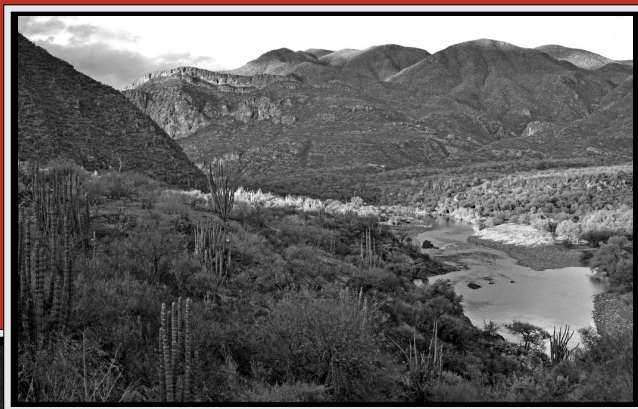


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Avian Richness, Status, and Conservation in the Northwestern Neotropics in Sonora, Mexico

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ABSTRACT: We assessed the status and richness of birds in a remote region of northwest Mexico and provided the first description of a bird community in foothills thornscrub vegetation across the full annual cycle of seasons. Our efforts were part of a broad program to describe biodiversity and conservation value of the Northern Jaguar Reserve. This large private reserve was recently proposed for federal protection, in part, because it supports the northernmost breeding population of jaguars (*Panthera onca*) and extensive riparian woodlands along the largest free-flowing river in western Mexico. The reserve and surrounding region are dominated by foothills thornscrub, which is a vegetation community that covers a vast transition zone between tropical forest and desert-scrub in northwest Mexico but is not represented in the federal system of Natural Protected Areas. Bird species richness was similar to that found in other protected areas in western Mexico. Over seven years, we observed 214 species of birds and estimate that 241 species are present (95% CI = 225–257). Community composition was temporally dynamic; 49% of species were winter residents or passage migrants, 31% were permanent residents, and 15% were summer residents. We observed 10 species that were breeding or wintering north of the previously described limits of their geographic ranges. We observed 13 species of conservation concern in Mexico, including the Bald Eagle (*Haliaeetus leucocephalus*) and Military Macaw (*Ara militaris*) that occur at the extreme southern and northern edges of their breeding ranges, respectively. High environmental variation and unique biogeographic and physiographic settings in this region promote high bird species richness and high conservation value.

Index terms: distribution, foothills thornscrub, Mexico, Natural Protected Area, Northern Jaguar Reserve, richness, Sonora

INTRODUCTION

Information on the diversity and status of wildlife is important for assessing conservation priorities and for designing reserve networks at national and regional scales. Nonetheless, data on wildlife communities to inform conservation efforts are often limited in remote regions with high potential conservation value. In Mexico, data on wildlife communities are often sparse in remote regions, and representation of the full range of biotic communities and vertebrate species in the federal system of Natural Protected Areas (NPAs) is incomplete (Ortega-Huerta and Peterson 2004; Ceballos 2007; Hannah et al. 2007). Conservation efforts in Mexico are of global significance because it is a mega-diverse country that spans a broad Neotropical-Nearctic transition zone (Rzedowski 1978; Halffter 1987; Mittermeier et al. 1998) and because threats to biodiversity are high (Mas et al. 2004; Calderon-Aguilera et al. 2012). Such threats include large-scale deforestation that has reduced some vegetation communities to fractions of their historic coverage, and habitat loss and degradation due to urban growth, overgrazing, and development along the international border (Trejo and Dirzo 2000; Stoleson et al. 2005; Valdez et al. 2006; Flesch et al. 2010).

The primary mechanism for biodiversity conservation in Mexico has been the designation of NPAs by the federal government. A recent national assessment of nearly half of Mexican NPAs, however, found that only 54% were effective at preventing land-use and land-cover change, and that other NPAs were weakly effective or ineffective (Figuroa and Sánchez-Cordero 2008). Because few NPAs are owned exclusively by the federal government, managed solely for biodiversity conservation, or placed systematically based on scientific criteria, additional mechanisms and information on spatial patterns of biodiversity are important for conservation in Mexico (Ortega-Huerta and Peterson 2004; Valdez et al. 2006).

Private efforts and public-private partnerships focused in regions of high conservation value offer additional mechanisms for biodiversity conservation in Mexico (Valdez et al. 2006; Rands et al. 2010; Rosas-Rosas and Valdez 2010). In 2003, two conservation organizations—Naturalia and the Northern Jaguar Project—began a binational partnership to purchase private land in a remote region of northwest Mexico to protect the northernmost breeding population of jaguars (*Panthera onca* L.). Since 2003, the Northern Jaguar Reserve (NJR) has grown to 20,140 ha, its mission has expanded to focus more generally on

biodiversity conservation, and the region has been proposed for federal protection as a NPA. This region has high potential conservation value because it is remote, situated along the largest free-flowing river in western Mexico, and supports extensive riparian woodlands, which in these semi-arid environments provide important resources for wildlife but have been highly degraded in adjacent lowlands. Moreover, the NJR is located near the northern extent of subtropical vegetation in the Western Hemisphere and protects large areas of foothills thornscrub, which is not represented in the federal system of NPAs and has been the focus of very little study despite being among the most dominant vegetation communities in the state of Sonora.

As part of a broad effort to document biodiversity in this region of Mexico and to evaluate the potential merits of a proposed federal NPA, we assessed the status and richness of birds and evaluated the region's conservation value for birds. Our efforts complement recent studies of jaguar (Gutiérrez-González et al. 2012) and herpetofauna (Rorabaugh et al. 2011) in this region and provide the first description of a bird community in foothills thornscrub vegetation throughout the complete annual cycle of seasons. We estimated richness, residency and breeding status, relative abundance, and habitat use of all birds we observed during surveys that spanned all major seasons and habitat types over seven years (2007–2013). To assess conservation value, we compared estimates of avian richness with that in other regions of western Mexico, evaluated the distributional significance of populations by assessing species that were not known to breed or winter in this region, and identified populations of conservation concern in Mexico and the neighboring United States (US).

METHODS

Study Area

The NJR is in east-central Sonora, 55 km north of Sahuaripa and approximately 200 km south of the US-Mexico border (centered near 29°25' N, 109°10' W; Figure 1).

This region is situated west of the northern end of the Sierra Madre Occidental, surrounded on three sides by deep, lowland canyons of the Aros and Yaqui Rivers, and is among the largest and least fragmented wildlands in Mexico. We considered an approximately 50,000-ha study area that included the NJR and adjacent areas along the Aros-Yaqui river corridor (Figure 1).

