and/or extirpated from this bioregion.

3. Beedy and Hamilton 1999.

4. CDFG and PRBO 2001.

5. Eckerle and Thompson 2001.

Chapter 6. Population Targets

California Partners in Flight and the Riparian Habitat Joint Venture seek to develop population targets that will guide avian and habitat conservation efforts and provide them with a gauge of success. 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 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 *in press*).

In this document, two approaches for deriving population targets of riparian focal species are examined. The first approach provides estimates of population size, where data exists, from two avian monitoring techniques (point counts and spot mapping) for the 17 focal species in each bioregion (Table 6-1). These density estimates are to be used with caution and are provided as a reference for comparison when collecting similar data. In general, these estimates are taken from the highest recorded density in regions where populations are believed to be viable as estimated from demographic monitoring (Sherry and Holmes 2000). The second approach is a process still in development that has been completed for six species in the 12 basins of the Central Valley (Figure 3-1). The following six species were used primarily because of data availability and distribution in the Central Valley: Yellow Warbler, Common Yellowthroat, Yellow-breasted Chat, Spotted Towhee, Song Sparrow, and Black-headed Grosbeak. Other species estimates and more detailed descriptions may be found on the CalPIF website. The description as follows has been presented and critiqued at various meetings (Geupel et al. 2003) and incorporated into the Strategic Plan of the RHJV.

Photo by James Gallagher, Sea and Sage Audubon

Population targets will help guide avian and habitat conservation efforts.

Table 6-1. Estimates of maximum breeding abundance by species and bioregion[a].

Species	Bay-Delta		South Coast		Sierra		San Joaquin		Central Coast	
	Point Count[b]	Spot Map[b]	Point Count	Spot Map[c]	Point Count[d]	Spot Map[e]	Point Count[b]	Spot Map	Point Count	Spot Map
Swainson's Hawk	-	-	-	-	-	-	-	-	-	-
Spotted Sandpiper	-	-	-	-	-	-	-	-	-	-
Yellow-billed Cuckoo	-	-	-	-	-	0.85	-	-	-	-
Willow Flycatcher	-	-	-	-	-	9.6	-	-	-	-
Warbling Vireo	1.30	18.0	-	-	1.20	-	-	-	0.54[b]	-
Bell's Vireo	-	-	-	-	-	-	-	-	-	-
Bank Swallow	-	-	-	-	0.56	-	-	-	-	-
Tree Swallow	0.16	-	-	-	0.20	-	1.50	-	-	-
Swainson's Thrush	1.90	322.2	-	-	0.04	-	-	-	0.56[b]	-
Yellow Warbler	-	-	-	0.20	2.50	-	-	-	0.30[b]	-
Common Yellowthroat	0.42	-	-	-	0.83	-	0.53	-	0.10[b]	-
Wilson's Warbler	1.69	288.6	-	-	-	-	0	0	1.20[b]	-
Yellow-breasted Chat	-	-	-	-	0.40	-	-	-	0.15[b]	-
Black-headed Grosbeak	0.91	117.6	-	-	0.17	-	0.43	-	0.72[b]	-
Blue Grosbeak	-	-	-	-	0.05	-	0.33	-	0.07[b]	-
Song Sparrow	3.10	509.6	-	-	1.20	-	3.00	-	1.53[b]	-
Tricolored Blackbird	-	-	-	-	-	-	-	-	-	-

Notes:

[a]Numbers provided from point counts are the average number of detections within 50 meters of the observer during five minute counts. Numbers from spot mapping are pairs per 40 hectares during the breeding season. Reference populations are cited and may not be representative of healthy populations. 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.

[b]PRBO unpublished data: Bay Delta data are from Point Reyes Nat'l Seashore; Central Coast data from Salinas River, Scott Creek and Moore Creek.

[c]Cardiff (1996).

[d]Heath and Ballard (1999).

[e]Shaver and Kern River.

Table 6-1. Estimates of maximum breeding abundance by species and bioregion[a].

Species	Klamath		Sacramento Valley		Modoc		Mojave		Colorado Desert	
	Point Count[b]	Spot Map[b]	Point Count[b]	Spot Map[f]	Point Count[b]	Spot Map[b]	Point Count	Spot Map	Point Count	Spot Map[g]
Swainson's Hawk	-	-	-	-	-	-	-	-	-	-
Spotted Sandpiper	-	-	-	-	0.25[h]	-	-	-	-	-
Yellow-billed Cuckoo	-	-	-	-	-	-	-	-	-	-
Willow Flycatcher	-	-	-	-	0.45	7.9	-	-	-	-
Warbling Vireo	0.41	-	-	-	1.30	33.2	0	0	0	0
Bell's Vireo	0	0	-	-	0	0	-	-	-	-
Bank Swallow	-	-	0.04	-	-	-	-	-	-	-
Tree Swallow	0.50	-	0.98	-	1.20	-	-	-	-	-
Swainson's Thrush	-	-	-	-	0.06	-	0	0	0	0
Yellow Warbler	1.60	16.0	0.13	0.13	1.10	33.2	-	-	-	-
Common Yellowthroat	-	-	1.0	-	-	-	-	-	-	-
Wilson's Warbler	-	-	0	0	0.95	33.2	0	0	0	0
Yellow-breasted Chat	1.20	25.0	0.32	-	-	-	-	-	-	-
Black-headed Grosbeak	0.87	32.0	1.80	-	1.0[h]	-	-	-	-	-
Blue Grosbeak	0	0	0.19	-	0	0	-	-	-	5.0
Song Sparrow	0.79	16.8	1.33	-	1.80	77.6	-	-	-	-
Tricolored Blackbird	-	-	-	-	-	-	-	-	-	-

[a]Numbers provided from point counts are the average number of detections within 50 meters of the observer during five minute counts. Numbers from spot mapping are pairs per 40 hectares during the breeding season. Reference populations are cited and may not be representative of healthy populations. 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.

[b]PRBO unpublished data: Sacramento Valley data are from Sul Norte, La Baranca, Dye Creek, Llano Seco, Ohm, and Kopta Slough. Modoc data are from Lassen Volcanic NP and Lassen Volcanic NF. Klamath data are from Lower Clear Creek Floodway Restoration Project.

[f]Gaines (1974).

[g]Rosenberg (1991).

[h]Humple et al. (2002).

Population Size Estimates

Estimates of current population sizes were calculated for select species using mean values from current point count data (1994-2002) for each basin. As a first step, density was calculated using the number of detections within 50 meters x 1/detectability coefficient. Because of variation of species detectability using the point count method, coefficients were derived from sites where point count surveys overlaid spot mapping plots. Spot map data was used for density estimates for species whose populations were rare and patchily distributed (Song Sparrow and Yellow Warbler). Density estimates were then extrapolated across basins using current riparian habitat data layers as determined (Figure 3-1).

Population Target Estimates

Estimates of target populations were calculated with the median of the top 50% (75th percentile) of corrected density estimates from current point count data. This correction of 75% was used in preference to the true mean due to the assumption that most current populations were degraded but could be enhanced. Spot map data also were used from the nearest suspected viable population when point count data were not available (normally due to lack of detections). A riparian data layer based on historical extent of riparian forests and/or the current extent of soil types (The Bay Institute 1998) was used and corrected for permanent habitat loss (urbanization) to extrapolate the 75th percentile density. The amount of current and potential riparian habitat as determined from the GIS data (Table 6-3) was used to calculate population targets in each basin for two select species: Black-headed Grosbeak (Figure 6-1) and Song Sparrow (Table 6-2).

Demographic data (primarily nest success) also may be used to qualify density estimates (see Small and Gardali *in prep*, Sherry and Holmes 2000). The range of nest success observed for Song Sparrow in the Central Valley of 5% to 24% does not allow the growth rate to be positive (lamda > 1). This suggests that populations of Song Sparrows are not viable and will decline in the absence of immigration. Based on the information presented, a minimum target value for nest success of Song Sparrows in the Central Valley should be at least 27%.

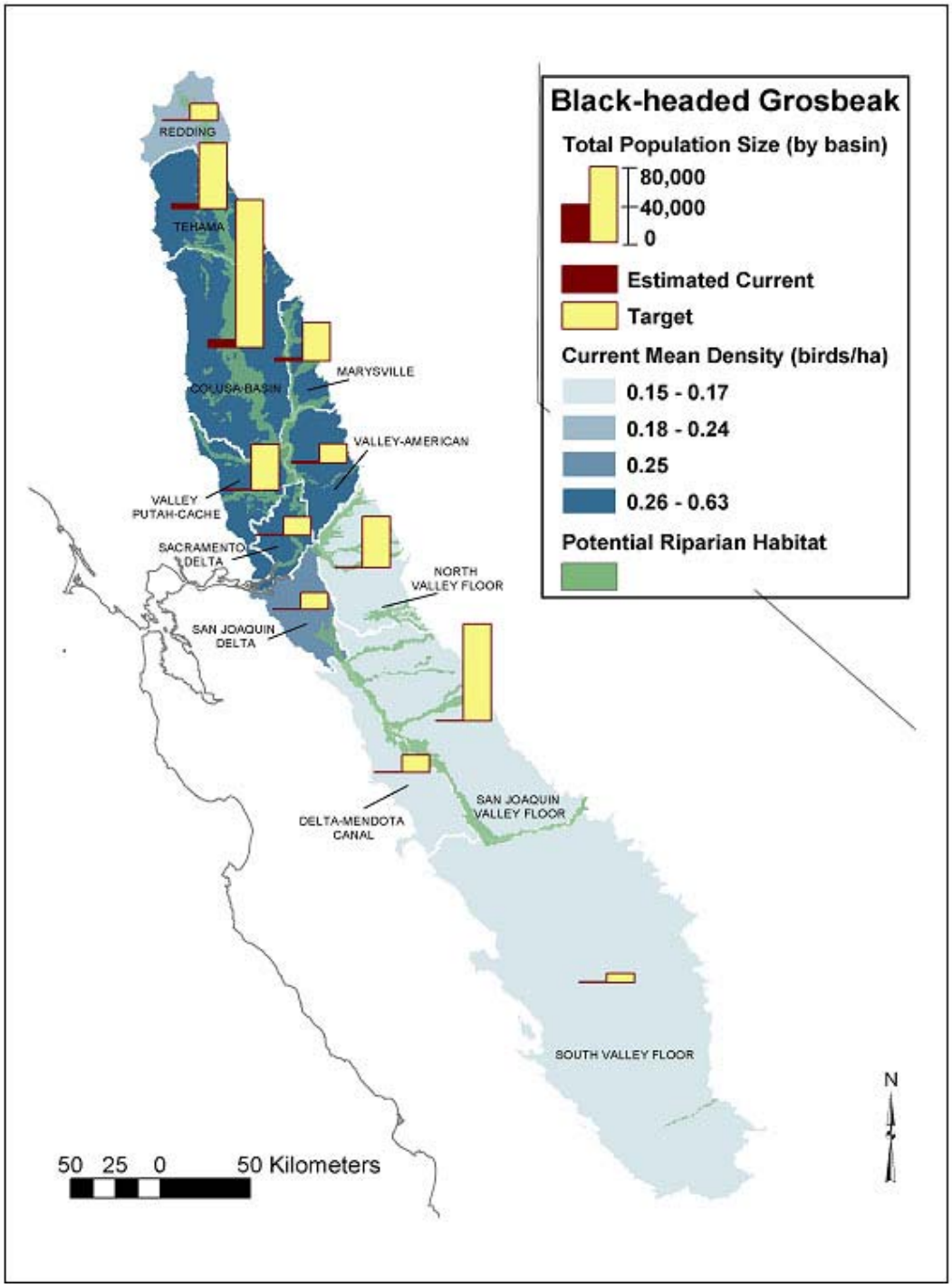

Figure 6-1. Black–headed Grosbeak current population estimates and targets for 12 basins in the Central Valley.

Table 6-2. Song Sparrow current population estimates and targets for 12 basins in the Central Valley.

Basin	Current Birds/Ha, Riparian Point Counts	±SE**	Current Population Size	±SE**	Target Birds/Ha	Target Population Size
Colusa Basin	0.09	±0.06	1128	±750	0.99 (1)	112,360
Marysville*	0.10	na	617	na	0.99 (1)	29,550
North Valley Floor*	0.90	na	2581	na	2.65 (2)	103,937
Redding	0.33	±0.12	1297	±448	0.99 (1)	13,132
Sacramento Delta*	0.10	na	168	na	0.99 (1)	14,279
Tehama	0.01	±0.004	39	±30	0.99 (1)	50,012
Valley Putah-Cache*	0.10	na	122	na	0.99 (1)	34,771
Valley-American*	0.10	na	280	na	0.99 (1)	14,747
Delta-Mendota Canal	1.24	±0.22	1949	±356	2.65 (2)	35,319
San Joaquin Delta	1.22	±0.24	2180	±420	2.65 (2)	33,894
San Joaquin Valley Floor	0.70	±0.16	3403	±788	2.65 (2)	198,253
South Valley Floor	0.93	±0.30	4440	±1444	2.65 (2)	18,805

* If a basin contained less than 30 point count stations, current density estimates were derived from all stations in the respective valley (Sacramento or San Joaquin) and standard errors are not presented (because sample size is not specific to basin). (1) In the Sacramento Valley, spot map densities from known source populations were used as target densities for *Melospiza melodia mailliardi*. (2) In the San Joaquin Valley point counts (75th percentile) were used *for Melospiza melodia heermani*.

** Estimates of population sizes are the product of: a) estimate of number of detected birds per ha for each basin (N); b) inverse of the detectability coefficient; and c) estimate of the number of ha of riparian habitat. There was uncertainty, and thus error, associated with each component. As a first approximation to estimating overall error in population size, we assumed the contribution of the latter two factors to the overall standard error was equal in magnitude to the standard error associated with estimation of N (which could be directly assessed). We thus used the standard error obtained in estimating N and multiplied by 2 to yield a rough estimation of the overall standard error.

Table 6-3. Amount of riparian habitat by Central Valley basin.

Basin	Current Riparian Hectares	Potential Riparian Hectares	Proportion Currently Forested	Number of Riparian Point Counts
Colusa Basin	12,380	113,610	0.11	139
Marysville	6,041	29,879	0.19	16
North Valley Floor	2,880	39,175	0.07	22
Redding	3,903	13,278	0.25	108
Sacramento Delta	1,647	14,438	0.10	9
Tehama	8,131	50,568	0.15	199
Valley Putah-Cache	1,199	35,158	0.03	8
Valley-American	2,746	14,911	0.11	6
Delta-Mendota Canal	1,578	13,312	0,12	90
San Joaquin Delta	1,787	12,775	0.13	46
San Joaquin Valley Floor	4,884	74,724	0.06	166
South Valley Floor	4,751	7,088	0.57	56
Central Valley Totals	51,927	418,916	0.12	865

Species-Specific Objectives

Although the RHJV strongly endorses the concept of multiple species management, it recognizes that special-status species often receive more careful management than non-listed species due to legal mandate. Special status species are those whose populations have been reduced or are in decline, the magnitude of which warrants more immediate conservation action relative to other taxa. Therefore, more information on listed species exists and the species-specific objectives offered in this plan reflect that special knowledge. However, conservation actions must include efforts to monitor their effects on multiple species, not only those on special-status lists. What positively affects one species may have a negative impact upon another. Minimal adjustments to conservation efforts targeting single species may positively impact multiple species, thereby greatly increasing the effectiveness of conservation dollars. Finally, conservation planners must bear in mind that population dynamics are influenced by many factors other than breeding habitats (e.g., over wintering survival) and may result in population declines even as efforts increase available habitat.

Data and figures presented in this section are from the species accounts developed by the authors listed on pages 22-23. Species accounts are an electronic appendix to this document and may be found at http://www.prbo.org/calpif/htmldocs/riparian.html.

Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis)*

Population:

The current Western Yellow-billed Cuckoo population is about 60 to 100 pairs statewide (Halterman et al. 2001; see Figure 5-4 for statewide range). The RHJV recommends restoring habitat in 25 locations to support 625 pairs (25 pairs per location). Simulation modeling indicates that populations of less than 10 pairs are very unstable, becoming extinct in a short period of time. Current predictions suggest that a minimum of at least 25 pairs in a subpopulation with interchange with other subpopulations should be reasonably safe from extinction by stochastic events. Given that presumably stable populations are at least 25 pairs and that territory size averages 20 to 25 hectares (a minimum of 10 hectares), the optimal goal for each population is to protect and restore habitat in minimum 20-hectare patches that collectively total 500 hectares within a watershed or river reach. The statewide habitat restoration and protection target, in addition to that currently managed for the cuckoo, equals approximately 21,000 hectares statewide, including areas in Arizona along the Colorado River. See Table 6-4 for a summary of the recommended habitat restoration sites.

Table 6-4. Minimum management goals for subpopulations, pairs, and reforestation of suitable habitat, based on 40 hectares per pair, for Western Yellow-billed Cuckoos.

Locality	Subpopulation	Number of Pairs	Current Suitable (hectares)	Reforestation Suitable (hectares)
		Northern California		
Sacramento R.	6	150	2,370	3,700
Feather R.	1	25	240	770
Stanislaus R.	1	25	240	770
Cosumnes R.	1	25	0	1,010
Merced R.	1	25	0	1,010
Kings R.	1	25	0	1,010
Mendota	1	25	0	1,010
Subtotal	**12**	**300**	**2850**	**9,280**
		Southern California		
Kern R.	1	25	400	610
Prado Dam	1	25	240	770
Mojave R.	1	5	80	930
Owens R.	1	25	0	1,010
Subtotal	**4**	**100**	**720**	**3,320**
		Colorado River		
Needles-Parker	4	100	670	3,380
Parker-Blythe	2	50	0	2,020
Blythe-Yuma	3	75	0	3,040
Subtotal	**9**	**225**	**670**	**8,440**
TOTAL	**25**	**625**	**4,240**	**21,040**

MANAGEMENT

Habitat patch size:

Restoration to benefit the Western Yellow-billed Cuckoo requires patches be a minimum of 20-40 hectares, with a minimum width of 100 meters. Optimal habitat for a pair would be 75 hectares or more in length, with a width of more than 600 meters. Research by Laymon and Halterman (1989) led to the development of these parameters based on occupancy rates of existing habitat patches along the Sacramento River. Additionally, higher canopy closure, higher foliage volume, intermediate basal area, and intermediate tree height relative to random sites are preferred by cuckoos for nesting. The best habitats for nesting are therefore at large sites with high canopy cover and foliage volume and moderately large and tall trees. The cuckoo's primary food source, katydid and sphinx moth larvae, hibernate underground and are therefore not available in lowland floodplains in wet years with late-spring flooding. Therefore, upland refugia habitats for foraging in wet years should also be a component of Western Yellow-billed Cuckoo habitat protection and restoration projects.

Pesticide use:

Occasionally, cuckoos nest or forage in orchards adjacent to riparian areas. Pesticide use by farmers may deter cuckoos from more frequent use of these crops. More research is needed as to whether or not Western Yellow-billed Cuckoos more readily use orchards grown with integrated or organic pest management techniques.

Other factors:

Areas of apparently suitable habitat are unoccupied by Western Yellow-billed Cuckoos every year (e.g., Kern River Preserve). Other factors (e.g., over winter survival, juvenile survival and dispersal) should therefore be addressed (M. Halterman pers. comm.).

Photo by Claire DeBeauvoir, Sea and Sage Audubon

Least Bell's Vireo *(Vireo bellii pusillus)*

Photo by James Gallagher, Sea and Sage Audubon

Population:

Grinnell and Miller (1944) once characterized Least Bell's Vireo as one of the most common birds found in riparian habitat throughout the state (Figure 5-7). Over the past sixty years, destruction of riparian habitat and the invasion of California by the parasitic Brown-headed Cowbird have contributed to a steep decline in the vireo's population. Currently, Least Bell's Vireos are restricted to approximately eight counties in southern California and are on the federal Endangered Species List (USFWS 1998).