Climate is seasonally arid with hot summers and cool winters; annual precipitation averages 38 cm in Sahuaripa, of which 72% occurs during the summer monsoon from June through September (Brown 1982). Vegetation in uplands is predominantly foothills thornscrub (FT), which is drought deciduous, in leaf during and soon after the summer monsoon, and dominated by short trees, shrubs, and cacti (Brown 1982). FT covers a large region of foothills and interior valleys west of the Sierra Madre Occidental, and together with its coastal counterpart (e.g., coastal thornscrub; Martin et al. 1998) is the dominant vegetation community in a broad transition zone between tropical forest and desert-scrub at the northwestern edge of the Neotropics. Floristically, FT is similar to but shorter and less floristically and structurally diverse than tropical deciduous forest, into which it transitions in southern Sonora and Sinaloa (Gentry 1982; Búrquez et al. 1999). Dominant plants include the trees *Lysiloma divaricatum* (Jacq.) J.F. Macbr., *L. watsonii* Rose, *Bursera fagaroides* (Kunth), *Fouquieria macdougalii* Nash, *Acacia cochliacantha* Humb. & Bonpl. ex Willd., *Ipomoea arborescens* (Humb. & Bonpl.), *Ceiba acuminata* (S. Watson) Rose, *Parkinsonia praecox* (Ruiz & Pav. ex Hook.), and the columnar cactus *Stenocereus thurberi* (Engelm.) F. Buxb. Riparian areas on deep soils and flats are dominated by woodlands of mesquite (*Prosopis velutina* Wooton), acacia (*A. occidentalis* Rose), and Mexican ebony (*Havardia Mexicana* (Rose) Britton & Rose). In rocky canyons, riparian vegetation is dominated by *L. watsonii*, palms (*Sabal uresana* Trel. and *Brahea brandegeei* (Purpus) H.E. Moore), and a drought deciduous oak known locally as “encino amarillo” (*Quercus tuberculata* Lieb.). Riparian vegetation in mesic canyons are dominated by willows (*Salix bonplandiana* Kunth and *S. gooddingii*

C.R. Ball), sycamore (*Platanus wrightii* S. Watson), and button-willow (*Cephalanthus salicifolius* Humb. & Bonpl.). At higher elevations, oak woodlands and mountain scrub are dominated by *Q. chihuahuensis* Trel., *Q. toumeyi* Sarg., *Q. alboncinta* Trel., and other oaks that are often mixed with FT or *Dodonaea viscosa* Jacq.

Design and Field Surveys

To assess bird species richness, status, and habitat use, we surveyed birds using both standardized and unstandardized techniques during four seasons across multiple years. We focused standardized surveys along two sets of transects; eight transects that we placed in representative areas across a full range of vegetation communities at elevations between 470 and 1100 m on the NJR (hereafter “extensive transects”), and 14 additional transects in canyons, beachfronts, and riparian areas along the Aros-Yaqui river corridor on and around the NJR (hereafter “river transects,” Figure 1). Transects ranged from approximately 700 to 3000 m in length and followed drainages, narrow roads, or trails. We accessed extensive transects via land and river transects via boat. Upland vegetation along transects was dominated by FT that included short thornscrub at low elevations (<500 m), tall thornscrub on sheltered slopes and in canyons at moderate elevations (550–750 m; see Warshall and Flesch 2013), and by oak woodland, mountain scrub, and grasslands at high elevations (>1000 m).

We used distance-sampling methods to survey birds along transects. We surveyed no earlier than 30 minutes before local sunrise and no later than five hours after sunrise. Surveys in spring, summer, and fall rarely extended more than three hours after sunrise, whereas those in winter typically began one hour after sunrise and continued for four hours due to low bird activity during cold mornings. We surveyed extensive transects up to four times per season for two or three years. We surveyed river transects once in up to three seasons (spring, summer, and winter) during a single year. Sampling in summer was during the monsoon from 9 to 23 July (2007, 2008, 2012)

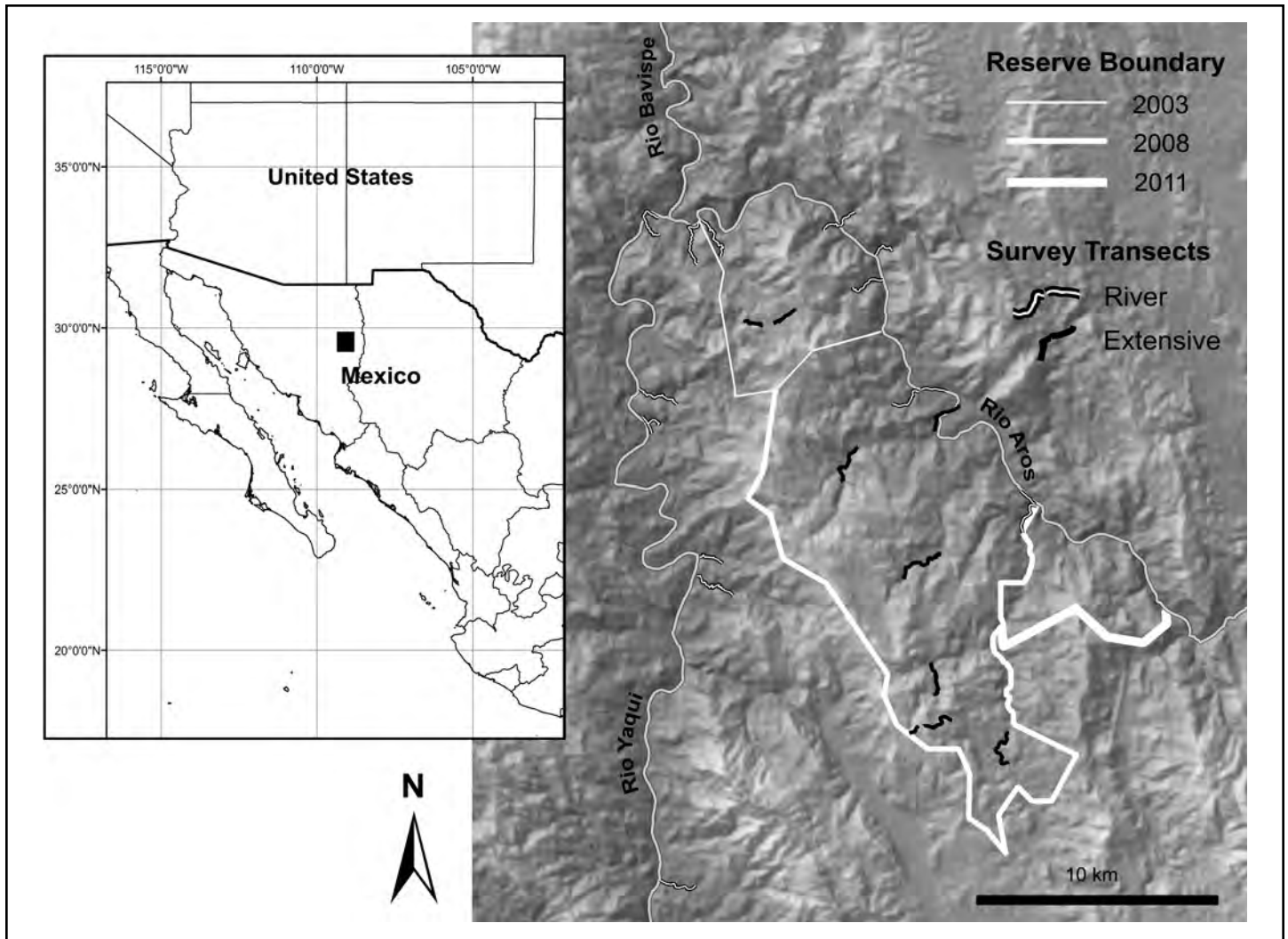


Figure 1. Map of study region on and around the Northern Jaguar Reserve, illustrating the locations of survey transects, reserve boundary, and major rivers in east-central Sonora, Mexico. Different boundary lines show expansion of the reserve to the south and east since its establishment in 2003. The reserve is bounded to the east and north by the Aros River. Solid black lines are extensive transects, which were surveyed up to four times per season in two to three years, and black-and-white lines are river transects, which were surveyed during one year in as many as three seasons (spring, summer, and winter). Only the region east of the Rio Yaqui was included in the study area.

when vegetation was in leaf, most bird species were breeding, and the first fall-season migrants were beginning to arrive. Sampling during spring and fall occurred between 21 March and 27 April (2010 and 2011) and from 12 to 28 September (2007 and 2009), when many migratory bird species were moving through the region and some breeding species were beginning or completing breeding activity. Sampling during winter was between 12 December and 6 January (2009, 2010, 2011), when winter residents were present and early breeders (e.g., hummingbirds) were beginning courtship.

To increase survey coverage, both spatially

and temporally, we gathered observations of birds across a wider range of times, environments, and elevations (360 to 1300 m). Those efforts included unstandardized surveys conducted while floating Rio Aros and Yaqui Rivers, mist netting, and other incidental observations made during expeditions in the backcountry throughout the year. To assess the presence of nocturnal species, we broadcasted recorded calls of owls and nightjars at night on an opportunistic basis. During the breeding season, we searched for nests and young and observed bird behavior to assess breeding status. Collectively, survey effort totaled >1000 person days.

Analyses

We calculated observed species richness by summing the total number of species detected during surveys. Because detection probability often varies widely among species and, thus, some species that are present are not detected (Boulinier et al.1998), we estimated species richness based on the observed abundance distribution (e.g., number of individuals, pairs, or flocks detected of each species) and a limiting form of the jackknife estimator (Burnham and Overton 1979) implemented by program Specrich (see <http://www.mbr-pwrc.usgs.gov/software.html>). To assess the range of

likely values of richness, we calculated a 95% confidence interval (CI).

To assess breeding status, we used North American Ornithological Atlas Committee (1990) methods to classify the status of each species as possibly, probably, or confirmed breeding, or as nonbreeding. To assess residency status, we used observations gathered during the study and information on migration times from Sonora and adjacent southern Arizona (Russell and Monson 1998; Corman and Wise-Gervais 2005; Flesch 2008). Some species that we classified as permanent residents likely have different wintering and breeding populations. To assess abundance, we used estimates of density based on distance sampling and the total number of encounters of each species to classify abundance in six categories: (1) abundant (conspicuous and invariably seen); (2) common (frequently encountered); (3) fairly common (a few individuals or pairs observed); (4) uncommon (present but may not be found regularly during surveys); (5) rare (present but rarely detected or restricted to localized area); or (6) sporadic (present only during some years). To describe habitat use, we classified the three most frequently used habitat types for each species among 13 types: FT, riparian woodland, oak woodland, grassland, desert-scrub, mountain scrub, beachfronts and emergent vegetation, aquatic, palm groves, cliffs and rocky outcrops, fields and man-made vegetation openings, houses or other developed areas, and aerial. To assess conservation value, we evaluated the distributional significance of populations in the region, compared estimates of species diversity with those in other regions in western Mexico, and calculated the number of species of conservation concern in Mexico and the neighboring United States (USFWS 2008; SEMARNAT 2010).

RESULTS

Richness and Status

We observed 214 species of birds in 17 orders and 42 families, including 161 species that we detected during standardized surveys along transects (Appendix:

See Appendix note Pg. 294). The most diverse families were Tyrannidae (25 species), Parulidae (22), Emberizidae (21), Accipitridae (11), Trochilidae (11), and Cardinalidae (11). We classified 105 species (49%) as predominantly winter residents or passage migrants, 66 (31%) as permanent residents, and 33 (15%) as summer residents (Table 1). The Status of 10 species (5%) was unknown, including: (1) five that are likely winter residents or migrants (Golden Eagle (*Aquila chrysaetos*) (avian nomenclature follows the American Ornithologists' Union), Greater Yellowlegs (*Tringa melanoleuca*), Burrowing Owl (*Athene cunicularia*), Pacific-slope Flycatcher (*Empidonax difficilis*), and Cordilleran Flycatcher (*Empidonax occidentalis*)); (2) four that are likely rare summer visitors or rare breeders (Short-tailed Hawk (*Buteo brachyurus*), Ruddy Ground-Dove (*Columbina talpacoti*,

Plain-capped Starthroat (*Heliomaster constantii*), Yellow Grosbeak (*Pheucticus chrysopleplus*); and (3) one that may be a rare permanent resident (Common Poorwill (*Phalaenoptilus nuttallii*)). We classified 108 species (50%) as potential breeders (Table 1, Appendix: See Appendix note Pg. 294). We confirmed breeding for 53 species—49% of all potential breeders. Based on the observed species abundance distribution, which included 23 species we detected only once, we estimate that 241 ± 8.7 (\pm SE) species occur in the region (95% CI = 225–257).