To be reclassified as "threatened," the Least Bell's Vireo population must achieve one of the following criteria for at least a period of five consecutive years (taken from USFWS 1998):

- Stable or increasing populations/metapopulations, each consisting of several hundred or more breeding pairs, are protected and managed at the following sites: Tijuana River, Salzura Creek/Jamul Creek/Otay River, Sweetwater River, San Diego River, Camp Pendelton/Santa Margarita River, Santa Ana River, an Orange County/Los Angeles County metapopulation, Santa Clara River, Santa Ynez River, and an Anza Borrego Desert metapopulation.

- Stable or increasing Least Bell's Vireo populations/metapopulations, each consisting of several hundred or more breeding pairs, become established and are protected and managed at the following sites: Salinas River, a San Joaquin Valley metapopulation, and a Sacramento Valley population.

- Threats are reduced or eliminated so that Least Bell's Vireo populations/metapopulations listed above are capable of persisting without significant human intervention, or perpetual endowments are secured for cowbird trapping and exotic plant control in riparian areas occupied by least Bell's Vireos.

MANAGEMENT

Habitat enhancement:

Riparian habitat creation and restoration is underway throughout the state. Much of this effort in southern California has been propelled by the need for more Bell's Vireo habitat. Bell's Vireos have responded favorably to restoration efforts, demonstrating increases in occupation at restored sites, and nest success rates similar to non-restored natural habitat (Kus 1998).

The Santa Clara River Enhancement and Management Plan:

This plan seeks to protect the ecological integrity of the longest, unchannelized river in the South Coast bioregion. Current efforts to develop along the Santa Clara and its tributaries may endanger the integrity of the plan.

Brown-headed Cowbird control:

In the short-term, trapping of cowbirds is one of the most effective ways to increase the reproductive success of Least Bell's Vireo on a local scale. At Camp Pendelton, nest parasitism dropped from 47% to less than 1% in less than 10 years (USFWS 1998). However, cowbird trapping is only a temporary remedy to be used in emergency situations. The population cannot be considered healthy until it can survive without significant human intervention.

Monitoring and research:

Research elucidates the habitat variables required to re-establish healthy populations. Monitoring provides important information on population trends, allowing for the employment of appropriate adaptive conservation techniques.

Willow Flycatcher (*Empidonax traillii*)

Photo by James Gallagher, Sea and Sage Audubon

Population:

Willow Flycatchers historically nested throughout California, preferring riparian deciduous shrubs, particularly willow thickets. Currently, three subspecies of the Willow Flycatcher breed in California (Figure 5-5). Each has been listed as state endangered and US Forest Service Region 5 Sensitive in California. The USFWS designated the Willow Flycatcher as a sensitive species in Region 1 (Washington, Oregon, Idaho, California and Nevada). Furthermore, the Southwestern Willow Flycatcher *(Empidonax traillii extimus*) is federally listed as endangered.

Management:

Sierra Nevadan populations have dropped precipitously in the last 50-60 years. Most Sierran meadows are already publicly owned, but many are grazed under permit. Goals for increasing Willow Flycatcher populations focus on increased monitoring, improving management and restoration of habitat, and where necessary, through proper grazing management.

Southwestern Willow Flycatcher:

These flycatchers are concentrated in lowland habitats. The UFWS has recently released a Southwest Willow Flycatcher Recovery Plan (http://ifw2es.fws.gov/Library/ListDocs.cfm) that details management recommendations for this imperiled subspecies. Managers should prioritize the protection and restoration of riparian deciduous shrub vegetation and address the problem of cowbird parasitism, which has severely affected populations in southern California. For example, at the South Fork Kern River Preserve, an average of 63.5% of nests were parasitized from 1989 to 1992, with a range from 50% in 1989 to 80% in 1991. However, Brown-headed Cowbird trapping at the South Fork Kern River Preserve has resulted in a decreased rate of parasitism, "buying time" for this population as riparian habitat restoration proceeds.

Tricolored Blackbird (*Agelaius tricolor*)

Population:

Photo by James Gallagher, Sea and Sage Audubon

The Tricolored Blackbird is largely endemic to California and has been listed as a state Species of Special Concern. Surveys indicate that populations have been rapidly declining for decades, probably due to water diversion, land conversion and heavy predation by mammals, corvids and Black-crowned Night Herons (Beedy and Hamilton 1997, Hamilton et al. 1999). Tricolors are colonial breeders, nesting mainly in wetlands or in dense vegetation near open water. No population targets have been established for this species.

Management:

Hamilton et al. (1999) outlines many specific recommendations for conserving Tricolored Blackbird populations in California. Included are:

Protect existing colonies: Managers must seek to protect existing tricolor colonies and nesting sites (Figure 5-18). Adequate tricolor habitat needs to be designated in Habitat Conservation Plans (HCPs). Managers also need to reduce predation pressure to allow populations to expand. Problem species such as ravens, night herons, and coyotes should be properly managed whenever possible (Hamilton *in press*).

Proper water management can enhance their natural nesting habitat and reduce depredation rates (nest predation by mammals increases when water levels around nesting sites drop). If feasible, a simple water level management strategy is to maintain the level present when initial tricolor settlement occurred.

Consider disturbance effects: Private landowners must be encouraged to consider the needs of tricolors and to avoid harvesting, pesticide application and other disturbances to the species during the breeding season.

Provide suitable nesting habitat: Tricolors will often use exotic plants, such as Himalaya blackberry, as nesting substrates. Efforts that remove shrubs used by tricolors should include plans to replant a suitable alternative. Restoration efforts should emphasize native plants.

Public education: Conservation efforts must educate the public about the species' status and needs (Beedy and Hamilton 1997). Managers should encourage development of colonies in conspicuous urban environments where their educational value will be useful (Hamilton *in press*).

Research and Monitoring: Further research will indicate the variables affecting their reproductive success, outline the threats posed to colonies and monitor population changes over time. For a more extensive review of monitoring needs, see Beedy and Hamilton (1997) and Hamilton et al. (1999).

Chapter 7. Bioregional Conservation Objectives

California harbors more naturally occurring species of plants, insects, vertebrates, and other life forms than any comparable area north of the subtropics (Biosystems Analysis 1994). Isolation by the Sierra Nevada mountain range and southern deserts fostered the evolution of more endemics than any other state in the United States except Hawaii. The great diversity of plants and animals renders conservation planning for the entire state more difficult.

Numerous authorities have divided the state into discrete geographical sections, or bioregions, based on natural communities, climate, topography, and soils. The California Biodiversity Council (RAC 1998) divided the state into 10 bioregions (Figure 7-1) while others, including Biosystems Analysis (1994) and Sawyer and Keeler-Wolf (1995) recognize 11 discrete regions. California Partners in Flight followed the Biodiversity Council's 10-region scheme for the purposes of the bird conservation plans.

Figure 7-1. Bioregions of California. From the Biodiversity Council (2003).

Many organizations have embraced planning on a bioregional basis because bioregions facilitate an adaptable, site-specific focus for projects. Setting and achieving conservation goals by bioregion will:

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

This chapter introduces each of the 10 bioregions considered in this plan (the Sacramento and San Joaquin are discussed together). These descriptions are offered as an overview; the issues and needs vary depending on particular sites within a bioregion. For more information on each, consult the Resource Agency of California's (1998) *Preserving California's Natural Heritage*.

Portfolio Sites

For each bioregion, we list regional Portfolio Sites. These sites stand out for their significance and contribution to conservation, either through management practices or their value as a reference site. CalPIF and the RHJV are constantly seeking to expand this list of portfolio sites in California. Inquiries concerning the suitability of an area for recognition as a portfolio site should be directed to the RHJV coordinator (http://www.prbo.org/calpif/htmldocs/rhjv/). A specific project, geographic area, or discrete patch of habitat may be designated as a Portfolio Site if:

- It has been recognized as a "flagship project" by the RHJV for outstanding riparian habitat management and restoration activities.

- It implements adaptive management strategies by "closing the feedback loop," i.e., gathering data that provides information about wildlife responses to management practices, then incorporating such data into future management decisions.

- RHJV science partners recognize that the site merits long-term monitoring of avian populations. Long-term data collection provides an important baseline against which to measure short-term changes in regional bird populations and reproductive success. Such projects can serve as reference sites when comparing avian response to management or restoration in other areas with similar habitat and climate. Only through long-term data collection will conservation biologists and ecologists avoid the ongoing pitfall of "shifting baselines," i.e., the phenomenon whereby slowly deteriorating conditions over time can become the norm or standard against which to measure healthy ecological systems.

Sacramento and San Joaquin Valleys

California's Great Central Valley provides breeding, migratory stopover and wintering grounds to millions of birds annually. Though seriously degraded due to human disturbance, the Valley still contains vital riparian habitat, freshwater wetlands and seasonally flooded agriculture, vernal pools, and naturalized annual grasslands. Most think of the Central Valley only in terms of its robust agricultural industry. Yet, the Valley once hosted an extensive network of riparian forests with a rich shrub and herbaceous understory, wetlands, and adjacent upland habitats. However, development pressure from a rapidly expanding population and an increasing demand for water threaten the remnants of the once vast riparian system. Without prompt action, the opportunity to restore critical habitat may be lost.

Portfolio Sites

Lower Clear Creek supports the largest breeding population of Yellow Warbler and Song Sparrow in the region. Priority should be given to ensuring a continuous riparian corridor from Clear Creek to the main stem of the Sacramento River and improving habitat quality through restoration and restoring natural processes.

The Lower Feather River, which includes the Audubon Bobelaine Sanctuary, provides important breeding and migratory stopover habitat for numerous songbird species and has high potential for range expansion of riparian birds.

The Sacramento River continues to provide nesting habitat for many species, including Bank Swallow, Swainson's Hawk and Western Yellow-billed Cuckoo. Many species once common in the area, including the Least Bell's Vireo, have been extirpated while the Yellow Warbler, Song Sparrow, Yellow-breasted Chat, and Blue Grosbeak are missing locally (Nur et al. 1996). Protection efforts include the extensive Sacramento River National Wildlife Refuge Complex. The largest river system in the state, the Sacramento has great potential to support vast expanses of riparian habitat. We recommend focusing restoration efforts in areas where dynamic fluvial processes are still intact, and where connectivity can be established with adjacent intact habitat. Examples of ongoing riparian restoration projects include the Rio Vista Unit owned by the USFWS and CDFG's Pine Creek Unit. These sites can be found at the following web sites: http://www.sacramentoriver.org; http://www.riverpartners.org.

Cottonwood Creek is the largest undammed tributary to the Sacramento River in the Central Valley. The hydrology of Cottonwood Creek still resembles a historical flow regime with high stream flows during rainy winter months and very low flows during dry summer months. With natural flow regimes fairly intact, extensive wildlands in the upper watershed, and intact adjacent upland habitat, it is likely that Cottonwood Creek provides valuable habitat to numerous riparian associated bird species. Current threats to riparian habitat on Cottonwood Creek include subdivision of large properties into ranchettes resulting in an increased intensity of land use within and adjacent to riparian habitat, increased demand for water from a growing population, and the encroachment of exotic invasive plant species.

The Tuolumne River has recently garnered conservation attention primarily through the restoration efforts of agencies and groups such as the Friends of the Tuolumne. Though mining, dredging, water diversion and development continue along its reach, the river continues to support breeding Song Sparrows, Common Yellowthroats, Blue Grosbeaks, and Swainson's Hawks. Fairly large habitat patches remain, especially in the river's upper reach.

The Mokelumne River's riparian habitat is currently restricted to linear patches directly along the river corridor due to agriculture and development as well as upstream dams that limit flows. However, a developing partnership between private landowners and the East Bay Municipal Utility District is pursuing riparian restoration along the river to increase the amount of habitat for the benefit of both farmers and wildlife.

Photo by Dan Stark, USFWS

Riparian habitat near the Sacramento River.

The San Joaquin River's water flows and habitat have been seriously diminished by the development of agriculture or mining along nearly every mile of its reach and the construction of Friant Dam. The demand for water from the river is immense. It irrigates the world's largest agricultural industry and can run nearly dry in parts of its reach during the summer. The river continues to host a number of riparian species, including Song Sparrow, Blue Grosbeak, Black-headed Grosbeak, and Swainson's Hawk. For the past two years Yellow Warblers have been documented breeding at the San Joaquin River National Wildlife Refuge (PRBO unpublished data). This hopeful sign that an extirpated breeder has returned to the valley floor is the result of protection and restoration efforts along the river, including the establishment of open space reserves near Friant Dam and a growing network of wildlife areas and refuges along its middle reach. These efforts include the San Luis National Wildlife Refuge Complex, Great Valley Grasslands State Recreation Area, and the San Joaquin River Parkway (Conservation) Trust.

Modoc

Of the California bioregions, perhaps the Modoc most resembles its historic state. It is characterized by hot, dry summers and cold, wet winters, extensive stands of conifers and oaks, and high elevation desert conditions in its northeast portion (RAC 1998). It has the smallest population of the states 10 bioregions, though it is expected to grow as California's population expands. A major effort to restore aspen stands has been taking place in the Eagle Lake Ranger District of the Lassen National Forest since 1999. Here they have employed an aggressive strategy of clear-cutting conifers and fencing the boundaries of aspen stands where livestock grazing is an issue. Preliminary results have been positive with extensive resprouting of aspen stems and associated herbaceous species. In 2004, a monitoring component will be added to this project in order to determine the effects aspen release treatments have on songbirds.

Portfolio Sites

Humbug Valley, totaling over 500 hectares, is the largest meadow in the Northern Sierra Nevada. Fed by two perennial streams, willows, alders, sedges and other wet meadow associated vegetation undoubtedly dominated the valley historically. Overgrazing and subsequent stream erosion has resulted in a drying out of this site over the past 180 years. Fencing off the riparian habitat in the mid-1980's, followed by the complete removal of grazing in 2001, has resulted in a dramatic recovery of this site. New willow and herbaceous vegetation has returned to large portions of the valley. The population of Willow Flycatcher has increased from two singing males in 2002 to at least 13 singing males in 2003 (Humple and Burnett 2004). With full recovery of this site, the valley could potentially sustain over 50 pairs of breeding Willow Flycatcher. Other focal species that breed in the valley that should benefit from the recovery of riparian habitat include Spotted Sandpiper, Tree Swallow, Warbling Vireo, Yellow Warbler, Wilson's Warbler, and Song Sparrow. Current conservation efforts are focused on providing permanent protective status for this biologically important mountain meadow.

Warner Valley, a CDFG wildlife area adjacent to the Lassen National Forest and Lassen Volcanic National Park, is one of the most significant breeding areas for Willow Flycatchers in the state. Approximately 10-15% of the Sierra Nevada population of this species breed at this one location (King and King 2003, Humple and Burnett 2004). Substantial numbers of Wilson's Warbler, Yellow Warbler, and a small population of the regionally rare Swainson's Thrush breed here as well. The Willow Flycatcher population here is now being intensively studied as part of a demographic study of the Willow Flycatcher in the Sierra Nevada.

Bear Creek Meadow, located on private property adjacent to the headwaters of the Fall River, is the site of an extensive meadow restoration project. The meadow already contains numerous Yellow Warblers and several other focal species, including Wilson's Warbler and Warbling Vireo. With the maturation of re-vegetation and natural regeneration following the restoration of a hydrologically functional stream, this site has the potential to provide significant breeding habitat for Willow Flycatcher and other riparian focal species.

The Modoc region now appears to be the only area in the Sierra Nevada where the Willow Flycatcher population is stable or increasing (Humple and Burnett 2004, Green et al. 2003, R. Siegel pers. comm.). This population increase in the Lassen area can be attributed primarily to recolonization of former breeding sites on Pacific Gas and Electric (PG&E) lands. The only restoration action taken on these lands has been the complete cessation of cattle grazing. While grazing remains a highly debated subject in the Sierra Nevada, this evidence suggests that restoring mountain meadows to an ecologically healthier state may be accomplished with minimal active restoration in this region. A rigorous study examining the effects of cattle grazing and the recovery of meadows where it has been removed is vital for ensuring the long-term sustainability of many meadow dependent Sierra bird species.

Photo by Steve Zack, WCS

Willow Flycatcher abundance is increasing in the Lassen

Klamath

The Klamath/North Coast bioregion consists of rocky, steep shorelines, rich conifer forests, and lush riparian corridors. The region is one of the wettest in California, with cool, foggy summers along the coast and rainy winters throughout. Though vast tracts of habitat remain, logging, cattle ranching and agriculture have degraded much of the historic riparian habitat. While the old growth redwoods garner much of the attention of conservationists, riparian habitat merits significant attention as well, providing habitat for salmon, mammals and numerous birds, including the Pacific-slope Flycatcher, Bank Swallow and Willow Flycatcher (RAC 1998).

Portfolio Sites

The Trinity River supports important breeding habitat for half of the focal species. It is also used by large numbers of Willow Flycatchers during the pre-migration and migratory periods (Ralph and Hollinger 2003). Congressional legislation has provided the directive for the restoration efforts by the USDI Bureau of Reclamation Trinity River Restoration Program. Proposed bank rehabilitation and flow manipulation projects are aimed at recreating historic aquatic and riparian habitat conditions primarily in the upper reach of the system. Ongoing bird monitoring within the restoration sites will provide population and habitat use information for effective adaptive management.

Central Coast

The Central Coast Bioregion is characterized by a mild climate, a wide variety of habitat types, and numerous small mountain ranges that roughly parallel the coastline. The region supports a robust agricultural industry, which includes cattle grazing, row crops and vineyards. In recent years, the Central Coast has experienced a dramatic population increase fueled largely by prosperous industries, including the booming computer industry in the Santa Clara "Silicon Valley." This expansive growth seriously threatens riparian habitats in the region because of land conversion, water diversion, resource extraction, intensive grazing, habitat clearing and the introduction of invasive plant species. These changes have rendered the Central Coast one of the three most threatened ecoregions in California, along with the Central Valley and Southwest Ecoregions (TNC 1997), and merits immediate attention for conservation and protection efforts.

Valley areas in the Central Coast once supported large floodplain forests of deciduous riparian trees and shrubs. These areas, dominated by sycamore, willows and cottonwoods, were considered the most productive riparian habitat in terms of biodiversity (Roberson and Tenney 1993). Because of land use practices such as grazing and agriculture and associated flood control and groundwater extraction, valley riparian habitat is rare (TNC 1997). Riparian patches on the Salinas, Nacimiento, and Carmel Rivers and a few other localities in the region are important remnants for native wildlife.

Portfolio Sites

The Big Sur River is one of the most intact free-flowing rivers in the Central Coast region. The majority of the upper portion flows through the Ventana Wilderness and the Los Padres National Forest; the lower portion runs through both state and private lands. The riparian corridor is dominated by dense stands of willow, alder, and cottonwood accompanied by mature sycamore alluvial woodlands. The river provides important breeding habitat for a variety of riparian focal species including Warbling Vireo, Swainson's Thrush, Wilson's Warbler, Black-headed Grosbeak, and Song Sparrow. Data collected from long-term monitoring in the lower Big Sur River valley suggest that the breeding population of Warbling Vireos is significantly declining on a local level (VWS unpublished data). This coastal riparian corridor also provides critical stopover habitat during both spring and fall migration. Monitoring along the lower Big Sur River continues, making this a valuable reference site.

Photo by BSOL

Riparian habitat along the Big Sur River.

The Carmel River flows northwest out of the Carmel Valley between the Santa Lucia Mountains on the South and the Sierra del Salinas Mountains to the north and east, draining approximately 255 square miles. Following the establishment of two dams and intensified floodplain development over the past 80 years, the river and its riparian corridor has shrunk dramatically. The watershed recently has become the focus of multiple restoration programs in an attempt to restore critical coastal riparian habitat and hydrologic function. The primary objective of songbird monitoring at these sites is to study avian responses to habitat restoration efforts, with particular attention given to riparian focal species. Currently, seven riparian focal species breed within the watershed. Although water diversion and intensive development continue, the river still provides important breeding, migratory-stopover, and overwintering habitat.