Most species were uncommon or rare (36–37%) during their season of peak abundance, fewer were common or fairly common (10–15%), and very few were abundant (2%; Table 1). Abundant species were typically breeding summer residents such as Five-striped Sparrow (*Amphispiza*

Table 1. Residency, breeding, abundance, and conservation status of 214 bird species observed on and around the Northern Jaguar Reserve in east-central Sonora, Mexico, between 2007 and 2013.

Group	Species	Percent
Residency		
Summer	33	15.4
Winter and migrant	105	49.1
Permanent	66	30.8
Unknown	10	4.7
Breeding		
Confirmed	53	24.8
Probable	34	15.9
Possible	21	9.8
Nonbreeding	106	49.5
Abundance		
Abundant	4	1.9
Common	32	15.0
Fairly common	21	9.8
Uncommon	77	36.0
Rare	79	36.9
Sporadic	1	0.5
Conservation Concern		
Mexico – endangered	2	0.9
– threatened	2	0.9
– special protection	9	4.2
U.S. – special concern	24	11.1

quinquestrata), Yellow-breasted Chat (*Icteria virens*), and Hooded Oriole (*Icterus cucullatus*). Of the 65 species that we classified as permanent residents, 75% had largely static distributions and abundances among seasons, which suggested most individuals made little to no seasonal movements. For other species classified as permanent residents, however, abundances were lower in winter or distributions shifted to lower elevations, suggesting significant proportions of these populations made local seasonal movements. Among passage migrants, we observed Painted Bunting (*Passerina ciris*) and Orchard Oriole (*Icterus spurius*) only during fall. We observed Black Swift (*Cypseloides niger*), Eastern Phoebe (*Sayornis phoebe*), Northern Parula (*Setophaga americana*), and Black-and-white Warbler (*Mniotilta varia*) only once, and classified them as rare migrants or winter vagrants.

We observed several species of conservation concern including Bald Eagle (*Haliaeetus leucocephalus*) and Military Macaw (*Ara militaris*), which are listed

as endangered in Mexico, Mallard (*Anas platyrhynchos diazi*; Mexican subspecies) and Golden Eagle, which are listed as threatened, and nine other species that are subject to special protection. Additionally, we observed 24 species that are designated as species of conservation concern in the neighboring United States (Appendix: See Appendix note Pg. 294).

Habitat and Distribution

Riparian woodlands, FT, and oak woodland were the most frequently used habitat types (Figure 2). Despite its limited coverage in the region, riparian woodlands were frequently used by >64% of species, including 42% as their primary habitat type. In comparison, FT and oak woodland, which cover much larger portions of the study area, were used by 50 and 25% of species, respectively. Other habitat types were used with much lower frequency (0–8%), except beachfronts and emergent vegetation, which were used by 14% of the community.

We observed 10 species north of the previously described limits of their breeding or wintering ranges. Among breeding species, we observed Fan-tailed Warbler (*Basileuterus lachrymosa*) breeding in wet canyon bottoms and Military Macaw breeding on tall limestone cliffs approximately 150 and 230 km north of the previously described limits of their breeding ranges, respectively. Among wintering species, we observed Common Black-Hawk (*Buteogallus anthracinus*), White-eared Hummingbird (*Hylocharis leucotis*), Berylline Hummingbird (*Amazilia beryllina*), Tufted Flycatcher (*Mitrephanes phaeocercus*), Cassin's Kingbird (*Tyrannus vociferans*), Brown-backed Solitaire (*Myadestes occidentalis*), Wilson's Warbler (*Cardellina pusilla*), and Slate-throated Redstart (*Myioborus miniatus*) north of their known winter ranges. Six of these species were observed in the same areas during two or more winters, suggesting they regularly occur, and two others (Common Black-Hawk and Tufted Flycatcher) were observed along portions of the Aros-Yaqui