The Salinas River is the Central Coast bioregion's largest river, flowing through the longest inter-mountain valley in the state. Remnant habitat patches on the Salinas are important for the restoration and recolonization potential they provide for lowland forests and associated species, and include some of the last known potential breeding areas of the Least Bell's Vireo. Over 75% of the riparian habitat along the Salinas is considered disturbed or degraded (Roberson and Tenney 1993), underscoring the need for restoration and Brown-headed Cowbird management.

Priority streams and rivers were identified by TNC after it conducted a biological assessment of the Central Coast Bioregion. Priorities were determined based on factors such as landscape integrity, species richness of targeted species, and the presence of sycamore alluvial woodlands (TNC 1997). Highest priority sites include Pescadero Creek, Scott Creek, Uvas Creek, lower Salinas River, Arroyo Seco, Nacimiento River, upper San Benito River, Big Sur River, Arroyo de la Cruz, San Simeon Creek, San Antonio Creek, and Santa Ynez River.

Vandenberg Air Force Base supports some of the most extensive riparian habitat along the Central Coast (Farmer 1999). The base has high avian diversity and productivity and should be a conservation priority (Gallo et al. 2000).

Bay Delta

The Bay Area Delta Bioregion includes the San Francisco Bay area and spreads eastward to encompass the sprawling Sacramento San Joaquin River Delta. The climate is generally mild, with regular fog on the coast, wet winters, and warm summers inland. Historically, it supported a lush interconnected system of marshes, wetlands and riparian habitat. Though much has been lost to water projects and land conversion, the region continues to provide vital breeding habitat to riparian associated species.

Portfolio Sites

The Point Reyes National Seashore supports significant amounts of riparian habitat in the form of many small willow-alder dominated creeks. The National Park Service in collaboration with PRBO Conservation Science has conducted extensive bird monitoring at three riparian sites: Muddy Hollow, Redwood Creek and Lagunitas Creek. Currently, seven riparian focal species breed within these watersheds; most of which occur here in densities far higher than any other bioregion (Table 6-1). In addition to breeding habitat, these sites also provide critical stopover habitat during spring and fall migration.

The Cosumnes River Preserve, located at the eastern tip of the bioregion, is focused around the only undammed river on the west slope of the Sierras and encompasses over 5,670 hectares of riparian and upland habitats. The Preserve protects the largest remaining tracts of valley oak riparian forest. Management of the Preserve is an excellent example of a working partnership between BLM, The Nature Conservancy, California Dept. of Fish and Game, Ducks Unlimited, Sacramento County and the Wildlife Conservation Board. The Preserve is also an ideal site for studies assessing landbird response to natural recruitment restoration. Managers there have breached levees to capitalize upon natural flooding events and allow natural recruitment of riparian habitat within the Cosumnes bottomlands. The mosaic of different aged patches of habitat resulting from regeneration demonstrates the dynamic processes that result from a river being reconnected to its floodplain. However, low productivity of Song Sparrows and other species in some of these habitats along the Cosumnes indicates that these populations may be in danger of local extirpation, as seems to already have occurred locally in portions of the lower Sacramento River Valley (PRBO unpublished data).

South Coast

The South Coast bioregion includes miles of sandy beaches and steep cliffs along the Pacific, small mountain ranges, and extensive riparian, scrub and conifer habitats. The human population continues to expand rapidly, converting and fragmenting native landscapes at an alarming rate. The climate is arid and warm year round, increasing the importance of the few remaining riparian areas. The South Coast serves as the last refuge for the Least Bell's Vireo in California. Though the species once bred in riparian habitat throughout the state (Grinnell and Miller 1944), years of habitat reduction, nest predation and parasitism by the Brown-headed Cowbird have severely reduced the species' range (USFWS 1998).

Portfolio Sites

The Santa Clara River, is the largest unchannelized river in southern California. The Santa Clara River Enhancement and Management Plan, developed by the USFWS, the California Coastal Commission, and several southern counties, seeks to protect the natural resources and wildlife along the river and proactively avoid the listing or extirpation of any new species. However, current efforts to develop areas along the river's reach may further jeopardize the habitat.

Mojave and Colorado Deserts

While the desert regions have yet to be adequately assessed in this plan, desert oases and associated riparian habitat clearly represent critical bird breeding grounds that also serve as important migratory stopover and wintering sites for many species (Grinnell and Miller 1944, Massey and Evans 1994, Flannery et al. 2004). Water diversion, grazing, exotic plant species and recreational activities threaten riparian habitat in desert oases. The Colorado River hosts an impressive suite of resident and Neotropical migratory breeders (Rosenberg et al. 1991). Efforts along the Colorado River seek to restore some of the native habitat after over a century of degradation due to human disturbance, water diversion and exotic plant invasions. Riparian habitats in the Mojave and Colorado Desert bioregions will be covered more extensively in the CalPIF Desert Bird Conservation Plan (CalPIF *in prep*.).

Portfolio Sites

The Colorado River has recently become the focus of a multi species conservation plan that includes provisions for fish, birds and plants. Restoration efforts include protection and restoration of riparian vegetation and exotic plant control (specifically for tamarisk). Management of flows and reconnection of the river to historic backwater areas will benefit native fish, recreational fishing and riparian habitat.

Sierra

The Sierra Bioregion has faced over a century of land and water conversion, resource exploitation, invasive plant species and rural sprawl. The Sierra Nevada range is considered to be one of 233 sites of globally important biodiversity. Of those sites, it is one of 110 considered critically threatened or endangered (Olson and Dinerstein 1998). While riparian montane meadows historically provided ample habitat for species such as the Yellow Warbler and Willow Flycatcher, they have been degraded or destroyed by grazing and water diversion. Siegel and DeSante (1999) and the Sierra Nevada Ecosystem Project (Davis and Stoms 1996) provide an extensive review of conservation needs and recommendations for the Sierra Nevada region.

The Sierra Bioregion, as distinguished by the Biodiversity Council (RAC 1998), includes a portion of the eastern Sierra escarpment and the western Great Basin. Desert riparian habitats of the Owens Valley alluvial fan zone provide spring and fall migration and dispersal habitat not only for riparian associated species, but also upland species breeding in adjacent sagebrush habitats (Heath et al. 2001, Heath and Ballard 2003). Higher elevation riparian aspen habitats harbor the most diverse breeding songbird communities in the region (Heath and Ballard 2003[a]).

The Los Angeles Department of Water and Power (LADWP), the primary water rights and landowner of lands adjacent to the Owens River and Mono Basin feeder streams, has begun restoration efforts of riparian habitats in the eastern Sierra. Restoration plans for both the Mono Basin feeder streams and the lower Owens River rely primarily on returning water to these diverted systems. A majority of the Sierra Bioregion lands are managed by public agencies. Resource managers and landowners appear willing to invest time and money into finding more ecologically sound management practices and are incorporating conservation recommendations into work plans and project goals (LORP 1999, Siegel and DeSante 1999, Heath et al. 2001).

Portfolio Sites

Sierran mountain meadows are critically important for breeding and post breeding dispersal of Neotropical migrants and resident landbirds (Siegel and DeSante 1999, Burnett and Geupel 2001). These meadows also provide important stopover habitat for many migrating species. Examples of important Sierran meadows include Perazzo, Humbug Valley, Little Truckee River, and Sage Hen.

The South Fork Kern River supports high species diversity and an intensively managed program to support the reproductive success of riparian birds. It remains a high conservation priority, as it provides one of the most important breeding grounds for Yellow-billed Cuckoos and Willow Flycatchers in the West and continues to host a richly diverse bird community (including most of the 17 focal species considered in this Conservation Plan).

The Mono Lake tributaries, compromised for decades by water diversions to the Los Angeles aqueduct, are currently undergoing restoration and have been void of livestock grazing since the 1991 removal of cattle and sheep (LADWP 1996). The streams have been rewatered since 1989 and now harbor abundant breeding populations of many of the riparian focal species (Heath et al. 2002[b]). Rush Creek harbors the densest breeding population of Yellow Warblers currently recorded in the state, and a small population of Willow Flycatchers has recently been discovered breeding among Rush Creek's wild rose patches (Heath et al. 2002[c], McCreedy and Heath *in review*). Court mandated restoration monitoring efforts in the Mono Basin focus on hydrological functions, fish populations and plant regeneration. Songbird monitoring of Mono Basin streams continues to investigate songbird community response to passive riparian regeneration.

The Owens River and its riparian habitat, though compromised due to water diversions since the early 1900's, harbors remnant breeding populations of the Southwest Willow Flycatcher and perhaps the Western Yellow-billed Cuckoo (Laymon and Williams 1994). Once, this river system provided breeding or migratory habitat for nearly all of the 17 riparian focal species, including the Least Bell's Vireo (Fisher 1893, Laymon and Williams 1994, MacMillen et al 1996). As part of the Lower Owens River Project, water is scheduled to be released into over 60 miles of the River system by 2005. Restoration efforts will be primarily passive, relying on the reintroduction of water into the decades long dry channel (LORP 1999). Extensive baseline songbird monitoring on the Lower Owens River began in 2002 and will continue for several years after initial rewatering (Heath and Gates 2002).

Chapter 8. Conservation Recommendations

This chapter provides specific recommendations for riparian 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/htmldocs/riparian.html). 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 riparian-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 the RHJV's central mission, which is to promote conservation and restoration of riparian habitat sufficient to support the long-term viability and recovery of native bird populations.

Habitat Protection Recommendations

Objective 1

Prioritize riparian sites for protection and restoration.

Recommendations

1.1. Prioritize potential riparian 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 riparian conservation programs. After a four-year study of passive riparian restoration, Dobkin et al. (1998) suggested that the presence of "key" species in areas undergoing restoration during their third and fourth years signaled the beginning of avian restoration.

Key or "rapid-indicator" species are those that:

- Are still locally abundant in riparian habitats throughout the state.
- Can rapidly colonize an area.
- Depend upon early successional riparian shrub habitats.

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 recolonized by extirpated species. Along the San Luis Rey and San Diego Rivers in San Diego County, Kus (1998) documented Least Bell's Vireos' occupation of restored sites more rapidly in habitats adjacent to mature and intact riparian habitat. Tewksbury et al. (2002) found, for the Sacramento River basin and four other western study areas, that sites surrounded by more riparian habitat at the regional scale (5 km) tended to have more long-distance migrants, as well as resident birds.

1.3. Protect and restore riparian areas with intact adjacent upland habitats.

Riparian-associated birds make use of grass, shrub and woodland habitats adjacent to riparian zones throughout their lives. Upland zones provide migratory stopover grounds, foraging habitat, and dispersal corridors for non-breeding adults and juveniles. The Western Yellow-billed Cuckoo, Common Yellowthroat, and Least Bell's Vireo are among the many riparian species that commonly use upland habitats adjacent to riparian nesting sites. These areas act as both flood refugia and supplemental foraging areas. For example, the Common Yellowthroat will not nest over water and therefore must have access to alternative upland nest sites during late spring floods. The Western Yellow-billed Cuckoo's prey base, largely katydid and sphinx moth larvae, winters underground. In wet years, cuckoos must forage in upland areas until the prey base in the lower floodplain recovers. Because most extant riparian habitat is in the primary floodplain, floods may regularly reduce the cuckoo's prey-base and contribute to the decline of cuckoos in the West. Several riparian bird species, including the Warbling Vireo and Black-headed Grosbeak, commonly nest in upland habitats adjacent to riparian zones.

Riparian areas can also support primarily upland nesting bird species. For example, narrow riparian strips in the Owens Valley alluvial fan of the eastern Sierra Nevada provided perching sites, nesting material, foraging and watering areas for predominantly sagebrush nesting species. Additionally, these water birch drainages received an influx of Sage Sparrow families in late summer, suggesting the importance of riparian habitat for post-fledgling dispersal of sagebrush-associated juveniles (Heath and Ballard 2003[b]).

The importance of adjacent intact habitats can be illustrated by taxa other than birds. The Arroyo Southwestern Toad is another example of an animal that uses both riparian and upland habitats, and continuity between the two habitat types may be essential for species survival. This federally listed endangered species uses common riparian types in southern California for foraging and dispersal, even though dense, tall vegetation structures are least preferred for burrows. Females and breeding season males prefer channel and terrace habitats to campground, agricultural or upland habitats, but males use uplands after breeding season commences (Griffin and Case 2001).

A study on riparian lizards on the South Fork of the Eel River concluded that "rivers can feed the forests" and demonstrated that strong links between rivers and surrounding watersheds has implications for resource management. Riparian systems provide food and prey for riparian and

upland lizard species alike. Land uses (e.g., river impoundments) that alter downstream productivity and diversity of insects may influence not only downstream river biota, but adjacent terrestrial biota as well (Sabo and Power 2002).

1.4. Prioritize sites with an intact natural hydrology or the potential to restore the natural processes of the system.

Of the 11 focal riparian bird species that have suffered population declines, seven prefer to nest in early successional riparian habitat, particularly willow/alder shrub habitats with dense understory cover. To flourish, early successional habitats depend upon natural hydrology, including flooding, soil deposition, and point bar formation, for establishment (Sacramento River Advisory Council 1998). Seed dispersal and natural tree regeneration and growth also are sometimes compromised due to the absence of high peak flows or seasonal fluctuations in water levels (Smith et al. 1991, Stromberg and Patten 1992). Restoring or mimicking natural hydrology contributes to recreating the structural diversity found in natural riparian systems, increasing the habitat quality for native wildlife. Sites with intact natural hydrology or the potential to return to one should receive special consideration.

For the long-term conservation of the federally endangered Arroyo Southwestern Toad, management of natural disturbance regimes such as flooding, fires, and successional dynamics that promote continuous availability of preferred channel and terrace breeding sites is essential. Reservoirs, low water tables, paving, sediment mining, and exotic flora introduction have all negatively impacted habitats vital for Arroyo Toad breeding and larval development (Griffin and Case 2001).

1.5. Prioritize sites according to surrounding land use.

Management of riparian areas at a watershed-level is the best method for conserving bird populations. Landscape scale land use patterns may significantly affect the sustainability of riparian bird populations over the long term (Petit et al. 1995). 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 12 kilometers between foraging grounds and the nest sites of their hosts (Mathews and Goguen 1997). For more information, refer to Recommendation 6-3.

The Swainson's Hawk demonstrates the need for protected and properly managed habitats surrounding riparian zones. In the Central Valley, Swainson's Hawks prefer to nest in riparian vegetation but typically forage upland. Historically, they hunted small mammals in native perennial grasslands. Today, they seek prey in grazed grasslands and certain forms of agricultural land (Table 8-1). Landscape-scale variables determine habitat suitability for these hawks: nest placement not only depends on vegetation characteristics around the nest site, but the suitability of surrounding habitat for foraging. In this case, protecting or restoring a pristine riparian forest is insufficient for the conservation of this species.

Table 8-1. Ranking of various habitats as foraging habitat for Swainson's Hawks in California[1]

Vegetation Type	Rank [2]	Access to Prey [3]	Prey Abundance [4] (Prey Population size and availability)
Perennial Grassland	1, 2	Consistently high	High prey and high availability
Alfalfa	1, 2	Consistently high	High prey and high availability
Fallow Fields	3, 5	Consistently moderate	Moderate prey and high availability
Dryland Pasture	4	Consistently moderate	Low prey, but high availability
Beets	4, 5	Usually low, high at harvest	Moderate prey, only highly available at harvest
Tomatoes	5, 6	Normally low, high at harvest	Moderate prey, only highly available at harvest
Weedy/Ruderal Field	5-11	Highly variable	Moderate prey with variable availability
Irrigated Pasture	7	Consistently low	Very low prey, but high availability
Shrub/Sage	7-12	Highly variable	Low prey and moderate availability
Grains	8	Consistently low	Low prey and low availability
Other Row Crops	9-12	Consistently low	Low prey and low availability
Orchard/Vineyard	10-12	Consistently low	Low prey and low availability

1. Table based on studies in the Central Valley (Estep 1989) and Great Basin (Woodbridge 1991).
2. Ranked from 1 to 12, highest to lowest value as foraging habitat, depending on prey abundance and availability.
3. Different foraging habitats provide varying amounts of prey throughout the year. Tilling and harvest activities strongly affected the availability of prey within each crop type (Estep 1989).
4. Ranked as high, moderate or low prey abundance and the degree of availability of the prey. Each crop type supports a different abundance of prey (Estep 1989).

The following land uses within a riparian buffer zone are listed in general order of preference. This list provides only rules of thumb and must be considered in context with many other factors when assessing each unique conservation opportunity. The land uses generally beneficial with sustainable management are:

- Natural habitat not used for commodity production (e.g., wilderness).
- Unimproved parks/open space (provided substantial non-native species problems do not exist).
- Commercially managed habitat (e.g., grazed oak woodlands or timber production forest).

The land uses that can be beneficial, neutral, or detrimental depending on the wide variety of crops, cultivation, and pest control techniques used (Table 8-1) are:

- Horse/cow pasture.
- Campgrounds and picnic areas.
- Row crops.
- Permanent crops (e.g., orchards, vineyards).

The land uses within a riparian corridor or buffer zone that can be detrimental to birds because they support and attract cowbirds and predators are:

- Manicured parks and golf courses.
- Rural homes/ranchettes.
- Dairies and intensive feedlots.
- Intensive development (urban/suburban) and intensive agriculture.

The land surrounding a proposed protection or restoration site should be assessed for its risk of change or conversion and how that may affect bird populations. For example, is the land available for conversion to other uses? Or, is it permanently prohibited from development (e.g., in a floodplain; in public ownership; or protected through an agricultural conservation easement, a habitat conservation plan, local zoning, or an urban limit line)?

Objective 2

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

Recommendations

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

The size and connectivity of riparian 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., a cottonwood willow patch within the valley foothill riparian type). 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., Western Yellow-billed Cuckoo) 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).

Western riparian habitats are naturally linear systems with extensive edges. Patch isolation (lack of connectivity) may influence bird communities as much as habitat fragmentation. Small patch size and/or patch isolation may increase predation and brood parasitism rates and limit population dispersal. For example, although a number of riparian areas in California are of sufficient size (41 hectares, Laymon and Halterman 1987, 1989) and structure to support Western Yellow-billed Cuckoos, individuals may not colonize these areas because of their distance from existing populations and the lack of enough potential mates in close proximity. Some studies have suggested that amount of available riparian habitat, at various spatial (e.g., Tewksbury et al. 2002) and temporal (e.g., Greco et al. 2002) scales, is more important than patch size *per se*. Because riparian systems are dynamic, patch sizes may differ from year to year and should be considered on a landscape scale (Greco et al. 2002).

2.2. Restore natural hydrology in riparian systems wherever possible. (see Recommendation 1.4).

Restoration Recommendations

Objective 3

Increase the value of ongoing restoration projects for bird species.

Recommendations

3.1. Restore and manage riparian forests to promote structural diversity and volume of the understory. (See Recommendation 5.2.)

Loss of appropriate microhabitat, such as habitat structure or heterogeneity, may explain a species decline or absence in areas where riparian habitat appears intact. In restored riparian areas, large tree size and high foliage volume promote avian diversity, but diversity of vegetation structure may be even more important (Nur et al. 1996, Holmes et al. 1999). Seven of the ten focal species that have suffered the greatest range reductions and/or are declining tend to depend upon early successional riparian habitat, particularly willow-alder shrub habitats with dense understory cover. These include the Willow Flycatcher, Song Sparrow, Bell's Vireo, Blue Grosbeak, Yellow-breasted Chat, Yellow Warbler, and Common Yellowthroat. Many other species, such as the Wilson's Warbler, Spotted Towhee, and Swainson's Thrush nest on or near the ground and need a healthy understory to successfully reproduce (PRBO unpublished data). The nest success of some species, such as Calliope Hummingbirds, Bushtits and Black-headed Grosbeaks in the eastern Sierra Nevada is positively influenced by herbaceous ground cover or wild rose shrub cover, even though these species tend to nest in the higher layers of the riparian canopy (Heath et al. 2001). Among several bioregions, riparian bird abundance, richness and occurrence is significantly and positively associated with herbaceous or shrub cover as well as tree DBH and tree cover (Gardali et al. 2001, Small et al. 2001, Heath and Ballard 2003a).

In coniferous forest habitats, managers frequently plant conifers in riparian corridors to produce large, woody debris that provides aquatic habitat. This practice should be reassessed, minding that a deciduous component creates the structural diversity needed to support riparian-dependent terrestrial species. For example, in aspen riparian habitats of the eastern Sierra Nevada, breeding bird species richness decreased as conifer cover and white fir cover increased, but was positively influenced by the cover of herbaceous layers, willow shrubs, and snowberry (Heath and Ballard 2003a).

3.2. Restore the width of the riparian corridor.

Most riparian corridors today are much narrower than they were historically, particularly in the Central Valley. Hence, restoration planners should consider increasing corridor width to historic margins when possible. In coastal riparian habitats, for example, the presence of Warbling Vireos, Common Yellowthroats, and Swainson's Thrushes positively correlates with the width of the riparian corridor. The mean riparian corridor width at sites supporting Warbling Vireos was 82 meters, 30 meters greater than the mean width at sites without vireos (Holmes et al. 1999, Gardali et al. 2001). Breeding bird diversity in the eastern Sierra Nevada is positively associated with riparian width at several landscape scales (Heath and Ballard 2003b).

Quantifying a specific target width of riparian habitat is extremely complex; the effect of riparian width varies by bird species and riparian type and is only one of many variables affecting species occurrence and reproductive success. For example, while insufficient width of riparian corridors has been shown to negatively affect the breeding success at some locations (Bednarz et al. 1998, Small and Geupel 1998), riparian width had no affect on Yellow Warbler nest success in 50m – 250m wide riparian sites in eastern California (Heath and Ballard 2002b). Future research and landscape-level analysis will elucidate the problem. Regardless, wider riparian corridors are likely to provide more and better habitat.

Objective 4

Ensure that large landscape scale management and flood control projects maximize benefits to wildlife while benefiting agriculture and urban populations. Achieving multiple goals simultaneously enhances the overall value of such projects to the people of California.

Recommendations

4.1. Management of new or existing flood bypass areas should consider the benefits of a regenerating riparian habitat against those of other uses.

Recent floods in California, such as the New Year's flood of 1997 or the Napa River flood of 1997-98, demonstrate the need for a new model for flood control and habitat protection. Management of bypass areas as riparian habitat maximizes the public benefits of floodway/bypass projects currently under consideration throughout the state.

The preliminary report of the California governor's Flood Emergency Action Team (1997) stated that new or enlarged flood bypass or levee setback systems should be considered as options for nonstructural flood control. This approach may be particularly useful in areas with little permanent infrastructure or development, such as the San Joaquin River floodplain and the Delta. The Army Corps of Engineers recently assessed the Sacramento and San Joaquin River Valleys for the potential to initiate nonstructural alternatives (NSAs), such as levee setbacks and flood bypass channels, rather than traditional flood control projects (i.e., dams, levees, and channelization).

Cultivated Restoration Recommendations

Restoration and improved management are the best means by which to increase the amount and quality of riparian habitat in the state, thereby increasing the reproductive success and population sizes of riparian-associated birds. California's restoration experts have pioneered the development of riparian habitat restoration techniques over the past few decades.

Scientists are evaluating restoration's effects on threatened or endangered bird populations in California (e.g., Kus 1998, McKernan and Braden 2001), and the Herculean effort of restoring riparian habitat to the Lower Colorado River has been well studied in regards to its benefits to bird populations (e.g., Anderson and Ohmart 1982, Rosenberg et al. 1991). Yet, only recently have scientists evaluated the effects of restoration on more common bird species in other regions of the state (Gardali et al. 2001, Larison et al. 2001, DiGaudio 2003, Haff 2003, Jaramillo and Hudson 2003) and many data remain unpublished or in report form (e.g., Geupel et al. 1997a, b; Small et al. 2000, Burnett and DeStaebler 2001, Small et al. 2001, Heath and Gates 2002, Heath et al. 2002[a]). The results from many of these studies suggest that greater attention should be directed to restoration of the understory to increase cover, particularly forbs (Larison et al. 2001, Burnett and DeStaebler 2002, Recommendation 5.2). Furthermore, primary and secondary cavity nesters greatly benefit when deadwood is maintained at a restoration site (Marzluff and Ewing 2001, Gilchrist et al. 2002).

Objective 5

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

Recommendations

5.1. 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 8-2, 8-3). 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). Results from three years of monitoring of restoration sites along the lower Sacramento River indicate that bird diversity in an area increases when two or more shrub species are present and is substantially greater when there are seven or more species (Geupel et al. 1997a). Because many of the "shrubs" detected are actually young trees, high shrub species richness may indicate riparian forests with good structure and regeneration. Studies in coastal Marin County show that bird species diversity in riparian habitats significantly correlates with tree species richness, tree height, and tree girth (Holmes et al. 1999).

5.2. 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 riparian bird species, especially in newly restored habitats (Larison et al. 2001, Twedt et al. 2002, DiGaudio 2003). 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.

Many revegetation projects enhance growth of tree plantings by mowing the restoration plots during the first two years. After mowing, restoration managers should plant a second stage to enhance recruitment of a native understory, thereby increasing the quality of the shrub and forb layers.

5.3. Plant native forb and sedge species.

The Common Yellowthroat and Spotted Towhee use native grass and sedge frequently in the Sacramento Valley as nest substrate. An excellent resource detailing type, sources, and techniques for planting and restoring native grasses is provided in *Bring Farm Edges Back to Life!* (YCRCD 1998).

5.4. Cultivate tree species where natural hydrological processes are compromised and natural tree regeneration is limited or absent.

Seed dispersal and natural tree regeneration is sometimes compromised due to the absence of high peak flows or seasonal fluctuations in water levels (Stromberg and Patten 1990, Smith et al. 1991). Cultivating tree species where regeneration is lacking is recommended.

5.5. Plant vegetation in a mosaic design with dense shrub patches interspersed with trees to achieve a semi-open canopy.

Plantings that are concentrated into clumps will create more productive patches of habitat for nesting birds than plantings uniformly spaced over a large area. "Clumped" planting designs more closely mimic the natural establishment of vegetation after scouring or soil deposition from a flood. For example, many willows grow naturally in clumps and can be easily planted this way.

Table 8-2. The following plant species and cover types have been found to positively influence breeding bird diversity or breeding species richness in riparian habitats, by California bioregion.

	Sacramento and San Joaquin Valleys[1]	Modoc	Klamath[2]	Central Coast	Bay-Delta[3]	South Coast	Mojave and Colorado Deserts[5]	Sierra Nevada[4]
Canopy layer	• Large trees • Oregon ash	No data	• Tree cover • Big leaf maple	No data	• Tree DBH • Tree cover • Tree richness	No data	• Freemont cottonwood • Black willow	• Aspen • Black willow • # snags
Shrub layer	• Blue elderberry • Box elder • Willow species • Wild rose • California blackberry • Wild grape • Poison oak • Shrub richness • Mugwort • Shrub cover	No data	• Big leaf maple • Ponderosa pine	No data	• Shrub height diversity	No data	No data	• Willow • Snowberry • Shrub cover
Ground cover	• Mugwort	No data	• Blackberry (Himalayan or California)	No data	No data	No data	No data	• Herbaceous cover • Grass cover • Rush cover

[1] Geupel et al. 1997[a], Small et al. 2001, Burnett and DeStaebler 2001, Burnett et al. *in press.*
[2] Nur et al. 1996.
[3] Gardali et al. 1999; Gardali et al. 2001, Holmes et al. 1999, DiGaudio 2003.
[4] Heath et al. 2001, Heath and Ballard 2003a, Heath and Ballard 2003[b], Heath 2002, Stefani 2000.
[5] Anderson et al. 1983.

5.6. Retain at least some existing trees on restoration sites, planting around them, to promote occupancy of the plot by birds requiring mature trees (e.g., cavity nesters, orioles, etc.). Projects that plan to remove orchards should consider leaving a few trees in small clumps (with the exception of fig or other species with invasive root stocks).

Both primary and secondary cavity nesters are common in natural forests and are excluded from nesting on restoration sites that lack older trees due to lack of nest sites. When possible, restoration managers should leave a few old trees with cavities and snags or girdle younger, healthy, non-native trees. It is essential to provide cavity nesters with habitat until planted trees grow sufficiently to provide nests.

Photo by Eric Preston, ericjpreston.com

Consider the needs of cavity nesters at restoration sites.

5.7. Connect patches of existing riparian habitat with strips of dense, continuous vegetation that are at least 3-10 meters wide.

The connection of habitat patches is an important restoration consideration. Relatively sedentary species, such as Song Sparrows, Spotted Towhees, and Wrentits, 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 (such as linking the Butte Sink, which supports Song Sparrows, with the Sacramento National Wildlife Refuge, which does not, despite appearing to have suitable habitat). Even narrow strips may function as dispersal corridors. Song Sparrows, Wrentits, and Spotted Towhees have been observed in strips as narrow as 1 meter, and other species have been observed in strips 10 meters wide (Soulé 1988, PRBO unpublished data). These strips probably do not provide adequate breeding habitat, and nesting individuals may have low reproductive success. However, they may be vital in linking populations that would otherwise be isolated from one another, a benefit which outweighs the low reproductive success of relatively few individuals.

Management Recommendations

Effective management of riparian areas is as crucial as habitat restoration to the survival and recovery of riparian 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 riparian bird populations remain stable over the long term.

Objective 6

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

Recommendations

6.1. Manage riparian and adjacent habitats to maintain a diverse and vigorous understory and herbaceous layer, particularly during the breeding season.

The number of young produced in a bird population (reproductive success) may be the most important factor influencing a species' occurrence and persistence in an ecosystem. When less than 20% of nests survive to fledge young, nest success is considered poor and it probably indicates a nonviable population (Martin 1992, Robinson et al. 1995, Trine 1998, Budnik et al. 2000). Early successional habitats with a dense, shrubby understory and herbaceous groundcover are critical for successful nesting of nine of the 17 focal riparian species. Not surprisingly, shrub cover around the nest is an important variable in nest-site selection for many species (Table 8-3). The following recommendations will promote understory and groundcover quality:

- Use groundcover in orchards and vineyards to discourage foraging by Brown-headed Cowbirds, thereby increasing birds' reproductive success. Use of a native species groundcover is preferable. Managers should either avoid mowing through the nesting season or maintain the layer to 6 inches in height to discourage use by nesting birds.

- Control star thistle and other "weedy" non-native species to promote a diverse herb layer.

- Allow natural disturbance regimes, particularly periodic floods.

Grazing, mowing, and burning are common land management practices that significantly affect the understory. Options for managing these activities include:

- Manage grazing intensity and location to ensure riparian deciduous shrubs are recruiting well and are not "highlined" (i.e., cattle do not destroy all the foliage within their reach).

- Manage grazing intensity and timing to avoid direct impacts to low-nesting birds during breeding season.

- Postpone mowing until after peak breeding season. If mowing must be done during breeding season, maintain a low herbaceous layer of no more than 6 inches to discourage birds from nesting there in the first place.

- If burning must be used as a management technique, burn the groundcover in riparian habitats after the end of the breeding season.

The Willow Flycatcher demonstrates how land management activities can affect a breeding population. The subspecies of Willow Flycatcher *E. t. brewsteri* depends upon montane meadows in the Sierra Nevada for nesting. Grazing cattle in mountain meadows during the breeding season has both direct and indirect effects on Willow Flycatchers. Directly, cattle move through meadow willows and destroy Willow Flycatcher nests by bumping against or trampling them. Indirectly, browsing decreases foliage density in willows and other shrubs at heights lower than 1.5 meters, where Willow Flycatcher nests occur. This reduces the number of available nest sites and exposes existing nests to predators.

In desert riparian areas, grazing by wild burros severely affects riparian vegetation and associated bird species. The effects of burros in some areas include (BLM 1998):

- High browse lines and severe hedging of riparian trees and shrubs, which eliminates understory nesting habitat.

- Pulling forage plants out by the roots, possibly contributing to invasion by competitive non-native plants.

- Soil compaction along burro trails, which leads to erosion or inhibits seedling establishment.

These effects combine to destroy the vegetation, and in the harsh desert environment, the habitat recovers more slowly than in other riparian types in California.

Table 8-3. The following plant species and cover types have been found to positively influence select focal species occurrence[a], abundance[b], nest success[c] and nest site selection[d] in riparian habitats, by California bioregion.

	Sacramento and San Joaquin Valleys[1]	Bay-Delta[2]	South Coast[3]	Sierra Nevada[4]
Willow Flycatcher	Species not present	Species not present		• Willow cover[a,b] • Foliage density[a,b]
Warbling Vireo		• Tree richness[a] • Shrub height diversity[a]		• Aspen[a] • Tree height[a]
Least Bell's Vireo	Species not present	Species not present	• Shrub cover[a,b] • Tree cover[a,b] • Tree DBH[c] • Herbaceous cover[d] • Low Aquatic vegetation[d]	Species not present
Swainson's Thrush		• Tree cover[a,d] • Tree height[a] • Hedgenettle[d]		• Canopy closure[a] • Willow patch size[a]
Yellow Warbler	• Himalayan blackberry[b] • Valley oak[b]			• Grass[a] • Wild rose[c] • Willow[a]
Common Yellowthroat	• Shrub richness[a] • Mugwort[a] • Santa Barbara sedge[a]	• Herb cover[a] • Marsh cover[a] • Shrub cover[a]		

Table 8-3 continued

	Sacramento and San Joaquin Valleys[1]	Bay-Delta[2]	South Coast[3]	Sierra Nevada[4]
Wilson's Warbler		• Tree richness[a] • Small trees[a] • California bay[c]		
Yellow-breasted Chat	• Sedge[b] • Black mustard[b] • Sandbar willow[b] • California blackberry[b]			
Black-headed Grosbeak	• Tree richness[a] • California blackberry[a] • Mugwort[a] • Freemont cottonwood[b] • Black mustard[b]	• Tree height[a] • Shrub height diversity[a] • Tree cover[a] • Shrub cover[a] • Tree richness[a]		• Tree species richness[a] • Wild rose[c]
Blue Grosbeak		• Tree richness[a] • Shrub cover[a]		
Song Sparrow	• Valley Oak[b] • Pipevine[b] • Mugwort[b] • Black mustard[b]	• Marsh cover[a] • Shrub height[a] • Herb cover[a] • Red alder[c] • Litter depth[c] • Shrub cover[a,c] • Tree richness[a]		• Willow[a]

[1] Small et al. 2001, Burnett and DeStaebler 2001, Burnett et al. *in press.*
[2] Holmes et al. 1999, PRBO data, Gardali et al. 1999, DiGaudio 2003, Haff 2003.
[3] Salata 1981, Salata 1983, Goldwaser 1981, RECON 1989, Olson and Gray 1989, Kus 1998.
[4] Heath and Ballard 2003, Heath et al. 2001, Heath and Gates 2002, Stefani 2000, Bombay et al. 2003, Bombay 1999, Sanders and Flett 1989.

6.2. Manage or create "soft" edges (through establishment of hedgerows at field margins) appropriate to historical vegetation patterns.

"Soft" edges are gradual boundaries between differing vegetation or land uses where plant succession occurs. Historically, along many of California's rivers, a wetland area graded into scrubby willow that graded into riparian forest. This pattern created a mosaic landscape, where different habitats smoothly merged together into an ecotone. Soft edges are preferable to "hard" edges (abrupt changes in vegetation type) because predation levels along hard edges are higher (Suarez et al. 1997). Creating hedgerows using native plant species along forested riparian zones at the edge of agricultural fields results in "softer" edges. The Yolo County Resource Conservation District publication, *Bring Farm Edges Back to Life!* (YCRCD 1998), details how to create and mange hedgerows.

6.3. 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) near riparian nest sites 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. In the eastern Sierra Nevada, weekly point counts at pack stations and adjacent riparian areas revealed significantly more cowbirds at pack stations than in riparian areas in most years and at most sites (Heath et al. 2002[a], 2002[b]). Furthermore, managers should discourage human habitation near riparian areas and bird feeders should be avoided during the breeding season if cowbirds are using them as supplemental food. In the eastern Sierra Nevada, weekly evening area searches in a suburban development near a riparian drainage documented, on average, six cowbirds per visit, with as many as 60 cowbirds observed foraging at one bird feeder on several occasions (PRBO data).

The proximity of active livestock grazing may also determine the feeding distributions of cowbirds and the distances they will commute between foraging and laying areas (Mathews and Goguen 1997). Grazing and human facilities within one kilometer of breeding sites affect reproductive success more negatively than facilities located farther away. Establishing cowbird buffer zones around riparian areas during the avian breeding season may reduce the impact of cowbirds on host species. The creation of such buffers may be difficult, however, since cowbirds may regularly commute up to 12 km between foraging and laying areas (Mathews and Goguen 1997).

In the Bitteroot River Valley of Montana, cowbird abundance declined significantly with increasing distance from agriculture (Tewksbury et al. 1998). Additional feeding areas (i.e., agriculture, livestock) located farther than one km from a laying area have no apparent additional impact on the density of cowbirds or brood parasitism. However, this study did not assess the effect of facilities located at greater than one km from the riparian zone in the absence of facilities located within a one km range. Forest Service management guidelines focused on the Willow Flycatcher recommend avoiding the establishment of new facilities within a two to five km range of important riparian areas. If this is not possible and if landscape features aggregate livestock, then livestock use should be limited during the breeding season (generally, April 1- June 30 for lowland nesting species and May 15 August 15 for nesting areas at high-elevation).

6.4. Brown-headed Cowbird trapping should only be used as an interim/emergency measure. Trapping can save or maintain a threatened population of host species while sustainable, habitat based solutions are developed, but should not be considered a long-term solution.

The consensus of expert opinion indicates that cowbird trapping is at best a temporary stopgap solution (Morrison et al. 1999). Preferably, land managers should focus on restoring riparian habitat and guide land use to lessen the negative impacts of cowbirds. A species will never fully recover as long as they rely upon human intervention for their survival (Kus 1999). The North American Cowbird Advisory Council recently formed to address trapping issues, review trapping programs, and advise land managers and regulatory agencies (http://cowbird.lscf.ucsb.edu/). Cowbird trapping is not an appropriate response to parasitism in many cases because:

- The Brown-headed Cowbird is a native North American breeding species
- It is not a long-term solution.
- It can be expensive and requires constant management
- There are ethical considerations and impacts on non-target species.
- A permanent trapping program may be a factor that weighs against delisting of threatened and endangered species (Kus 1999, Morrison et al. 1999).
- It may be detrimental to host species by removing experienced female cowbirds that are more selective in their host selections and egg laying, creating a void filled by more numerous, younger individuals (Hahn et al. 1999).

Additionally, cowbird trapping in areas such as the lower Sacramento River and the Cosumnes River, where restoration of habitat through large-scale natural recruitment is currently underway, would preclude the ability to monitor wildlife response to restoration efforts in the absence of cowbird trapping. Therefore, we will miss opportunities to learn whether songbird populations can recover simply due to habitat restoration without active cowbird management.

6.5. Manage or influence management at the landscape level (i.e., land surrounding riparian corridors or, preferably, the whole watershed).