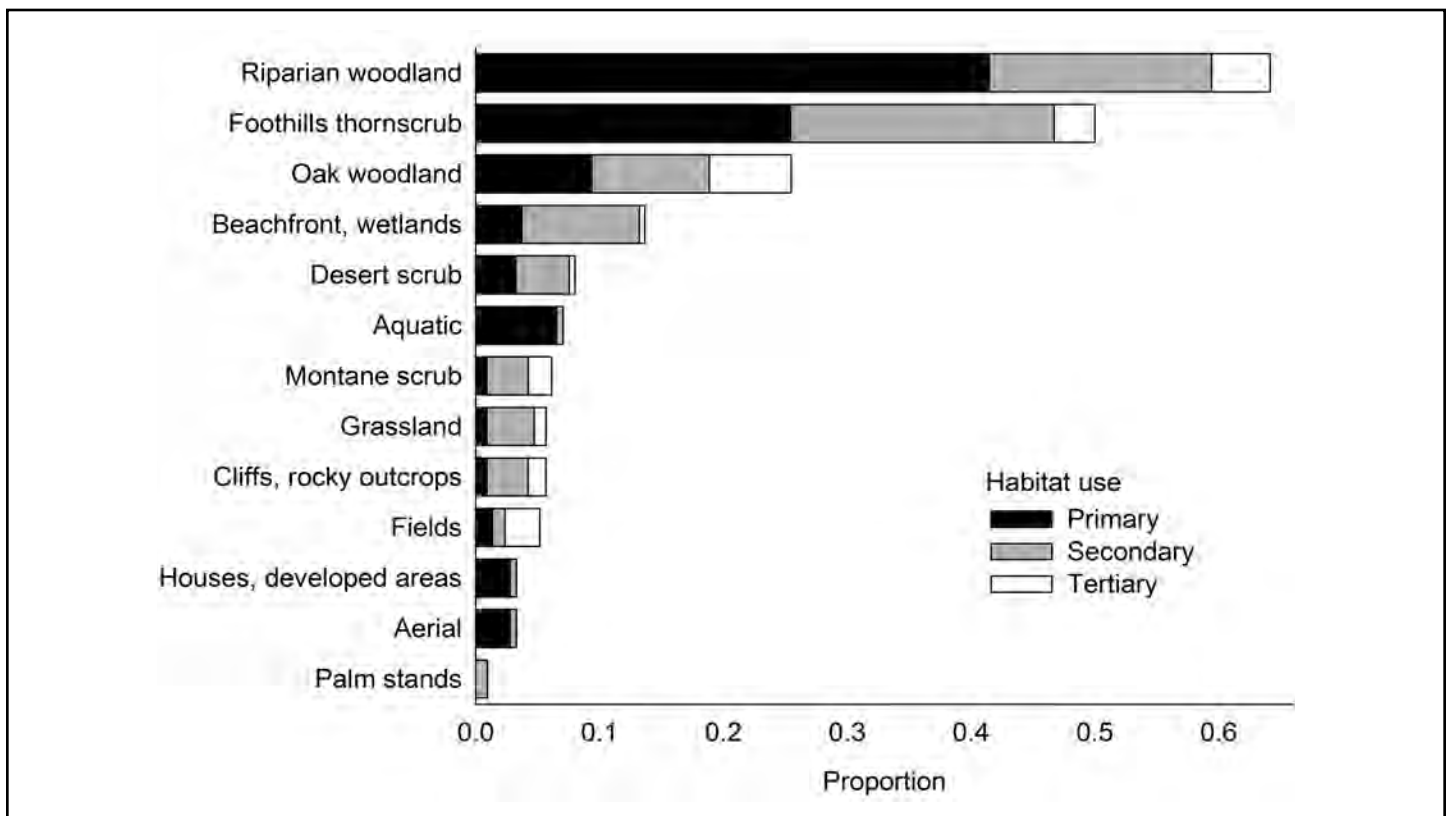


Figure 2. Habitat use of birds observed on and around Northern Jaguar Reserve in east-central Sonora, Mexico, 2007–2013. The primary, secondary, and tertiary habitat types used by each species were classified among 13 habitat types represented in the region.

river corridor during the only winter we surveyed those areas. Nonetheless, all extralimital wintering species were rare and distributed locally except Brown-backed Solitaire, which was uncommon in riparian woodlands along the Aros-Yaqui river corridor in December 2011 (21 individuals, including 18 singing). Other notable breeding species included Least Grebe (*Tachybaptus dominicus*) nesting approximately 100 km north of the northernmost known breeding locality in Sonora. Moreover, Yellow-green Vireo (*Vireo flavoviridis*), Blue Mockingbird (*Melanotis caerulescens*), and White-striped Woodcreeper (*Lepidocolaptes leucogaster*) were paired in breeding habitat during two or more years and historically, have been observed in breeding habitat only once or twice to the north.

DISCUSSION

Richness and Status

We observed 214 species of birds in FT, riparian woodland, oak woodland, and other habitat types on and around the NJR over seven years. Thus, this region supports at least 40% of the 531 bird species that have been documented in Sonora, 46% of the 467 species that have been documented in Sonora that are not associated exclusively with marine environments, and 20% of the 1070 bird species known in Mexico (Howell and Webb 1995; Villaseñor-Gómez et al. 2010). Based on the observed species abundance distribution, we estimate 241 species of birds occur in the region, with a range of likely estimates as high as 257 species.

Avian richness in this region of Sonora is similar to that observed in other regions of western Mexico, including some that are larger, more tropical, and include a much broader range of elevations. Manzano-Fischer et al. (2006), for example, observed 227 bird species over 10 years in a much larger region (250,000 ha) of temperate grassland, shrubland, and riparian woodland in northwest Chihuahua that was recently designated as a NPA. Further south in tropical deciduous forest on the Chamela-Cuixmala Biosphere Reserve

in western Jalisco, Ornelas et al. (1993) observed 153 species over two years. Moreover, in a larger region and broader range of vegetation communities on and around Chamela-Cuixmala, Ramírez-Albores (2007) observed 246 species, including 26 associated largely with marine environments. Similarly, in a broader range of vegetation types between tropical deciduous forest and pine (*Pinus* spp.) forest in southern Sinaloa and western Durango, Medina-Macías et al. (2010) observed 209 species. Because tropical deciduous forest is similar to FT but taller, more structurally and floristically diverse, and occurs at more southern latitudes (Gentry 1982), similar richness that we report at this relatively high latitude in Sonora is notable. High bird species richness in this region is driven by broad elevation and vegetation gradients, extensive riparian woodlands that provide important stopover and wintering habitats along an inland migratory corridor, and close proximity to the Madrean, Sinaloan, Sonoran, and Chihuahuan biogeographic provinces.

We provided the first overall assessment of richness and status for a bird community in FT vegetation across the full annual cycle of seasons. Formerly, assessments of breeding and residency status of birds in FT were limited to studies at Lo de Campa in central Sonora (Russell and Monson 1998). Prior to our efforts, data on birds in this region of Sonora were limited to accounts of notable species near Sahuaripa, records from highland forests east of Sahuaripa, and observations obtained along the Aros, Bavispe, and Yaqui Rivers (Clark 1984; Brown 1988; Rodríguez-Estrella and Brown 1990; Russell and Monson 1998; O'Brien et al. 2006). More generally, data on birds in many lowland vegetation communities in western Mexico are still limited in seasons other than winter (Hutto 1980, 1992; Villaseñor-Gómez 2006, 2008).

Distribution

The NJR and surrounding region provide important habitat for many species of breeding and wintering birds found at the margins of their geographic ranges. We documented 10 species that were not

known to breed or winter this far north in Mexico, and others that have been observed in breeding habitat during the breeding season at very few localities to the north. Wintering species at the northern edge of their range included three species of elevational migrants—Tufted Flycatcher, Brown-backed Solitaire, and Slate-throated Redstart—that breed in montane forests in the adjacent Sierra Madre Occidental, and that seem to have expanded their breeding ranges northward in recent decades (Flesch 2014). Other extralimital winter residents are species that likely migrate longer distances (e.g., Common Black-Hawk, Cassin's Kingbird, Wilson's Warbler), were thought to winter only as far north as extreme southern Sonora (Howell and Webb 1995; Russell and Monson 1998), and that may also be expanding their winter ranges northward. Importantly, all of those species were observed wintering in riparian areas or FT along the vast lowland corridor formed by the Aros and Yaqui Rivers, which in winter provides a warm subtropical environment unlike any other in east-central Sonora. For those elevational migrants, areas along the river corridor provide what are likely the closest potential wintering habitats. For long-distance migrants, subtropical lowland vegetation at these relatively high latitudes in interior Sonora are connected to similar environments to the south only by this narrow river corridor.