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. Grazing should be avoided during the breeding season in livestock pastures bordering riparian areas (Goguen and Mathews 1999, Hochachka et al. 1999). Linking and buffering large sections of riparian and associated upland habitat may restore top predators, such as coyotes or bobcats to the riparian system. These predators may, in turn, reduce populations of avian nest predator such as skunks, raccoons and snakes.

When grazing or agriculture constitutes a significant percentage of the landscape near the riparian corridor (particularly within a 1-12 km distance), the following are recommended:

- Use integrated pest management or organic production as an alternative to pesticide use. This prevents damage to nesting birds and increases available foraging habitat, especially in orchards immediately adjacent to healthy riparian areas. Riparian songbirds rely on local insect populations to feed young during the breeding season.

- Use groundcover crops in orchards and vineyards to minimize cowbird foraging habitat. Managers should limit or avoid mowing groundcover during the breeding season (see Recommendation 6-1).

- Eliminate, reduce, or closely manage grazing in spring and during the breeding season (April-July) to maximize the understory habitat value to wildlife and minimize foraging habitat for cowbirds.

- If grazing must occur in riparian zones, establish wide pastures and move cattle often to avoid the devastating impacts of year-round grazing.

6.6. Limit restoration activities and disturbance events such as grazing, disking, herbicide application, and highwater events to the nonbreeding 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 California may begin as early as March and continue through August, depending on region, habitat type and elevation (Table 8-4).

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

Extending riparian habitat restoration and management beyond avian requirements alone is essential. Many non-avian species respond positively to vegetation components and riparian functions that are important for bird populations in riparian habitats of California. The federally endangered riparian brush rabbit is an excellent example of a riparian-dependent species that needs our attention immediately. The riparian brush rabbit, or "brush bunny," is a small cottontail rabbit that is one of eight subspecies of brush rabbits native to California. Like many birds outlined in this document, they depend on a dense understory in riparian oak forests that includes willow thickets, California wild rose, wild grape and Pacific blackberry. In response to their perilous status, the Endangered Species Recovery Program leads a captive breeding program to reintroduce brush rabbits into California riparian areas. The story of the brush bunny illustrates a critical conservation concept: not only do birds benefit from dense riparian understories, but also other species like the endangered brush rabbit. For more information on the riparian brush rabbit, see the following web site: (http://sacramento.fws.gov/es/animal_spp_acct/riparian_brush_rabbit.htm).

Table 8-4. Dates of earliest egg, latest first egg, peak of egg initiation and timing of breeding season for riparian-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
Sacramento Valley				
Clear Creek[5]	1st week March	2nd week July	April 30 – June 30	mid March – mid August
San Joaquin Valley				
San Luis NWR	April 12	July 23	April 1 – August 20	
Modoc[1]				
Lassen NF and NP	April 10	----	----	April 5 – August 31
Klamath	No data for this bioregion			
Central Coast	No data for this bioregion			
Bay-Delta				
West Marin county[4]	March 19	July 6	----	mid March – mid August*
South Coast	No data for this bioregion			
Mojave Desert	No data for this bioregion			
Colorado Desert	No data for this bioregion			
Sierra				
Owens Valley alluvial fan[2]	March 29	July 21	May 16 – June 15	Mar 25–August 31
Mono Basin[3]	April 4	July 25	May 16 – June 15	April 1–August 31
> 2500m Mono and Inyo co[3]	April 29	July 26	May 16 – June 15	April 20–August 31

[1] King et al. 1999
[2] Heath et al. 2001
[3] Heath et al. 2002a, Heath et al. 2002b
[4] Gardali et al. 1999
* Hummingbirds can nest year-round in this bioregion.

Objective 7

Protect, enhance or recreate natural riparian processes, particularly hydrology and associated high water events, to promote the natural cycle of channel movement, sediment deposition, and scouring that create a diverse mosaic of riparian vegetation types.

Recommendations

7.1. Avoid impacts on the natural hydrology of meadows, streams, and river channels, particularly in high-priority areas managed for riparian species. (See Recommendation 1.4)

The following options minimize damage to natural hydrology:

- Protect areas where grazing may be drying meadows or streams through soil compaction and gullying; provide alternative water sources for cattle.

- Implement grazing standards that protect natural hydrology; reduce soil compaction, erosion, and water pollution due to grazing.

- Limit or contain recreational use of meadows (e.g., off-road vehicles, horses, camping) that can compact soils and negatively affect hydrology.

- Manage upslope areas (e.g., timber harvest, road building) so that hydrologic function is maintained.

- Implement revegetation projects such as "willow walls" to prevent erosion and provide habitat.

7.2. At sites with dams or other flood control devices, manage flow to allow a near natural hydrograph (i.e., mimic natural flood events) sufficient to support scouring, deposition, and point bar formation. Time managed flood events to avoid detrimental impacts on Bank Swallow nesting colonies.

Managers should modify reservoir storage during wet years to simulate the natural, seasonal pattern of short duration flood peaks. The establishment and succession of native riparian vegetation rely upon a natural hydrology in the river system and provide essential habitat for many riparian-associated birds. Interruptions of these processes, including dams, levees, and water diversion, have significantly contributed to the decrease in riparian habitat and the consequent decline in songbird populations. Many non-native plant species are flood-intolerant, and the loss of regular scouring floods has abetted their invasion of the Central Valley. As invasive plants increasingly dominate a habitat, many native birds lose essential nesting and foraging habitat. For more information, please see the Sacramento River Conservation Area Handbook (Sacramento River Advisory Council 1998).

Bank Swallows are particularly vulnerable to poorly timed water management. The Bank Swallow nesting season extends from late March through early July, varying with seasonal weather fluctuations. During this period, the swallows nest in sandy banks along rivers. "Pulse flows" or "flushing flows" designed to mimic natural flood events may potentially wipe out entire colonies in a single event. These artificial flows, often used in fish management and restoration projects, should be prohibited (or at least severely curtailed and closely monitored) during the swallow's breeding season (April through July). Flows that artificially raise levels more than 2-3 feet during the breeding season should be avoided altogether. With 50% of the state's remaining Bank Swallow population nesting along the Sacramento River from Red Bluff to Colusa, a poorly timed flow event could have dire consequences.

7.3. Control and eradicate non-native plant species. Such control is best planned and implemented on a watershed scale.

The non-native plant species listed in Table 8-5 have invaded riparian habitats to the detriment of native flora and fauna. Their negative effects on bird communities are probably much more widespread than noted in the table. Invasive, introduced plants affect native birds by:

- Competing with native vegetation, thereby eliminating useful foraging and nesting habitat.
- Providing a sub-optimal nesting substrate, in which nest success is reduced
- Reducing several orders of native insects (NPS 1998).
- Enhancing non-native animal populations.

In river systems, these non-native plants often spread very quickly and should be controlled at the first sign of their presence. Managers should be especially concerned with the invasion of tamarisk and giant reed in desert riparian habitats. The species displace native vegetation and disrupt the system by drying perennial streams. Species diversity of resident songbirds was negatively correlated with riparian vegetation dominated by saltcedar at the Salton Sea and several bird species were negatively associated with saltcedar dominance (Holmes et al. 2003). Removal of these species can restore the flow of these seasonal streams (BLM 1998), allow native vegetation growth, and subsequently provide more and better habitat for birds.

Control of non-native species is much less expensive and more effective if conducted before the species has spread into extensive monotypic stands. This is particularly true in a riparian system where seeds, rhizomes and vegetation easily spread downstream. Control efforts, therefore, must be planned and undertaken on a watershed scale, preferably beginning with the removal of the invasive species which is furthest upstream.

In many areas, California black walnut is planted as a native; however, some botanists believe this plant was introduced early during the colonization of California. Black walnuts exude a sap that is a natural herbicide (juglans) that can result in a sparse understory beneath a black walnut canopy. Black walnut is detrimental to the nesting success of Yellow-billed Cuckoo and shows no positive influence on nest success of those species that do use it as nest substrate, including the Black-headed Grosbeak, Western Wood-pewee, Western Kingbird, House Wren, and Nuttall's Woodpecker. Black Walnut negatively influences nest-site selection by Lazuli Bunting, House Wren, and Spotted Towhee and negatively influences nest success of many cavity-nesting birds (Geupel et al. 1997[a]).

7.4. Control and eradicate non-native animal species.

Non-native animals can have a severely negative impact on birds. 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. To reduce the effects of non-native animals on native birds:

- Avoid establishing human habitat near riparian 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.

Table 8-5. Non-native species and their effects in riparian habitat.

Introduced Species	Scientific Name	Effects/Bird Species Affected [1]
Acacia	*Acacia dealbata*	Out-competes and hinders the establishment of willow-alder stands (Danner pers. comm.)
Black locust	*Robinia pseudoacacia*	Displaces native habitat
Black walnut	*Juglans californica*	Western Yellow-billed Cuckoo, Lazuli Bunting, Spotted Towhee, House Wren and other cavity nesters
Cocklebur	*Xanthium strumarium*	Bell's Vireo
Cape-ivy (German ivy)	*Delairea odorata*	Swainson's Thrush. Overtops and out-competes native understory and trees
Edible fig	*Ficus carica*	Western Yellow-billed Cuckoo
English ivy	*Hedera helix*	Chokes riparian trees
Giant reed	*Arundo donax*	Bell's Vireo
Periwinkle	*Vinca major*	Out competes understory plant species (Danner pers. comm.)
Purple loosestrife	*Lythrum salicaria*	Grows in dense stands that support less avian diversity but greater density than some native habitats (Whitt et. al. 1999)
Russian olive	*Elaeagnus augustifolius*	Willow Flycatcher
Sticky eupatorium	*Ageratina adenophora*	Obstructs waterways and forms dense strands on drier uplands (Danner pers. comm.)
Tamarisk	*Tamarix chinensis*	Least Bell's Vireo
Tasmanian blue gum	*Eucalyptus globulus*	Golden-crowned Kinglet, Ruby-crowned Kinglet
Opossum	*Didelphis virginiana*	Predator of many species, particularly those that forage and nest near or on the ground
House cats	*Felis catus*	Predator of many species, particularly those that forage and nest near or on the ground

[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/htmldocs/riparian.html.

Monitoring and Research Recommendations

Objective 8

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.

Recommendations

8.1. 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 (*in press*) 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 *in press*); 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.

8.2. 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. 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, reproductive success, parasitism, survival, vegetation data, suitable habitat requirements, and general life-history information. Managers can employ these data to make well-informed, adaptable management plans.

8.3. Investigate the relationship between herbaceous vegetation height and avian productivity and recruitment, especially in wet meadows.

Wet meadows are vital habitats for birds in the Sierra Nevada (Siegel and DeSante 1999). Grazing and other resource-extraction activities compromise these areas and endanger some local avian populations (see Chapter 7: Bioregional Conservation Objectives). More study of the effects of grazing, fire suppression and non-native plant invasion would facilitate the development of grazing prescriptions that are less detrimental to nesting and migrating birds.

8.4. 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, riparian 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 have 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.

8.5. Conduct selective monitoring at critical sites to determine the effects of cowbird parasitism on the Willow Flycatcher, Bell's Vireo, Warbling Vireo, Common Yellowthroat, Blue Grosbeak, Wilson's Warbler and Yellow Warbler.

Brown-headed Cowbird parasitism has potentially devastating effects on the populations of these and many other species in California. 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.

8.6. Conduct selective monitoring at key sites to determine the factors influencing nest success of the Song Sparrow, Lazuli Bunting, Yellow Warbler, Willow Flycatcher and Warbling Vireo.

Relatively recent, local extirpation and declines of these and other western species from their historical breeding range appear to be caused by low productivity (Johnson and Geupel 1996, Chase et al. 1997, Gardali et al. 1998, Gardali et al. 2000). Local extirpation may signal the early stages of a process of severe population declines. By determining the factors associated with low reproductive success, research may identify which management and restoration actions will help reverse songbird 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.

Objective 9

Maximize the effectiveness of ongoing monitoring and management efforts.

Recommendations

9.1. 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. For example, bird monitoring in restored riparian habitats on the Stony Creek Preserve along the Sacramento River has provided detailed information about breeding birds and their habitat requirements and offered suggestions on how maintenance activities can be implemented with minimal disturbance. Managers on the preserve can quickly incorporate new data into management regimes, honing their project designs to better benefit birds.

9.2. Use standardized monitoring protocols.

By standardizing monitoring techniques, researchers ensure that results can be compared across space and time. The USDA Forest Service published guidelines for standardized monitoring techniques for monitoring birds (Ralph et al. 1993). Please refer to Appendix A for more information.

9.3 The CALFED Bay-Delta Authority should continue to incorporate bird monitoring into all riparian and wetland habitat restoration projects as a way to assess avian response, evaluate projects, and most importantly, adaptively manage.

CALFED is a state agency in California formed to implement the Bay-Delta Accord, signed in 1994. The Accord agreed to develop a Bay-Delta Conservation Plan that would seek to address issues of water quality, water supply, wildlife habitat, and flood control. A major CALFED program is the Ecosystem Restoration Plan, which, when approved, could be implemented with close to $1 billion in state and federal funds over the next 20 years. While the Ecosystem Restoration Plan considers the Central Valley, Delta, and San Francisco Bay riparian and wetland habitats, it historically focused on aquatic species. Realizing the efficacy of bird monitoring programs and their ability to provide information to adaptively manage habitat projects, most new CALFED projects now contain a bird monitoring element. Furthermore, if mistakes are made and practices are harming bird populations, managers can alter their methods and avoid similar mistakes in the future. With additional monitoring, a steady feedback loop of management, monitoring, and revision of practices is established.

9.4. Maximize the cost effectiveness and value of existing specialized monitoring programs for listed species (e.g., those oriented toward Western Yellow-billed Cuckoo and Willow Flycatcher) 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 could 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.

9.5. Determine what habitat and population characteristics are necessary to successfully wean a songbird population from cowbird trapping.

Most experts agree that cowbird trapping is only a temporary measure for relieving parasitism pressure on landbirds (Morrison et al. 1999). Furthermore, intense cowbird trapping has proven ineffective for certain local populations on the edge of extirpation. Willow Flycatcher populations at both the Kern River Valley and Camp Pendleton failed to increase after extensive cowbird control efforts. It is likely that there are other factors negatively influencing these populations. Although some species experience marked population growth following cowbird trapping (i.e., Least Bell's Vireo), often times little attempt is made to assess the extent to which other management actions, such as improved and expanded habitat, have contributed to the increases (USFWS 2002).

9.6. Coordinate with monitoring and research projects targeted at non-avian taxa to maximize the benefits of the protection, management and restoration of riparian habitats. Stream amphibians also provide another means of measuring environmental stress, and like birds, amphibians can be good indicators of different niches within riparian habitats (Welsh and Olliver 1998). Like birds, widespread declines of amphibians are well documented (Blaustein and Wake 1990, Wake 1991 and 1998, Pechmann and Wilbur 1994) and amphibians use diverse riparian habitats throughout California. The federally listed endangered Arroyo Southwestern Toad uses most common riparian types in southern California for foraging and dispersal, and females and breeding season males prefer channel and terrace habitats to campground, agricultural or upland habitats. The natural flooding disturbance regimes that encourage understory vegetation growth and provide habitat for declining bird species also promote continuous availability of preferred breeding habitat for the Arroyo Toad (Griffin and Case 2001).

Objective 10

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

Recommendations

10.1. Identify and implement research relevant to management of Tricolored Blackbirds, which continue to decline in California.

The most recent surveys of Tricolored Blackbirds in California show a continued population decline in Central Valley wetland habitats. This is likely due to a lack of management for this species. Tricolored Blackbirds require acceptable nesting substrates and adequate water levels throughout the

breeding season to discourage mammalian predators. Harvesting of silage and plowing of weedy fields currently are the most common reasons for destruction of nesting colonies (Beedy and Hamilton 1999). Therefore, managers must make thoughtful, well-informed decisions to protect these populations.

10.2. Identify winter range, habitat, and possible overwintering conservation issues for as many Neotropical migrants as possible, including the Western Yellow-billed Cuckoo, Least Bell's Vireo, and Swainson's Hawk.

Wintering grounds play a significant role in the life cycles of Neotropical migratory birds. If a population is declining primarily due to low overwinter 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, little information is available on overwintering habitat requirements and survival. Least Bell's Vireos overwinters in unknown locations in Baja California. Western Yellow-billed Cuckoos show a very distinct sex ratio in their breeding populations (8 males to every 1 female); if the sexes have different wintering grounds, and the females' has been destroyed or compromised, the ratio could skew further in the future, further imperiling the population. Preliminary radio telemetry data indicate that the Central Valley Swainson's Hawk overwinters in Mexico and Colombia, while Swainson's Hawks from other regions winter in the pampas of Argentina. Conservationists would learn much from solving such questions regarding overwintering habitats.

10.3. Inventory the Central Valley for Swainson's Hawk territories and map distributions of nesting and foraging habitat to develop a target population size. Plan management strategies for protecting priority habitats.

Swainson's Hawks in the Central Valley are more closely associated with riparian habitats than populations in other bioregions. Migratory patterns, overwintering areas, and relative isolation of breeding grounds suggest that this area may support a distinct metapopulation, which should therefore be managed as such.

10.4. Conduct statewide surveys to establish current population and range sizes every five years for the Swainson's Hawk and Bank Swallow, and every 10 years for the Western Yellow-billed Cuckoo.

Such surveys will provide a comprehensive picture of the state of these species and monitor long-term population trends in California. They would alert managers to population declines or expansions. As recommended in 8-2, these surveys should include the collection of as much data as possible on all other riparian birds.

Objective 11

Use information gathered from avian monitoring and research programs to improve the effects of agricultural and land management techniques on birds.

Recommendations

11.1. Work cooperatively with agricultural researchers to assess the potential of agriculture adjacent to existing riparian areas to be more "bird friendly."

Researchers could explore:

- Techniques for minimizing or eliminating cowbird foraging habitat.

- The relative utility to wildlife of row crops versus permanent crops (e.g., orchards, vineyards) as buffers.

- Creating habitat within a farming system through the use of hedgerows, tailwater ponds, hill ponds, irrigation canal and levee revegetation, and roadside buffer strips (YCRCD 1998).

- USFWS records describe Swainson's Hawk mortality events involving from one to 40 birds killed by applications of organophosphate and carbamate insecticides in agricultural fields, particularly in autumn, when flocks fed on insects in harvested fields. Goldstein et al. (1999) attributed high hawk mortality in the pampas of Argentina to poisoning by the organophosphate insecticides monocrotophos and dimethoate, used to control grasshoppers.

11.2. Devise an urgently needed method for controlling giant reed.

Giant reed, often referred to as Arundo, has spread throughout riparian zones in southern and central California, wreaking havoc with native plant communities and the natural hydrology of the area (see Recommendation 7.3). Current control efforts, which primarily employ physical removal and herbicides, appear inadequate to halt the invasion of this species. More effective measures, including biocontrol, must be sought.

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 and the Riparian Habitat Joint Venture embody 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 the RHJV intend to use this Conservation Plan to guide their riparian conservation projects. These agencies include the California Wildlife Conservation Board, the U.S. Bureau of Reclamation, the U.S. Fish & Wildlife Service, the USDA Forest Service, and recent efforts by 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 12

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

12.1. 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. 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.

12.2. 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.

12.3. Land managers should consider the impacts of horses and burros on riparian vegetation and associated birds when designating acceptable numbers of wild horses and burros on public land.

Public Law 92-195, the Wild Free-roaming Horse and Burro Act of December 1971, mandates that the Bureau of Land Management and USFS manage and control wild horses and burros on public lands. Horse and burro population levels are to be maintained at an "optimum number" that results in a thriving ecological balance and avoids deterioration of the range (BLM 1998). Because browsing animals can significantly degrade riparian habitats, land managers must consider the requirements of breeding and migrating birds and monitor habitat quality when establishing acceptable ungulate population sizes.

12.4. 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 A 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).

12.5. Local governments should establish locally-relevant riparian buffer zones to protect riparian habitat and associated surrounding uplands from development and disturbance, through zoning ordinances and/or general plan provisions.

Many California cities and counties have adopted some type of riparian development setback requirements, prohibiting various types of construction activities within a given distance from a stream. Typical development setbacks range from 15 to 30 m from the stream centerline, depending on stream type (perennial vs. intermittent) or land use type (urban vs. rural). In many areas, this small setback distance may not even extend outside the riparian zone. Although some local governments have adopted setbacks that start at the edge of the riparian zone, this is still not general practice. In addition, most zoning ordinances address the construction of a "structure," but often do not require setbacks for other activities that could disturb riparian areas, including roads, corrals/pens, pools, and other types of impervious surfaces that are not "structures" (Clark, pers. comm.).

Existing development setback distances are generally adopted from forestry standards, which are based primarily on the height of the highest tree and are generally focused on protecting water quality and habitat for anadromous fish (Erman et al. 1977, Peterjohn and Cornell 1984). While many have advocated the protection of larger, variable-width riparian buffer zones that incorporate variations in local hydrology and vegetation (Moyle et al. 1996), the emphasis has largely been on aquatic, rather than terrestrial resources. While more research is needed to identify appropriate riparian buffer widths for different terrestrial species, the value of preserving at least the width of a species' home range is well recognized (Warner and Hendrix 1984, Granholm 1987, Chapel 1992). For many, if not most, riparian-associated species, home ranges extend well outside the riparian zone, including adjacent upland vegetation such as grassland, shrub, oak woodland, or coniferous forest. Much of the research to date on effects and appropriate sizes of riparian buffer zones have been conducted in forested landscapes, where the nearby disturbance is timber extraction (e.g., Hagar 1999, Pearsono and Manuwal 2001, Robichaud et al. 2002). Little research on the topic has been done in urban and suburban areas, where the level of disturbance is arguably much greater.

Local ordinances and general plan provisions on riparian development setbacks should be expanded to include a wide range of riparian disturbances, and should start from the edge of the riparian zone, providing an additional upland buffer zone for species whose home ranges extend outside the riparian zone. A review of reptile and amphibian minimum habitat requirements found that a buffer of up to 290 m from the stream edge would be necessary to protect the core habitat of these taxa (Semlitsch and Bodie 2003). While a similar review of home range sizes should be conducted for riparian-associated bird species, territory sizes of locally breeding species (see Table 5-2) may be used as a minimum guideline.

Objective 13

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

Recommendations

13.1. Establish a committee to review management and research objectives and progress for Tricolored Blackbirds, seeking to incorporate the efforts and viewpoints of those actively involved in wetland management for waterfowl and shorebirds.

As Tricolored Blackbirds continue to decline, a concerted effort is required to address the needs of this species within the context of overall wetland and waterbird management within the Central Valley. This committee should review and amplify protection, management and research

recommendations developed by researchers and agencies. The committee should maximize coordination of conservation efforts with conservation groups and land managers that are focused primarily on waterfowl or shorebird management. Distribution, abundance and reproductive success of Tricolored Blackbirds should be monitored annually.

13.2. Develop GIS layers representing the extent of riparian zone habitats throughout the state at a resolution fine enough for the analysis of territory-level bird data in association with the occurrence of various habitat types. Resulting maps should be field-verified and may be used to identify suitable habitat for riparian birds, including Western Yellow-billed Cuckoos and habitats for other declining or sensitive species.

Riparian habitat covers a small area relative to its importance and value to wildlife. Because most regional landcover maps are based on satellite imagery with 30-m pixel resolution, they generally do not adequately represent riparian habitats, which are often (a) smaller than the minimum mapping unit and/or (b) not easily distinguishable from surrounding uplands in forested areas. Although riparian vegetation may be mapped at a more local scale using high-resolution aerial photos, the quality and composition of the understory is not easily mapped without extensive ground-truthing (as is true for any forest vegetation type). Thus, existing riparian GIS layers are variable in spatial resolution, floristic detail and quality, as well as inconsistent in vegetation and hydrologic classification standards. The dynamic nature of riparian systems, as well as on-going restoration efforts also make this habitat particularly difficult to represent in map form.

Through the California Legacy Project, with the California Department of Forestry and Fire Protection (CDF) and the U.S. Forest Service, efforts are currently underway to develop an intermediate-scale statewide riparian vegetation map/GIS layer for the State of California. In addition, the Riparian Habitat Joint Venture (RHJV) is coordinating efforts to map smaller areas at a higher spatial resolution. Finally, a list of riparian GIS layers can be found at the California Partners in Flight website at: http://www.prbo.org/calpif/htmldocs/riparian.html.

Objective 14

Promote federal, state, and local government flood control policies that will benefit wildlife in tandem with community safety.

The Army Corps of Engineers' mandate to develop non-structural flood control alternatives for the state of California in the aftermath of the 1996-97 floods is a positive step in floodplain management. The importance of flood events has been discussed throughout this document. For specific examples, please see Recommendations 1.4, 4.1, 6.1, 7.1, and 7.2.

Chapter 9. Implementation of Conservation Plan Recommendations

The Riparian Habitat Joint Venture (RHJV) has developed a Strategic Plan and an Annual Operating Plan to achieve the habitat protection/restoration goals set forth in this Conservation Plan. The Strategic Plan articulates the vision, mission, and goals of the Riparian Habitat Joint Venture. It also provides a framework for understanding the long-term goals of the RHJV, and direction for the Operating Plan. The Operating Plan will detail the specific tasks the RHJV will undertake during each year to meet their mission, as well as identify tasks planned for the next three-five years. The Operating Plan will identify measures of success for each identified task, will document achievements, and will be updated annually. The RHJV anticipates working closely with other statewide conservation efforts with overlapping goals during the implementation phase, particularly the Biodiversity Council, Sacramento River Advisory Council (SB1086), and the Coordinated Resource Management Plan Council. Some of the tasks in the Operating Plan include:

- Develop a riparian map and data layer to identify the extent and condition of riparian habitat
- Develop conservation/restoration acreage objectives and a system to prioritize areas for conservation efforts.
- Conduct local workshops to familiarize constituents with the RHJV and the Conservation Plan and to identify partners and initiatives to collaborate with in implementing riparian conservation.
- Provide guidance for a statewide riparian policy to fully protect riparian habitat.

In areas that already have a thriving conservation process in place, such as the SB1086 program along the lower Sacramento River (from Keswick Dam to Verona), the process will provide support and technical assistance for ongoing efforts.

The North American All Bird 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, Partners in Flight, the Shorebird Conservation Plan, and the Colonial Waterbird Conservation Plan. This new, overarching program, known as the North American All Bird Conservation Initiative (NABCI), seeks to synthesize the efforts of all of 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." NABCI aims to ensure that populations and habitats of North America's birds are protected, restored, and enhanced through coordinated efforts at international, national, regional and local levels guided by sound science and effective management. It is designed to increase the effectiveness of new and existing initiatives through:

- Effective coordination;
- Building on existing regional partnerships such as joint ventures; and
- Fostering greater cooperation among the nations and the peoples of the continent.

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 (BCR) 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 embraced the concept of "all-bird" conservation.

Photo by Eric Preston, ericpreston.com.

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

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 Mojave Desert region. The state currently hosts five official joint ventures: the Central Valley Habitat Joint Venture, the San Francisco Bay Joint Venture, the Intermountain West Joint Venture, the Pacific Coast Joint Venture, and the Riparian Habitat Joint Venture (Chapter 1). Future bird conservation in California priority habitats will be achieved by encouraging adoption of the all-bird conservation concept within existing joint ventures or by creating new joint ventures, organized regionally around specific habitats and habitat conservation goals.

Chapter 10. Outreach and Education

Scientific efforts for conservation have little impact without the support of local communities, including private landowners, government land managers, and the public of all ages. To gain crucial support, research, management, and conservation programs must share their findings and involve community groups and partners in conservation through education and outreach. For the purposes of this chapter, outreach refers to communication with land managers, agencies, planners, business interests, nonprofit organizations, academia, and volunteers. Outreach activities include, but are not limited to, conferences and workshops that facilitate communication among experts, participation in land use planning, volunteer restoration and monitoring programs, field trips, and ecotourism. Education, an important component of outreach, refers to the range of activities that educate and involve students and adults. Education activities include visits for classes and groups to field sites, interpretive displays, specialized curricula, and participation in festivals.

This chapter will:

- outline key concepts to be disseminated through riparian focused outreach programs;
- identify user groups to address through outreach programs;
- summarize existing resources for use by educators and outreach groups; and
- highlight examples of educational opportunities and successful programs.

Key Concepts

The following list of *Key Concepts for Bird Conservation* should be incorporated into education and outreach programs. These concepts are important to include in any program concerning conservation, and are indispensable in programs focusing on birds and riparian habitats.

- **Reproductive success may be the most important factor influencing bird population health.** It contributes directly to a population's size and viability in an area. A number of factors influence reproductive success, including predation, nest parasitism (ex. Brown-headed Cowbird), nest site availability, and food availability.

- **Nesting habitat requirements vary among species.** Different bird species place their nests in different locations, from directly on the ground to the tops of trees. Most birds nest within five meters of the ground. Managers must consider that habitat needs for different species vary and manage for this diversity accordingly. This can be accomplished by managing grass and forbs to a height greater than 6 inches for ground nesters, retaining a structurally diverse shrub and tree layer for low to mid-height nesters, and leaving dead trees and snags for cavity nesters. Additionally, older tall trees should be retained for birds that build their nests in the canopy (Figure 5-1).

- **The breeding season is a vital period in birds' lives.** Birds nest during the spring and early summer of each year (generally mid-March-August). Nestlings are particularly sensitive to changes in the environment and are indicators of ecosystem health. Disturbances during the breeding season, such as vegetation clearing, habitat restoration, and recreation, may result in nest abandonment, remove potential nest sites, directly destroy nests, expose nests to predators, and decrease food sources such as insects. Predators, such as domestic cats, skunks, and jays, can decimate breeding populations, thus land managers should avoid subsidizing their populations through human food and garbage.

- **Understory (the weedy, shrubby growth underneath trees) is crucial to birds.** A healthy and diverse understory with lots of ground cover offers well-concealed nest and foraging sites. Manicured parks and mowed lawns provide poor nesting conditions for all but a few bird species.

- **Native plants are important to birds.** Native bird populations evolved with the regional vegetation, learning to forage and nest in certain species. Introduced plant species may not provide the same nutrition, host sites for insects, or nest site quality. Introduced plants can also quickly dominate an area, reducing the diversity of vegetation. Less diverse vegetation can lower the productivity and viability of a bird population.

- **Natural predator-prey relationships are balanced, but human disturbance creates an imbalanced system.** Interactions with predators are a natural and essential part of an ecosystem. However, a preponderance of non-native predators or a sustained surplus of natural predators severely affects the health and persistence of bird populations. Feeding wildlife, especially foxes, raccoons, and skunks, should be discouraged. Feeders that are frequented by jays, crows and cowbirds should not be maintained during the breeding season (most songbirds feed their young insects). Domestic and feral cats are responsible for an estimated 4.4 million birds killed each day (Stallcup 1991). It is not true that a well-fed cat will not hunt! In fact, a healthy cat is a more effective predator.

- **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.

"Did you know" and "How you can help" facts about Riparian Habitat

Did you know facts are a great way to teach the public of all ages about riparian habitats? Here are a few to include in educational programs, signs, curriculum, flyers, and presentations:

Did you know…

Cats kill approximately 4 million birds a day in this country alone.

How you can help….

- If you own a cat, help reduce the impact of cats on bird populations. Domestic cats kill hundreds of millions of native birds, reptiles and small mammals every year. This

unnecessary impact can easily be reduced if cat owners would keep their cats indoors, and if broad education on the impact of cats on wildlife is conducted.

- The American Bird Conservancy's (ABC) Cats Indoors! campaign seeks to educate the public on the facts of cat predation on birds and other wildlife, and the hazards to free roaming cats. This information is available at the American Bird Conservancy's web site at http://www.abcbirds.org.

- Educate your community about outdoor cats as a conservation threat to birds and other wildlife and distribute brochures and information from ABC's website broadly.

- Attend town hall meeting to raise awareness, especially in problem areas where there are large concentrations of feral or stray cats.

Other actions that cat owners can take to help birds:

- Keep cats as indoor pets.
- Don't abandon unwanted cats; rather, give them to the local SPCA or Humane Society.
- Spay and neuter your cats.
- Cats on ranches or farms, kept to control rodent populations, should be kept to a minimum. Spayed females tend not to stray or wander from the barn area. Keeping feed in closed containers also helps reduce rodent populations (Coleman et al. 1997). Trapping rodents can also be more effective than relying on cats to do the job.
- Don't feed stray or feral cat populations. A more humane alternative for cats and wildlife is to reduce the unwanted cat population by limiting reproduction and facilitating adoption by responsible pet owners.
- Support local efforts to remove feral cats.

Did you know…

Predation is the main cause of nest failure for songbirds. Humans can contribute to an unbalanced predator-prey relationship of both native and non-native predators. Increased numbers of these predators can depress bird populations.

How you can help…

- Eliminate outdoor sources of food including pet food dishes, garbage, and open compost piles that may attract stray cats, jays, raccoons, rats, opossums.
- Avoid indiscriminate open tray bird feeders or seed scattered on the ground that may attract jays, cowbirds, ravens, rats, squirrels, etc. and support unhealthy predator numbers (see the Feeding Birds Safely handout in the resource table).
- Keep cats indoors
- Construct safe bird boxes that are predator proof (see the Keeping your nest box safe Table 10-1).
- Do not feed wildlife or allow wildlife access to your trash when hiking or camping. If you feed birds, avoid doing more harm than good.

Did you know…

Feeding birds can be beneficial if properly done, but it always carries the potential for upsetting the natural balance between native predators and prey species. Improper feeding can help to spread disease, support predator populations that prey on birds and other organisms, or increase non-native populations that displace the natives.

How you can help…

- Feeder placement should be away from shrubs or bushes that provide places for cats to ambush birds (Coleman et al. 1997).

- Avoid feeding birds in the spring and summer. Feeding birds supplements their natural diet, but springtime feeding may encourage a lower quality diet for nestlings that need high-protein insects, which are naturally abundant throughout the breeding season.

- Do not supplement the diet of avian nest predators such as jays, magpies, crows and ravens by feeding them during the breeding season. These predators tend to benefit disproportionately from human habitation, and as their populations expand they are negatively affecting the health of other bird populations. The National Audubon Society produces bird feeders that discourage use by avian predators.

- Avoid supplementing the diet of Brown-headed Cowbirds, which parasitize songbird nests. If cowbirds come to your feeder, try eliminating millet from the birdseed you provide. Evidence indicates that Brown-headed Cowbirds are attracted to bird feeders primarily for millet. Sunflower seeds and other types of birdseed attract many songbird species, but may not attract cowbirds. In addition, do not use open tray feeders or scattered seed on the ground to feed birds; this attracts cowbirds as well as predators.

- When feeding birds in winter, change birdseed if it gets wet from rain as the moisture may promote mildew or sprouting, which can cause birds to become ill.

- In feeding hummingbirds, use a solution of four parts water to one part sugar. Do not use brown sugar, artificial sweeteners, or red dye. Place the feeders in the shade and change the feeder solution every two to three days to avoid cultivating pathogens that can cause hummingbirds to become ill. In freezing weather, bring feeders indoors at dusk and return them with lukewarm fluid at dawn. Clean feeders every 10 days using a few drops of bleach in the wash water, and let stand before rinsing. Rinse thoroughly many times.

Did you know…

Baby birds will often leave, or fledge, the nest before they look fully-grown. Newly fledged birds are often mistaken for "abandoned." Their parents, however, can find them on the ground and will feed them. Most fledglings will continue to be fed by their parents even after leaving the nest.

How you can help…

Leave young uninjured birds alone, as it is likely their parents are nearby. It is not true that parents will avoid young after humans have handled them, but it is still best to leave nests and young undisturbed. Fledglings should not generally be returned to their nest, as this may disturb the nest site. Trampled vegetation and human activity can alert predators to the presence of the nest. Allowing baby birds to remain in the care of their parents provides them their best opportunity for survival. Be aware that it is against federal law to collect wild birds, nests, or their eggs without a permit.

Did you know…

Bird watching is one of the fastest growing hobbies in this country. According to the US Fish and Wildlife Service, about one-fifth of the American population, more than 50 million people, watch birds each year. This outnumbers hunters and anglers combined. Bird watchers are excellent observers and can contribute to the conservation process.

How you can help…

If you are a bird watcher, volunteer for a bird monitoring program. There are increasing opportunities for bird watchers of all skill levels to gain training and experience in various bird monitoring techniques. Participants gain knowledge in a subject area of interest, learn new skills, and can directly contribute to the science of conservation while enjoying birds in the outdoors. There are increasing opportunities to contribute to bird monitoring projects in riparian habitats throughout the state. Subscribe to the Birder Conservationist, an online newsletter of the American Birding Association at http://www.americanbirding.org/programs/constbc.htm.

Key Audiences for Outreach

When designing and implementing education and outreach programs on riparian habitat in your region, you should ensure your program is addressing one or more of the target groups. The four key user groups that need to be targeted through riparian education and outreach programs are:

- Stakeholders (farmers, ranchers)
- Community Members (families, outdoor recreators, homeowners)
- Educators (school teachers and educators)
- Land managers (government agencies, private landowners, homeowners)

Each of the user groups is outlined here with suggestions of the types of outreach activities that are appropriate for each group.

Stakeholders: Stakeholders are people who rely on the habitat for their livelihood, ranching, farming, recreation companies, etc. These are often the group of people that have the highest potential for protecting riparian birds yet they may be the most difficult to reach. In order to effectively communicate with them, conservationists and educators need to find a common ground and build a relationship of trust. Often times highlighting the economic value of songbirds is a great way to reach these groups, e.g., highlighting the role of songbirds as natural pest control at farms.

There is a wide assortment of government funded agricultural/wildlife conservation programs for farmers (http://www.nrcs.usda.gov/programs/farmbill/2002/products.html). Effective programs that target stakeholders include restoration programs that provide incentives to landowners for restoration and conservation. Private landowners can be reached through flyers, brochures, posters, talks at local growers clubs, county fairs, farmers associations, Natural Resource Conservation Service (NRCS) groups, Resource Conservation Districts (RCD's), etc. Tours that take stakeholders into the field to observe the wildlife that depend and co-exist with their agricultural practices are another effective tool. Incorporating articles about riparian songbirds into stakeholder newsletters is a great way to communicate key messages for songbirds in your region. Perhaps most important is person-to-person contact.

Private landowner conservation programs on agricultural lands work best when there is a person getting to know the farmer and showing them the birds. For example, in the years 2001-2002, the Marin County Resource Conservation District (MRCD), in partnership with PRBO, hired a Riparian Habitat Conservationist. The purpose of this position was to link landowners with the riparian songbirds and habitat on their land through monitoring, newsletter articles, presence at MRCD meetings, and person-to-person contact. As a result, farmers who may not have otherwise thought about the songbirds on their land began allowing a biologist to monitor their creeks, agreeing to initiate restoration projects, and looking for ways to protect their creeks while still supporting their cattle operation. This project was an effective way of bridging the gap between a stakeholder group and wildlife conservation. For more information please contact the MRCD (415) 663-1170 or visit http://www.sonomamarinrcds.org/district-mc/.

Community Members: Community members include the public, birders, local businesses, homeowners, families, and outdoor recreation groups. Economically, this group has a lot of influence especially in terms of access to recreation areas. In addition, community members can participate in conservation indirectly through creating favorable public sentiment, promoting legislation to protect riparian habitat and voting on measures to protect and enhance riparian habitat. As a result it is important that education and outreach programs be targeted to these users.