Breeding species that we documented at or near the northern margins of their geographic ranges all had strong affinities to subtropical lowland environments to the south. Military Macaw and Fan-tailed Warbler, for example, are more common in tropical forest to the south, and nests we observed in this region are the northernmost confirmed breeding localities and the second and first nests, respectively, for these species in Sonora (Howell and Webb 1995; Russell and Monson 1998). The northern range limits of these bird species correspond to those of some important plant species and the northern extent of subtropical vegetation communities in general. The tree species *Ficus pertusa* L. f., *F. insipida* Willd., *Tabebuia impetiginosa* (Mart.), and *Sideroxylon persimile* (Hemsl.), which are important components of tropical forests

to the south, all reach the northern limits of their geographic ranges in this region of Sonora (Flesch and Jacobs, unpubl. data). Plants in these genera provide important foods for Military Macaw (Loza 1997; Contreras-González et al. 2009). Thus, presence of these and other plants, combined with tall limestone cliffs for nesting, explains the species' occurrence in this region. Although the structure and composition of FT varies widely across its range (Brown 1982; Búrquez et al. 1999; Warshall and Flesch 2013), the NJR supports some of the northernmost stands of tall, well-developed FT. These stands are where we observed Yellow Grosbeak, Blue Mockingbird, and other species with more tropical affinities at or near the margins of their geographic ranges.

Conservation

Although the importance of this region for jaguar conservation is well established (Sanderson et al. 2002; Rabinowitz and Zeller 2010), our results indicate it also has high conservation value for birds. In addition to protecting large areas of FT and riparian woodland, high environmental richness and unique biogeographic and physiographic settings promote high bird richness. This level of richness is similar to that found in other regions of western Mexico, including some regions that have been designated NPAs and that are larger and more tropical. Moreover, this region also provides habitat for numerous populations of birds at or near the margins of their geographic ranges, and species that are rare and of conservation concern, such as Bald Eagle and Military Macaw, which are endangered in Mexico.

Our results suggest this region is especially important for migratory birds. Approximately half the species we observed were winter residents or passage migrants, and another 15% were summer residents that migrate from the south. Thus, the proportion of migrants (approximately 65%) vs. permanent residents (31%) is similar to that found in more temperate environments in neighboring northwest Chihuahua (Manzano-Fischer et al. 2006) and much higher than that found in more

tropical southern regions (Ornelas et al. 1993; Vázquez et al. 2009; Medina-Macías et al. 2010). The geographic position and presence of extensive riparian woodlands likely promotes this region's importance to migratory birds (Villaseñor-Gómez 2008). Most migratory songbirds that breed in the western United States and Canada, winter and migrate across a relatively small area of western Mexico between the coastal plain and Sierra Madre (Fitzpatrick 1980; Hutto 1985). Along this route, riparian areas provide important stopover habitats for migrants that must cross vast arid lowlands in contrast to their eastern counterparts (Skagen et al. 2005). Thus, the geographic location and vegetation communities used by migratory birds along the western flyway are uniquely narrow in comparison to other landbird migration systems worldwide (Skagen et al. 2005; Faaborg et al. 2010). Because migrants often move in broad bands and follow major geographic features such as mountains and rivers (Hutto 2000; Gauthreaux et al. 2003; Faaborg et al. 2010), the position of this region along the largest lowland river corridor in northwestern Mexico, combined with the north-south orientation of the river and adjacent mountains, likely promote its value to migratory birds.

Although nearly 8% of Sonora has been designated as conservation reserves by the Mexican federal government, most reserves are not owned by the federal government or managed exclusively for biodiversity-conservation. Additionally, no federal reserve in Mexico protects the FT vegetation community (Búrquez and Martínez-Yrizar 1997, 2007). This lack of representation is noteworthy because FT is among the most dominant vegetation communities in Sonora (Brown 1982). Given this lack of representation, the region's value to birds and other wildlife (e.g., Rabinowitz and Zeller 2010; Rorabaugh et al. 2011), unique biogeographic and physiographic settings, and its remote and wild character, this region warrants consideration for federal protection.

Efforts to preserve and restore habitats for birds and other wildlife are major management foci on the NJR. Nonetheless, conservation efforts in the region face a range

of threats, including clearing of native vegetation, planting and natural invasion of exotic buffelgrass (*Pennisetum ciliare* Link), overgrazing by domestic livestock, and large-scale mining and hydroelectric projects that could alter hydrologic regimes and flood large areas of the Aros-Yaqui valley. The NJR provides protection from land clearing and overgrazing, and recent and proposed expansion of the reserve will protect more area. Nonetheless, only federal protection can limit threats from large-scale mining and hydroelectric projects. Efforts by both public agencies and private organizations, such as those by Naturalia and the Northern Jaguar Project in this region, are important for realizing the conservation of biodiversity in Mexico at large scales.

NOTE: All data referred to in Appendix are posted online and available at: <[http://www.aaronflesch.com/Appendix_NAJ.Vol.35\(2\).pdf](http://www.aaronflesch.com/Appendix_NAJ.Vol.35(2).pdf)>.

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LITERATURE CITED

- Boulinier, T., J.D. Nichols, J.R. Sauer, J.E. Hines, and K.H. Pollock. 1998. Estimating species richness to make inference in community ecology: the importance of heterogeneity in species detectability as shown from capture-recapture analyses of North American Breeding Bird Survey data. *Ecology* 79:1018-1028.
- Brown, B.T. 1988. Additional bald eagle nesting records from Sonora. *Journal of Raptor Research* 22:30-32.
- Brown, D.E. 1982. Sinaloan thornscrub. *Desert Plants* 4:101-105.
- Burnham, K.P., and W.S. Overton. 1979. Robust estimation of population size when capture probabilities vary among animals. *Ecology* 60:927-936.
- Búrquez, A., and A. Martínez-Yrizar. 1997. Conservation and landscape transformations in Sonora, Mexico. *Journal of the Southwest* 39:371-398.
- Búrquez, A., and A. Martínez-Yrizar. 2007. Conservation and landscape transformations in northwestern Mexico. Pp. 537-547 in R.S. Felger, B. Broyles, eds., *Dry Borders: Great Nature Reserves of the Sonoran Desert*. University of Utah Press, Salt Lake City.
- Búrquez, A., A. Martínez-Yrizar, R.S. Felger, and D. Yetman. 1999. Vegetation and habitat diversity at the southern edge of the Sonoran Desert. Pp. 36-67 in R.H. Robichaux, ed., *Ecology of Sonoran Desert Plants and Plant Communities*. University of Arizona Press, Tucson.
- Calderon-Aguilera, L.E., V.H. Rivera-Monroy, L. Porter-Bolland, A. Martínez-Yrizar, L.B. Ladah, M. Martínez-Ramos, J. Alcocer, A.L. Santiago-Pérez, H.A. Hernández-Arana, V.M. Reyes-Gómez, D.R. Pérez-Salicipup, V. Díaz Nuñez, J. Sosa-Ramírez, J. Herrera-Silveira, and A. Búrquez. 2012. An assessment of natural and human disturbance effects on Mexican ecosystems: current trends and research gaps. *Biodiversity and Conservation* 21:589-617.
- Ceballos, G. 2007. Conservation priorities for mammals in megadiverse Mexico: the efficiency of reserve networks. *Ecological Applications* 17:569-578.
- Clark, T.O. 1984. Notable records of birds from eastern Sonora, Mexico. *Western Birds* 15:134-136.
- Contreras-González, A., E. Rivera-Ortiz, C. Soberanes-González, A. Valiente-Banuet, and M.C. Arizmendi. 2009. Feeding ecology of Military Macaws (*Ara militaris*) in a semi-arid region of central Mexico. *Wilson Journal of Ornithology* 121:384-391.
- Corman, T.E., and C. Wise-Gervais, eds. 2005. *Arizona Breeding Bird Atlas*. University of New Mexico Press, Albuquerque.
- Faaborg, J., R.T. Holmes, A.D. Anders, K.L. Bildstein, K.M. Dugger, S.A. Gauthreaux, P. Heglund, K.A. Hobson, A.E. Jahn, D.H. Johnson, S.C. Latta, D.J. Levey, P.P. Marra, C.L. Merkord, E. Nol, S.I. Rothstein, T.W. Sherry, T.S. Sillett, F.R. Thompson, and N. Warnock. 2010. Recent advances in understanding migration systems of New World land birds. *Ecological Monographs* 80:3-48.
- Figueroa, F., and V. Sánchez-Cordero. 2008. Effectiveness of natural protected areas to prevent land use and land cover change in Mexico. *Biodiversity and Conservation* 17:3223-3240.
- Fitzpatrick, J.W. 1980. Wintering of North American tyrant flycatchers in the Neotropics. Pp. 67-78 in A. Keast, M.S. Morton, eds., *Migrant Birds in the Neotropics*. Smithsonian Institution Press, Washington, DC.
- Flesch, A.D. 2008. Distribution and status of breeding landbirds in the borderlands of northern Sonora, Mexico. *Studies in Avian Biology* 37:28-45.
- Flesch, A.D. 2014. Distribution, Abundance, Habitat, and Biogeography of Breeding Birds in the Sky Islands and Adjacent Sierra Madre Occidental of Northwest Mexico. University of Arizona, Tucson. doi: 10.13140/2.1.4938.5765.
- Flesch, A.D., C.W. Epps, J.W. Cain, M. Clark, P.R. Krausman, and J.W. Morgart. 2010. Potential effects of the United States-Mexico border fence on wildlife. *Conservation Biology* 24:171-181.
- Gauthreaux, S.A. Jr, C.G. Belser, and D. Van Blaricom. 2003. Using a network of WSR88-D weather surveillance radars to define patterns of bird migration at large spatial scales. Pp. 335-346 in P. Berthold, E. Gwinner, E. Sonnenschein, eds., *Avian Migration*. Springer Verlag, Berlin.
- Gentry, H.S. 1982. Sinaloan deciduous forest. *Desert Plants* 4:73-77.
- Gutiérrez-González, C.E., M.Á. Gómez-Ramírez, and C.A. López-González. 2012. Estimation of the density of the near threatened jaguar *Panthera onca* in Sonora, Mexico, using camera trapping and an open population model. *Oryx* 46:431-437.
- Halfpeter, G. 1987. Biogeography of the montane entomofauna of Mexico and Central America. *Annual Review of Entomology* 32:95-114.
- Hannah, L., G. Midgley, S. Andelman, M. Araújo, G. Hughes, E. Martinez-Meyer, R. Pearson, and P. Williams. 2007. Protected area needs in a changing climate. *Frontiers in Ecology and Environment* 5:131-138.
- Howell, S.N.G., and S. Webb 1995. *A Guide to the Birds of Mexico and Northern Central America*. Oxford University Press, New York.
- Hutto, R.L. 1980. Winter habitat distribution of migratory land birds in western Mexico, with special reference to small, foliage-gleaning insectivores. Pp. 181-203 in A. Keast, E.S. Morton, eds., *Migrant Birds in the Neotropics: Ecology, Behavior, Distribution and Conservation*. Smithsonian Institution Press, Washington, DC.
- Hutto, R.L. 1985. Habitat selection by non-breeding, migratory landbirds. Pp. 455-476 in M.L. Cody, ed., *Habitat Selection in Birds*. Academic Press, Orlando, FL.
- Hutto, R.L. 1992. Habitat distributions of migratory landbird species in western Mexico. Pp. 221-239 in J.M. Hagan III, D.W. Johnston, eds., *Ecology and Conservation of Neotropical Migrant Landbirds*. Smithsonian Institution Press, Washington, DC.
- Hutto, R.L. 2000. On the importance of en-route periods to the conservation of migratory landbirds. *Studies in Avian Biology* 20:109-114.
- Loza, S.C.A. 1997. Patrones de abundancia, uso de hábitat y alimentación de la guacamaya verde (*Ara militaris*) en la Presa Cajón de Peña, Jalisco, Mexico. MS thesis, Universidad Nacional Autónoma de Mexico, Mexico City.
- Manzano-Fischer, P., R. List, G. Ceballos, and J.L. Cartron. 2006. Avian diversity in a priority area for conservation in North America: the Janos-Casas Grandes prairie dog complex and adjacent habitats in northwestern Mexico. *Biodiversity and Conservation* 15:3801-3825.