Appropriate programs for this group include general awareness building programs such as informational flyers, birding trips, mist-netting demonstrations, presentations within the community, outreach at local fairs, articles in newspapers and newsletters, and educational materials on the web. In this broad audience there will be users that are receptive to messages about riparian songbird conservation such as birders or conservationists. Other users, such as homeowners, or equestrians, may be more difficult to reach because conservation measures may limit their activities. In this case, continued outreach is needed to build a trusting relationship. It is essential to provide conservation messages to the bilingual or multilingual communities. To improve communication in diverse communities it is important to work with partners in the community to build conservation connections.

Educators: Educating educators expands the potential to reach larger numbers of people with fewer direct staff. Training educators such as schoolteachers, naturalists, bird tour leaders, and docents in the key messages for riparian songbird conservation for each region is essential. Identifying existing education programs in schools, nature centers, and visitor centers and partnering to infuse conservation messages into their existing programs is a cost effective way to reach a broader audience.

To accomplish this, teacher trainings through existing networks and partnerships are an excellent way to train teachers. Providing them with materials in the form of activities, posters, and bird identification guides are well received. Aligning educational programs with state science standards also makes the teachers more receptive to the messages presented through our materials. When trying to reach educators at nature centers or other docent groups, it is best to offer training for staff and provide them with outreach materials to distribute (informational flyers, posters) (Table 10-1).

Land managers: Land managers are user groups that require more technical information to make informed decisions about changing land management practices to benefit songbirds. In addition, land managers are often charged with managing their preserve or refuge for a variety of resources and are often understaffed for the amount of work they are expected to accomplish. As a result, connecting land managers with riparian songbirds becomes extremely important. Getting land managers into the field with biologists, connecting them to their resource, and showing them the direct benefit their actions can produce for songbirds is critical. Clear, concise messages advising managers on how to alter practices are needed. Slide presentations are also effective in reaching this group.

Educational Opportunities and Successful Programs

We now understand that the majority of plant and wildlife population declines are intimately tied with habitat loss and degradation. Diverse flora and fauna depend on riparian habitats in California during some or all phases of their life cycles; however, with less than 5% of riparian habitat left from historical ranges, these species are under pressure. With these facts in mind, we must act now to turn the tide.

Certain educational programs teach hands-on activities, such as ecological restoration.

Targeted education and outreach programs are effective tools to heighten awareness about the biological wealth of riparian habitats. Thankfully, in California there are a number of innovative and inspirational education programs focused on riparian habitats and the surrounding watersheds, some of which are outlined in this section. The success of these educational programs is largely built around meaningful learning experiences that inspire appreciation, generate inquiry, and encourage action in the learner; moreover, the programs involve many regional partners in conservation.

Education programs engage participants most effectively when they involve hands-on activities. Conservation education has the whole of the outdoors as a classroom - what better way to elicit the interest and enthusiasm of students and the public! Teaching ecosystem connections between plants, birds, fish, invertebrates, amphibians, mammals, hydrology, etc. enriches riparian habitat education programs. There are, in fact, many commonalities between riparian-dependent species that lend themselves to excellent 'teachable topics'; for example, the endangered riparian brush rabbit and many nesting songbirds all need a dense understory of diverse plants in the riparian forest to successfully complete some part of their life cycle (see Recommendation 6.7). Seizing educational opportunities, building alliances among educators, and sharing your program's successes and challenges with other others (e.g., California Partners in Flight Education and Outreach Committee) will help ensure well-informed decision-making in California communities into the future.

Table 10-1. Outreach and education resources for schools, educators, and community groups.

Title	Description	Grade and language	Geographic Range	How to Order
International Migratory Bird Day	Celebration information on IMBD. Activities include bird walks, displays, videos	All grades, Spanish and English	Throughout the Americas	http://www.fs.fed.us/dxnf/IMBD.html
PRBO Teacher Resource Packets	11 activities teaching students about birds and conservation	Adaptable for all grades, English	All of CA	PRBO Education Program 4990 Shoreline Hwy. Stinson Beach, CA 94970 (415) 868-1221 or on the web: www.prbo.org/education
Where Do Birds Nest Poster	11 X 17 black and white poster showing where riparian focal species nest in riparian habitat	All grades, English	All of CA	PRBO Education Program Address previously listed
Helping Birds at Bird Feeders	Handout on safe tips for feeding songbirds	All grades, English	All of CA	PRBO Education Program Address previously listed
The Birders Handbook: A Field Guide to the Natural History of North American Birds	Book gives detailed life history information for all birds in North America	High-school, adult, teacher resource	All of CA	Ehrlich et al. 1988
The Sibley Guide to North American Birds by David Sibley.	Resource field guide	High-school, adult, teacher resource	All of CA	Sibley 2000
Bird Study Guide, Tiburon Audubon Society	On-line study guide for students with information about birds and habitats in Marin County.	Grades 4-12	Marin Co. CA	www.tiburonaudubon.org/jrbird/background.html
Bird Songs of California	Cornell's latest audio guide, "Bird Songs of California" - a 3-CD set featuring the voices of 220 bird species from across the Golden State.	All grades	All of CA	http://birds.cornell.edu/

Table 10-1 continued

Title	Description	Grade and language	Geographic Range	How to Order
Birds Beyond Borders	An international environmental education program linking students in the western US with western Mexico through birds.	Grades 3-6	All of the western US	Rocky Mountain Bird Observatory 14500 Lark Bunting Lane Brighton, CO 80601 303-659-4348 education@rmbo.org
The Songbird Blues	A trunk of materials and resources exploring neotropical birds	Grades K-5	All of the Americas	Montana Natural History Center 1617 Roland Ave. Missoula, MT 59801 406 543-6886
Birds in Hand and Field	An activity booklet that makes a great accompaniment to a visit to a mist-netting or bird banding demonstration	K-7	Throughout the West.	Rocky Mountain Bird Observatory 14500 Lark Bunting Lane Brighton, CO 80601 303-659-4348 education@rmbo.org
Keeping Your Nest Box Safe for Songbirds in the West	Handout on how to safely use nest boxes	All grades, English	All of CA	PRBO Education Program Address previously listed
Helping Birds At Home	Handout on how to landscape your yard to help songbirds	All grades, English	All of CA	PRBO Education Program Address previously listed

Table 10-2. Outreach and education resources for wildlife managers and stakeholders (farmers, ranchers).

Title	Description	Geographic Range	How to Order
Riparian Bird Conservation Plan	Science-based bird conservation plan containing recommendations for land managers on enhancing riparian habitat for birds	All of CA	California Partners In Flight 4990 Shoreline Hwy. Stinson Beach, CA 94970 (415) 868-0655 or on the web: www.prbo.org/calpif
Recommendations for Improving Riparian Bird Habitat on Private Lands in Marin County	Handout on how private landowners can enhance their Riparian habitat for birds	Marin County	PRBO Education Program 4990 Shoreline Hwy. Stinson Beach, CA 94970 (415) 868-1221 or on the web: www.prbo.org/education
Improving Songbird Habitat on Your Horse Ranch	Handout on how to improve songbird Habitat on Your Horse Ranch	All of CA	PRBO Education Program Address previously listed
Decreasing Crows and Ravens on Ranches and Dairies	Handout on how to decrease the number of crows and ravens associated with livestock.	All of CA	PRBO Education Program Address previously listed
Horse Keeping: A guide to Land Management for Clean Water	A guidebook prepared by the Bay Area Resource Conservation Districts outlining land management for clean water on horse facilities.	Designed for the Bay Area but could be used throughout CA.	PRBO Education Program Address previously listed

Educational Opportunities

The concepts and guidelines outlined in this chapter can be presented to the public and to students through a variety of media. Following is a list of common education opportunities and some suggestions for content:

Classroom Education

Programs in the classroom should focus on communicating key concepts to students through hands-on activities. Lessons should stress studying birds in the field - whether in the backyard, on school grounds, or in a nearby natural area - and include keeping field notes and observing natural behaviors of birds. Field trips to riparian areas with groups conducting bird conservation and monitoring projects fosters interest and enthusiasm for wildlife and teaches students the importance of conserving birds.

One method of educational outreach, called project-based learning, allows an open-ended approach to solving a conservation problem. Students identify a local conservation issue in their community and through library and field research plan and implement a project from idea conception to project completion. Teachers and students work co-operatively to make important decisions, while working with biologists, land managers, business people, private landowners and others in the community. Because of this investment and emphasis on self-direction, students take ownership of their work, and the lessons learned are profound and long lasting (Rogers, pers. comm.).

A great way to get students interested in birds is through bird observation in the field. While access to binoculars is sometimes limited, you can contact your local Audubon Society, nature center or other local wildlife education group to see if sets are available for check out. If you feel uncertain of your birding skills, contact your local Audubon Society or Nature Center to see if there are any docents or naturalists who will can join your class for a day of birding. An invaluable experience that catches students' interest immediately is to visit a mist-netting site where students have the opportunity to examine birds up close and interact with biologists.

There are many excellent sources for curriculum and hands-on bird activities for the classroom. Many can be found in the table of educational resources listed on pages 100-101. Another useful source is *A Guide to Bird Education Resources* produced by Partners in Flight and the National Fish and Wildlife Foundation. Copies of this book are available from American Birding Association Sales, PO Box 6599, Colorado Springs, CO 80934, phone 1-800-850-2473, member@aba.org. In addition, the California Partners in Flight Education Committee is working on producing educational tools, kits, and resource guides for educators in California. Contact the CalPIF Education Coordinator through the website at http://www.prbo.org/calpif/education.html to find out more.

Volunteer Involvement

Using volunteers to aid in data collection and restoration is an excellent way to gain additional help and to teach people about conservation. Increasingly, families and school groups have opportunities to participate in habitat restoration projects at local parks or nature preserves. Volunteers that participate in counting and studying birds quickly develop a connection to them, which intimately involves the volunteer in the conservation effort. Furthermore, volunteers provide additional support and resources that make long-term monitoring of songbirds viable. To ensure reliable data collection, supervisors must match monitoring techniques with the skill level of the volunteer.

Interpretation at Natural Areas

Interpretation is an excellent way to disseminate key concepts about bird conservation to the public. Displays at preserves, public parks, nature trails, picnic areas, and other natural areas should highlight the birds using the habitats and show the specific features of the habitat that are critical to bird reproduction and survival, including assemblages of native plants. Displays can effectively illustrate how individuals can make a difference at home (e.g., planting native plants in their yards or restraining cats from killing birds). These displays should be aimed at the general public, emphasizing the causes of the decline of songbirds. Again, integrating people as part of the solution encourages their support for conservation issues.

Participation in Birding Festivals and Environmental Fairs

Birding festivals are becoming a popular means of enhancing local economies through ecotourism, which can help to promote local support for conservation of natural areas–a requirement for long-term sustainability of conservation actions. Festivals also present an excellent opportunity to further educate people already familiar with birds about the scientific reasons behind bird conservation. Birders already recognize and love birds and can easily be taught the reasons for bird conservation and what a healthy bird population needs to survive. Birders also constitute a pool of experienced observers who may volunteer for monitoring programs.

Representation of bird conservation at environmental fairs is another way to reach large numbers of people, convey the key concepts behind bird conservation, and build conservation partnerships in the region. Booths that convey the key conservation messages and provide information on how individuals can help through interactive games or activities for children engage families and visitors in bird conservation topics. The National Fish and Wildlife Foundation has published Bridges to Birding, an interactive program for introducing birds, bird watching, and bird conservation to your community. It contains step-by-step instructions on how to put on a festival or fair focusing on birds. To obtain a copy contact IMBD Information Center at (703) 358-2318 or IMBD@fws.gov.

Conducting an International Migratory Bird Day celebration is another excellent way to get local recognition of birds through this international program of the National Fish and Wildlife Foundation. International Migratory Bird Day celebrates the incredible journeys of migratory birds between their breeding grounds in North America and their wintering grounds in Mexico, Central, and South America. The event, which takes place on the second Saturday in May each year, encourages bird conservation and increases awareness of birds through hikes, bird watching, information about birds and migration, public events, and a variety of other education programs. Schedule an IMBD celebration near you. For more information visit www.birdday.org.

Examples of Successful Programs

Mono Basin Birding Chautauqua

The Mono Basin Bird Chautauqua is a birding festival with a mission to enhance the appreciation and understanding of the Mono Basin's diverse and abundant bird life and to educate the public about the area's value to birds and people. The Chautauqua takes place annually over the summer solstice weekend when bird activity in the Basin is at its height. Through field trips, evening presentations by Mono Basin expert biologists, seminars, and special kids' activities, many levels of bird enthusiasts can find something of interest. The event is both volunteer operated and cooperatively organized by several agency and nonprofit partners including Inyo National Forest,

Mono Lake Tufa State Reserve, Mono Lake Committee, PRBO Conservation Science, and the Eastern Sierra Audubon Society. Interest and attendance has dramatically increased in the first two years of the Chautauqua, and enthusiasm for the event continues to grow. In 2002 and 2003, 150 and 250 people participated, respectively. The Mono Basin Bird Chautauqua is an excellent example of a bird-focused event that targets a diverse audience and provides a powerfully informative and affective experience for visitors. For more information about the event please visit the website: http://www.birdchautauqua.org/. A similar type of festival is held annually at the Kern River Preserve celebrating the wildlife of the Kern River Valley. For more information visit http://www.valleywild.org/bioregion.htm.

STRAW Bird Project

The STRAW Project coordinates and sustains a network of teachers, students, restoration specialists and other community members as they plan and implement watershed studies and restoration projects in Marin and Sonoma counties. STRAW provides teachers and students with the scientific, educational and technical resources to prepare them for hands-on, outdoor watershed studies, including ecological restoration of riparian corridors. STRAW's overarching goals are to empower students, support teachers, restore the environment, and reconnect communities. STRAW's educational programs include restoration, birds, water quality, and plants. For more information visit www.bay.org/watershed_education.htm.

Mist-netting demonstrations for the public

Providing opportunities for the public to observe mist netting and bird banding demonstrations is an excellent way to connect people with birds and bird conservation science. The following organizations and bird observatories offer public and/or school programs: Big Sur Ornithology Lab www.ventanaws.org/lab.htm, Klamath Bird Observatory www.kbo.org, Humboldt Bay Bird Observatory (a subsidiary of Klamath Bird Observatory), PRBO Conservation Science www.prbo.org, San Francisco Bay Bird Observatory www.sfbbo.org, and Wright Wildlife Refuge.

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Appendix A. How to Monitor Riparian Bird Populations

Adaptive management requires the periodic 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 riparian 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 (3-5 years).
- Many Neotropical migrants are dependent on early successional development in riparian habitats; therefore, they are good indicators of the success of natural recruitment restoration on an ecosystem scale.
- 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.
- 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, 1999b, Nur et al. 2000) have summarized methods, objectives, and implementing results.

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 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.

- **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.

- **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 three years. For restoration evaluation every other year, surveys should continue for at least 10 years.

- **Determination of population health or source/sink status.**

Method: census combined with demographic monitoring for a minimum of four years.

- **Reference site.**

Method: point count census, constant effort mist netting and nest monitoring at a minimum of every other year for 10 years.

Long-term Monitoring

Long-term monitoring provides a wealth of useful information about bird populations. Long-term data are vital to deciphering the difference between a true population decline and a natural fluctuation in population size. 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.

Monitoring Protocols

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). Online support, field protocols, example data sheets, and data entry and management resources are supplied at http://www.prbo.org/tools (Ballard 2003).

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 are 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).

Appendix B. How Birds Respond to Riparian Restoration

In measuring the success of habitat restoration/rehabilitation projects, there are two general levels of evaluation that can be undertaken. Measures of success for cultivated restoration projects include measurements of habitat, particularly survival, size, structure, etc., of regenerating vegetation or plantings. Cultivated measures provide two types of information:

- A picture of how closely restored habitats resemble the "reference-site ideal" for which one is striving.
- A measure of how closely the current restoration site resembles the intended project design.

However, for a measure of the actual benefits to wildlife, as well as the efficacy of a particular restoration design, measurements of wildlife response to restored habitats must be undertaken. Such measures may include all manner of wildlife monitoring techniques. Measuring demographic parameters, particularly reproductive success, are most likely the best measure of success (Martin 1993).

Riparian habitats are perhaps unique in California in that, provided that natural flooding and depositional processes remain, they can often regenerate quickly, providing significant benefits to wildlife in as little as two-three years. Natural recruitment restoration, in which habitat is allowed to regenerate naturally, as in a levee setback or flood bypass project, is probably the most effective and least costly form of restoration possible. However, when natural processes have been eliminated or altered, when non-native plants have become a dominant part of the vegetation, or when restoration outside the active floodplain is sought (i.e., floods occur less than one in four years), cultivated restoration is often employed, wherein intensive site preparation, collection of native-plant stock, and planting and maintenance of riparian vegetation takes place.

Kern River Preserve

Studies have shown that diversity and abundance (or density) can be misleading indicators of bird population health (e.g., Van Horne 1983); therefore, the goal of any restoration project should be ultimately to support populations with high productivity (i.e., high nest success on the breeding grounds). At the Kern River Preserve, 12 years of bird monitoring conducted by the Kern River Research Center in restored habitats suggest predictable patterns of response among bird species as riparian restoration sites regenerate and grow. Species diversity tends to increase significantly with the age of a restoration site; however, the best predictor of total bird species richness is mean tree height, followed by total foliage volume and mean quadratic diameter at breast height. Total foliage volume has been the best predictor of breeding bird density over the life of a riparian restoration site at the Kern River Preserve. In general, the richness and density of riparian obligate bird species increase with the age of the restoration plot. This does not mean, however, that managers should manage their sites or skew natural processes to prefer more mature sites over less mature sites. A mosaic of habitat ages is created naturally.

Patterns of response among individual bird species have also been found at the Kern River Preserve. Five general patterns have been identified: three that involve a positive trend in species population, one that demonstrates no trend, and one that involves a negative trend. A brief description of these patterns follows.

- Species occurring in small numbers before planting which gradually increase (for example, Northern Flicker, Mourning Dove, Nuttall's Woodpecker, Hairy Woodpecker, House Wren, Bushtit, Bewick's Wren, Brown-headed Cowbird, Bullock's Oriole, Spotted Towhee, Song Sparrow, and Lawrence's Goldfinch).

- Species not found before restoration that increase to the breeding population levels of natural forest sites (for example, Anna's Hummingbird, Yellow-billed Cuckoo, Black-chinned Hummingbird, Ash-throated Flycatcher, Western Kingbird, Western Scrub-jay, European Starling, Summer Tanager, and Lesser Goldfinch).

- Species found in low numbers before restoration that show a higher density subsequent to restoration than on natural forest sites (for example, Common Yellowthroat, Black Phoebe, Blue Grosbeak, Lazuli Bunting, and Red-winged Blackbird).

- Species found in small numbers before planting that show no trends as a result of restoration (for example, Downy Woodpecker, Western Wood-pewee, Willow Flycatcher, Tree Swallow, Oak Titmouse, White-breasted Nuthatch, Western Bluebird, American Robin, Yellow Warbler, and Yellow breasted Chat).

- Species that show a negative effect from restoration (for example, Horned Lark, Savannah Sparrow, and Western Meadowlark).

At the Kern River Preserve, restoration sites (with ages up to 12 years) averaged 18 to 22 species per plot, whereas natural forest sites averaged 41 species per plot. Much of the variation results from differences in structural diversity of vegetation. Additionally, natural forest sites show more diversity of habitats, with the interspersion of meadows, patches of mule fat, closed canopies of trees centuries old, and thickets of new growth (Nur et al. 1996).

Sacramento River

At a site restored by The Nature Conservancy, working in partnership with the U.S. Fish and Wildlife Service, PRBO found that in a newly restored riparian site along the Sacramento River bird species diversity increased by 73% from year two to year four of the restoration project. Revegetated sites ranging in age from four to 10 years supported species diversity comparable to mature riparian habitat. Moreover, habitat restoration will also benefit listed species, provided the needs of these species are taken into consideration during project implementation. Nine years after conducting the first riparian restoration at the Kern River Preserve, Yellow-billed Cuckoos nested on a habitat restoration site. Limited foraging use of restored areas began much sooner (after three years), but by the ninth year, restoration sites were used extensively for foraging. Willow Flycatchers began nesting in restored sites seven years after restoration.

Appendix C. Acronyms, Abbreviations, and Species Codes

List of Acronyms and Abbreviations

BBS:	Breeding Bird Survey
BLM:	U.S. Bureau of Land Management
BSOL:	Big Sur Ornithology Lab
CALFED:	CALFED Bay-Delta Program
Conservation Plan:	The California Partners in Flight Riparian Bird Conservation Plan
Corps:	U.S. Army Corps of Engineers
CalPIF:	California Partners in Flight
CDFG:	California Department of Fish and Game
DWR:	California Department of Water Resources
GIS:	Geographic Information Systems
HY:	hatch year
km:	kilometers
m:	meters
MAPS:	Monitoring Avian Productivity and Survivorship
NRCS:	Natural Resource Conservation Service
NSAs:	initiate nonstructural alternatives
PIF:	Partners in Flight
PRBO:	Point Reyes Bird Observatory
RHJV:	Riparian Habitat Joint Venture
USFS:	U.S. Forest Service
USFWS:	U.S. Fish and Wildlife Service
USGS:	U.S. Geological Service
VWS:	Ventana Wilderness Society
WHR:	Wildlife Habitat Relationships

List of Species Codes

BANS:	Bank Swallow
BHGR:	Black-headed Grosbeak
BLGR:	Blue Grosbeak
COYE:	Common Yellowthroat
LBVI:	Least Bell's Vireo
SOSP:	Song Sparrow
SPSA:	Spotted Sandpiper
SWHA:	Swainson's Hawk
SWTH:	Swainson's Thrush
TRES:	Tree Swallow
WAVI:	Warbling Vireo
WIFL:	Willow Flycatcher
WIWA:	Wilson's Warbler
YBCH:	Yellow-breasted Chat
YBCU:	Yellow-billed Cuckoo
YWAR:	Yellow Warbler

Appendix D. Scientific and Common Names

Plants

Common Name	*Latin Name*
Acacia	*Acacia dealbata*
Alder species	*Alnus spp.*
Alkali goldenbush	*Haplopappus acradenius*
Alkali sacaton	*Sporobolus airoides*
Arrowweed	*Pluchea sericea*
Baltic rush	*Juncus balticus*
Bent grass	*Agrostis spp.*
Bigleaf maple	*Acer macrophylum*
Black cottonwood	*Populus balsamifera*
Black locust	*Robinia pseudoacacia*
Black walnut	*Juglans californica*
Blue elderberry	*Sambucus mexicana*
Boxelder	*Acer negundo*
Buttonbush	*Cephalanthus occidentalis*
California Bay	*Umbellularia californica*
California blackberry	*Rubus ursinus*
California fan palm	*Washingtonia filifera*
California sycamore	*Platanus racemosa*
Cape ivy (German ivy)	*Delairea odorata*
Cattail	*Typha spp.*
Chokecherry	*Prunus virginiana*
Cocklebur	*Xanthium strumarium*
Common cattail	*Typha latifolia*
Common reed	*Phragmites australis*
Coyote willow	*Salix exigua*
Date palm	*Phoenix dactilifera*
Desert lavender	*Hyptis emoryi*
Dogwood	*Cornaceae spp.*
Douglas fir	*Pseudotsuga menziesii*
Edible fig	*Ficus carica*
Engelmann spruce	*Picea engelmannii*
English ivy	*Hedera helix*
Fremont cottonwood	*Populus fremontii*
Giant reed	*Arundo donax*
Himalayan blackberry	*Rubus himalaya*
Jeffrey pine	*Pinus jeffreyi*
Lodgepole pine	*Pinus contorta*
Mesquite	*Prosopis spp.*
Mojave seablight	*Suaeda torreyana*
Oatgrass	*Danthonia spp.*
Oregon ash	*Fraxinus latifolia*
Periwinkle	*Vinca major*
Poison oak	*Toxicodendron diversilobum*
Ponderosa pine	*Pinus ponderosa*
Purple loosestrife	*Lythrum salicaria*
Quailbush	*Atriplex lentiformis*
Red Fir	*Albies magnifica*

River bulrush	*Scirpus fluviatilis*
Rose species	*Rosa spp.*
Rush species	*Juncus spp.*
Russian olive	*Elaeagnus augustifolius*
Sagebrush species	*Artemesia spp.*
Sandbar willow	*Salix sessilifolia*
Sedge species	*Carex/Scirpus spp.*
Seep willow	*Baccharis glutinosa*
Serviceberry	*Amelanchier spp.*
Snowberry	*Symphoricarpos spp.*
Squaw waterweed	*Baccharis sergiloides*
Star thistle	*Centaurea spp.*
Sticky euphatorium	*Ageratina adenophora*
Tamarisk, salt cedar	*Tamarix chinensis*
Tasmanian blue gum	*Eucalyptus globulus*
Tule bulrush	*Scirpus acutus*
Valley oak	*Quercus lobata*
Velvet ash	*Fraxinus velutina*
Water Birch	*Betula occidentalis*
Western Juniper	*Juniperus occidentalis*
White alder	*Alnus rhombifolia*
White fir	*Abies concolor*
Wild grape	*Vitis californica*
Wild rose	*Rosa californica*
Willow species	*Salix spp.*
Wiregrass	*Juncus acutus*

Birds

American Crow	*Corvus brachyrhynchos*
American Robin	*Turdus migratorius*
Anna's Hummingbird	*Calypte anna*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Bank Swallow	*Riparia riparia*
Bewick's Wren	*Thryomanes bewickii*
Black Phoebe	*Sayornis nigricans*
Black-chinned Hummingbird	*Archilochus alexandri*
Black-crowned Night Heron	*Nycticorax nycticorax*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Blue Grosbeak	*Guiraca caerulea*
Brown-headed Cowbird	*Molothrus ater*
Bullock's Oriole	*Icterus bullockii*
Bushtit	*Psaltriparus minimus*
Clapper Rail (Light-footed)	*Rallus longirostris levipes*
Common Raven	*Corvus corax*
Common Yellowthroat	*Geothlypis trichas*
Downy Woodpecker	*Picoides pubescens*
European Starling	*Sturnus vulgaris*
Golden-crowned Kinglet	*Regulus satrapa*
Hairy Woodpecker	*Picoides villosus*
Horned Lark	*Eremophila alpestris*
House Wren	*Troglodytes aedon*
Lawrence's Goldfinch	*Carduelis lawrencei*

Lazuli Bunting	*Passerina amoena*
Least Bell's Vireo	*Vireo bellii pusillus*
Lesser Goldfinch	*Carduelis psaltria*
Nuttall's Woodpecker	*Picoides nuttallii*
Oak Titmouse	*Baeolophus inornatus*
Red-winged Blackbird	*Agelaius phoeniceus*
Ring-necked Duck	*Aythya collaris*
Ruby-crowned Kinglet	*Regulus calendula*
Savannah Sparrow	*Passerculus sandwichensis*
Snowy Plover	*Charadrius alexandrinus*
Song Sparrow	*Melospiza melodia*
Spotted Towhee	*Pipilo maculatus*
Summer Tanager	*Piranga rubra*
Swainson's Hawk	*Buteo swainsoni*
Swainson's Thrush	*Catharus ustulatus*
Swainson's Thrush (Olive-backed)	*Catharus ustulatus swainsoni*
Swainson's Thrush (Russet-backed)	*Catharus ustulatus ustulatus, C. u. oedicus*
Tree Swallow	*Tachycineta bicolor*
Tricolored Blackbird	*Agelaius tricolor*
Warbling Vireo	*Vireo gilvus*
Western Bluebird	*Sialia mexicana*
Western Kingbird	*Tyrannus verticalis*
Western Meadowlark	*Sturnella neglecta*
Western Wood-pewee	*Contopus sordidulus*
White-breasted Nuthatch	*Sitta carolinensis*
Willow Flycatcher	*Empidonax traillii*
Willow Flycatcher (Little)	*Empidonax traillii brewsteri*
Willow Flycatcher (Southwestern)	*Empidonax traillii extimus*
Wilson's Warbler	*Wilsonia pusilla*
Wrentit	*Chamaea fasciata*
Yellow Warbler	*Dendroica petechia*
Yellow-billed Cuckoo	*Coccyzus americanus*
Yellow-billed Magpie	*Pica nuttalli*
Yellow-breasted Chat	*Icteria virens*

Mammals

Bobcat	*Felis rufus*
Coyote	*Canis latrans*
Domestic cat	*Felis catus*
Fox, Gray	*Urocyon cinereoargenteus*
Fox, Red	*Vulpes vulpes*
Opossum, Virginia	*Didelphis virginiana*
Raccoon	*Procyon lotor*
Riparian Brush Rabbit	*Sylvilagus bachmani riparius*
Skunk, Striped	*Mephitis mephitis*

Amphibians

Arroyo Southwestern toad	*Bufo microscaphus californicus*

Invertebrates

Katydid	Family *Tettigoniidae*
Sphinx moth	Family *Sphingidae*

Appendix E. Riparian and Semi-riparian Natural Communities from a Manual of California Vegetation, 2nd Edition (Sawyer and Keeler-Wolf in prep)

Code	Group	Subgroup	Formation	Alliance	Scientific Name	Rare	CWHR Type
30.000.00	**SCRUB AND CHAPARRAL**					N	
33.000.00		Sonoran and Mojavean Desert Scrub				N	
33.200.00			Cheesebush Scrub		*Hymenoclea salsola*	N	
33.260.00				Sweetbush Riparian Scrub	*Bebbia juncea*	Y	
40.000.00	**GRASS & HERB DOMINATED COMMUNITIES**					N	
41.000.00		Native Grassland				N	
41.310.00				Knotweed-Echinochloa Riparian Grassland		N	
45.000.00		Meadows and Seeps not dominated by grasses				N	
45.500.00			Alkali Meadow			N	
45.550.00				Cocklebur Riparian Grassland	*Xanthium strumarium*	N	
45.560.00				Rush Riparian Grassland	*Juncus spp.*	N	
45.561.00				Common Rush Riparian Grassland	*Juncus effusus var. brunneus*	N	

Code	Group	Subgroup	Formation	Alliance	Scientific Name	Rare	CWHR Type
5.562.00				Baltic Rush Riparian Grassland	*Juncus balticus*	N	
45.563.00				Cooper Rush Riparian Grassland	*Juncus cooperi*	Y	
45.565.00				Mexican Rush Riparian Grassland	*Juncus mexicanus*	N	
60.000.00	**RIPARIAN AND BOTTOMLAND HABITAT**					N	
61.000.00		Riparian Forest and Woodland				N	
61.100.00			Cottonwood and Aspen Woodlands and Forests		*Populus spp.*	N	
61.111.00				Aspen Upland and Riparian Forests and Woodlands		N	ASP
61.120.00				Black Cottonwood Riparian Forests and Woodlands	*Populus balsamifera*	Y	MRI
61.130.00				Fremont Cottonwood Riparian Forests and Woodlands	*Populus fremontii*	Y	VRI, DRI, MRI
61.200.00			Willow Riparian Forests and Woodlands		*Salix spp.*	N	
61.201.00				Arroyo Willow Riparian Forests and Woodlands	*Salix lasiolepis*	Y	DRI, VRI, MRI

Code	Group	Subgroup	Formation	Alliance	Scientific Name	Rare	CWHR Type
61.202.00				Black Willow Riparian Forests and Woodlands	*Salix gooddingii*	Y	VRI, DRI
61.203.00				Hooker Willow Riparian Forests	*Salix hookeriana*	Y	VRI
61.204.00				Pacific Willow Riparian Forests	*Salix lucida ssp. lasiandra*	Y	DRI, VRI, MRI
61.205.00				Red Willow Riparian Forests	*Salix laevigata*	Y	VRI, DRI, MRI
61.206.00				Sitka Willow Riparian Forests	*Salix sitchensis*	Y	VRI, DRI
61.207.00				Mixed Willow Riparian Forests and Woodlands	*Salix spp.*	Y	
61.208.00				Southern Willow Scrub	*Salix spp.*	Y	
61.209.00				Narrow-leaf Willow Riparian Scrub	*Salix exigua*	N	VRI, DRI, MRI
61.210.00				Yellow Willow Riparian Scrub	*Salix lutea*	N	MRI
61.211.00				Gooding Willow Woodland	*Salix goodingii*	N	
61.300.00			Sycamore		*Platanus spp.*	N	VRI
61.310.00				California Sycamore	*Platanus racemosa*	Y	VRI

Code	Group	Subgroup	Formation	Alliance	Scientific Name	Rare	CWHR Type
61.311.00				Central CA Sycamore Alluvial Woodland	*Platanus spp.*	Y	VRI
61.312.00				Southern Sycamore - Alder Riparian Woodland	*Platanus spp.-Alnus spp.*	Y	VRI
61.313.00				Foothill Sycamore Riparian Woodland	*Platanus spp.*	Y	VRI
61.314.00				Central Coast Cottonwood - Sycamore Riparian Woodland	*Populus spp.-Platanus spp.*	Y	
61.400.00			Alder Riparian Forest		*Alnus spp.*	N	
61.410.00				Red Alder	*Alnus rubra*	N	RDW, VRI, MRI
61.420.00				White Alder Forest and Woodland	*Alnus rhombifolia*	N	MRI
61.500.00			Desert Wash Riparian Woodland			N	
61.510.00				Mesquite Woodland	*Prosopis spp.*	Y	
61.512.00				Honey Mesquite Scrub	*Prosopis glandulosa*	Y	
61.513.00				Tornillo Scrub	*Prosopis pubescens*	Y	
61.520.00				Fan Palm Woodland	*Washingtonia filifera*	Y	POS
61.530.00				Blue Palo Verde - Ironwood - Smoke Tree Woodland	*Cercidium floridum-Olneya tesota-Psorothamnus spinosus*	Y	

Code	Group	Subgroup	Formation	Alliance	Scientific Name	Rare	CWHR Type
61.540.00				Blue Palo Verde Woodland	*Cercidium floridium*	N	
61.550.00				Desert-willow Woodland	*Chilopsis linearis*	N	
61.560.00				Ironwood Woodland	*Olneya tesota*	N	
61.570.00				Smoke Tree Woodland and Scrub	*Psorothamnus spinosus*	N	
61.580.00				Desert Olive Scrub	*Forestiera pubescens*	Y	
61.800.00			Walnut		*Juglans spp.*	Y	
61.810.00				Hind's Walnut Unique Stands	*Juglans californica var. hindsii*	Y	
61.900.00			Mixed Riparian Forest and Woodland			Y	
61.910.00				Great Valley Mixed Riparian Forest		N	VRI
61.920.00				Southern Mixed Riparian Forest		Y	
61.930.00				Southern Riparian Forest		Y	
61.940.00				Mojave Riparian Forest		Y	DRI
61.950.00				Desert Dry Wash Woodland		N	DSW

Code	Group	Subgroup	Formation	Alliance	Scientific Name	Rare	CWHR Type
61.960.00				Oregon Ash Riparian Forest	*Fraxinus latifolia*	Y	VRI, MRI
63.000.00		Low to High Elevation Riparian Scrub				N	
63.100.00			Scrub Willow		*Salix spp.*	N	
63.110.00				Narrowleaf Willow	*Salix exigua*	Y	VRI, MRI, DRI
61.111.00				Tealeaf Willow Riparian Scrub	*Salix planifolia*	N	
61.112.00				Sierra Willow Riparian Scrub	*Salix eastwoodiae*	N	MRI
61.113.00				Lemmon's Willow Riparian Scrub	*Salix lemmonii*	N	MRI
61.114.00				Dusky Willow Riparian Scrub	*Salix melanopsis*	N	MRI
61.115.00				Grayleaf Sierra Willow Riparian Scrub	*Salix orestera*	N	MRI
61.116.00				Arctic Willow Dwarf Scrub	*Salix arctica*	N	MRI
61.117.00				Snow Willow Dwarf Scrub	*Salix reticulata*	N	MRI
63.120.00				Sandbar Willow	*Salix sessifolia*	N	VRI

Code	Group	Subgroup	Formation	Alliance	Scientific Name	Rare	CWHR Type
63.130.00				Southern Willow	*Salix spp.*	Y	
63.140.00				Great Valley Willow	*Salix spp.*	Y	VRI
63.150.00				Montane Wetland Shrub Habitat		Y	MRI
63.160.00				Subalpine Wetland Shrub Habitat		N	MRI
63.200.00			Alder Scrubs		*Alnus spp.*	N	
63.210.00				Mountain Alder Scrub	*Alnus incana*	Y	MRI
63.220.00				Sitka Alder Scrub	*Alnus viridis*	Y	MRI
63.300.00			Buttonbush Scrub		*Cephalanthus occidentalis*	Y	VRI
63.400.00			Elderberry Scrub and Savanna		*Sambucus spp.*	N	
63.410.00				Mexican Elderberry	*Sambucus mexicana*	N	VRI
63.510.00				Mulefat Scrub	*Baccharis salicifolia*	N	DRI, VRI
63.520.00				Emory Baccharis Scrub	*Baccharis emoryi*	N	DSW, DRI
63.530.00				Broom Baccharis Scrub	*Baccharis sergiloides*	Y	DSW, DRI
63.600.00			Birch Scrub		*Betula spp.*	N	
63.610.00				Water Birch Scrub	*Betula occidentalis*	Y	MRI

Code	Group	Subgroup	Formation	Alliance	Scientific Name	Rare	CWHR Type
63.700.00				Arrow Weed Scrubs	*Pluchea spp.*	N	DSW
63.710.00				Arrow Weed Scrub	*Pluchea sericea*	N	DSW
63.800.00			Vegetation dominated by Tamarisk		*Tamarix spp.*	N	
63.810.00				Tamarisk Scrubs and Woodlands	*Tamarix spp.*	N	DSW, DRI
63.900.00			Southern Riparian Scrub			Y	
63.901.00				North Coast Riparian Scrub		N	MRI
63.902.00				Central Coast Riparian Scrub		N	MRI
63.903.00				Montane Riparian Scrub		N	MRI
63.904.00				Modoc-Great Basin Riparian Scrub		N	
63.905.00				Mojave Desert Wash Scrub		N	DSW
63.906.00				Himalayan Blackberry Scrub	*Rubus discolor*	N	CSC
63.907.00				California Rose Riparian Scrub	*Rosa californica*	N	SEW
63.908.00				Salmonberry Scrub	*Rubus spectabilis*	N	CSC

Code	Group	Subgroup	Formation	Alliance	Scientific Name	Rare	CWHR Type
70.000.00	**BROAD LEAFED UPLAND TREE DOMINATED**					N	
71.000.00			Oak Woodlands and Forests			N	
71.040.00				Valley Oak Forests and Woodlands	*Quercus lobata*	Y	VOW, VRI
71.060.00				Coast Live Oak Forest and Woodland	*Quercus agrifolia*	N	COW
80.000.00	**CONIFEROUS UPLAND FOREST AND WOODLAND**					N	
82.000.00			Coastal and Montane Douglas-fir Forests and Woodlands		*Pseudotsuga spp.*	N	
82.500.00				Douglas-fir - Tanoak Forest	*Pseudotsuga menziesii-Lithocarpus densiflora*	N	DFR, COW, MHW, MHC