- Martin, P.S., D.A. Yetman, M. Fishbein, P. Jenkins, T.R. Van Devender, and R.K. Wilson, eds. 1998. Gentry's Río Mayo Plants. The Tropical Deciduous Forest and Environs of Northwest Mexico. University of Arizona Press, Tucson.
- Mas, J.F., A. Velázquez, J.R. Díaz-Gallegos, R. Mayorga-Saucedo, C. Alcántara, G. Bocco, and A. Pérez-Vega. 2004. Assessing land use/cover changes: a nationwide multirate spatial database for Mexico. *International Journal of Applied Earth Observation and Geoinformation* 5:249-261.
- Medina-Macías, M.N., M.A. González-Bernal, and A.G. Navarro-Sigüenza. 2010. Altitudinal distribution of birds in a priority area in Sinaloa-Durango, Mexico. *Revista Mexicana de Biodiversidad* 81:487-503.
- Mittermeier, R., N. Myers, J.B. Thomsen, G.A.B. da Fonseca, and S. Olivieri. 1998. Biodiversity hotspots and major tropical wilderness areas: approaches to setting conservation priorities. *Conservation Biology* 12:516-520.
- North American Ornithological Atlas Committee. 1990. Handbook for Atlasing North American Breeding Birds. Accessed 10 January 2012 <<http://www.bsc-eoc.org/norac/atlascont.htm>>.
- O'Brien, C., A.D. Flesch, E. Wallace, M. Bogan, S.E. Carrillo-Percástegui, S. Jacobs, and C. Van Riper III. 2006. Biological Inventory of the Río Aros, Sonora, Mexico: A River Unknown. US Geological Survey, Southwest Biological Science Center, Tucson, AZ.
- Ornelas, J.F., M.C. Arizmendi, L. Márquez-Valdelamar, M.D. Navarijo, and H.A. Berlanga. 1993. Variability profiles for line transect bird censuses in a tropical dry forest in Mexico. *Condor* 95:422-441.
- Ortega-Huerta, M.A., and A.T. Peterson. 2004. Modeling spatial patterns of biodiversity for conservation prioritization in Northeastern Mexico. *Diversity and Distributions* 10:39-54.
- Rabinowitz, A., and K.A. Zeller. 2010. A range-wide model of landscape connectivity and conservation for the jaguar, *Panthera onca*. *Biodiversity and Conservation* 143:939-945.
- Ramírez-Albores, J.E. 2007. Birds of four communities of western Jalisco, Mexico. *Revista Mexicana de Biodiversidad* 78:439-457.
- Rands, M.R., W.M. Adams, L. Bennun, S.H. Butchart, A. Clements, D. Coomes, A. Entwistle, I. Hodge, V. Kapos, J.P. Scharlemann, W.J. Sutherland, and B. Vira. 2010. Biodiversity conservation: challenges beyond 2010. *Science* 329:1298-1303.
- Rodríguez-Estrella, R., and B.T. Brown. 1990. Density and habitat use of raptors along the Río Bavispe and Río Yaqui Sonora, Mexico. *Journal Raptor Research* 24:47-51.
- Rorabaugh, J.C., M.A. Gómez-Ramírez, C.E. Gutiérrez-González, J.E. Wallace, and T.R. Van Devender. 2011. Amphibians and reptiles of the Northern Jaguar Reserve and vicinity, Sonora, Mexico: a preliminary evaluation. *Sonoran Herpetologist* 24:123-131.
- Rosas-Rosas, O.C., and R. Valdez. 2010. The role of landowners in jaguar conservation in Sonora, Mexico. *Conservation Biology* 24:366-371.
- Russell, S.M., and G. Monson. 1998. The Birds of Sonora. University of Arizona Press, Tucson.
- Rzedowski, J. 1978. Vegetación de México. Editorial Limusa, Mexico, D.F., Mexico.
- Sanderson, E.W., K.H. Redford, C.L.B. Chetkiewicz, R.A. Medellín, A.R. Rabinowitz, J.G. Robinson, and A.B. Taber. 2002. Planning to save a species: the jaguar as a model. *Conservation Biology* 16:58-72.
- SEMARNAT. 2010. Norma Oficial Mexicana NOM-059-SEMARNAT-2010, Protección ambiental-Especies nativas de México de flora y fauna silvestre-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo. Diario Oficial de la Federación. Cuauhtemoc, CP 06500 Mexico, DF.
- Skagen, S.K., J.F. Kelly, C. Van Riper, R.L. Hutto, D.M. Finch, D.J. Krueper, and C.P. Melcher. 2005. Geography of spring land-bird migration through riparian habitats in southwestern North America. *Condor* 107:212-227.
- Stoleson, S.H., R.S. Felger, G. Ceballos, C. Raish, M.F. Wilson, and A. Búrquez. 2005. Recent history of natural resource use and population growth in northern Mexico. Pp. 52-86 in J.L. Cartron, G. Ceballos, R.S. Felger, eds., *Biodiversity, Ecosystems, and Conservation in Northern Mexico*. Oxford University Press, New York.
- Trejo, I., and R. Dirzo. 2000. Deforestation of seasonally dry tropical forest: a national and local analysis in Mexico. *Biodiversity and Conservation* 94:133-142.
- [USFWS] US Fish and Wildlife Service. 2008. Birds of Conservation Concern 2008. US Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington. Accessed 6 August 2012 <<http://fws.gov/migratorybirds>>.
- Valdez, R., J.C. Guzmán-Aranda, F.J. Abarca, L.A. Tarango-Arámbula, F.C. Sánchez. 2006. Wildlife conservation and management in Mexico. *Wildlife Society Bulletin* 34:270-282.
- Vázquez, L., H. Moya, and M.C. Arizmendi. 2009. Avifauna of the tropical dry forest in the Sabino Canyon, Oaxaca, Mexico. *Revista Mexicana de Biodiversidad* 80:535-549.
- Villaseñor-Gómez, J.F. 2006. Habitat use and the effects of disturbance on wintering birds using riparian habitats in Sonora, Mexico. PhD dissertation, University of Montana, Missoula.
- Villaseñor-Gómez, J.F. 2008. Habitat use of wintering bird communities in Sonora, Mexico: the importance of riparian habitats. *Studies in Avian Biology* 37:53-68.
- Villaseñor-Gómez, J.F., O. Hinojosa-Huerta, E. Gómez-Limón, D. Krueper, and A.D. Flesch. 2010. Avifauna. Pp. 385-420 in F.E. Molina-Freaner and T.R. Van Devender, eds., *The Biological Diversity of Sonora, Mexico*. Universidad Nacional Autónoma de México, Mexico City.
- Warshall, P., and A.D. Flesch. 2013. Bird ecology and conservation on the Northern Jaguar Reserve—recent lessons. Pp. 91-96 in Gottfried, G.J. et al., eds., *Merging Science and Management in a Rapidly Changing World: Biodiversity and Management of the Madrean Archipelago III*. RMRS-P-67, US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

This table is the appendix for: Flesch, A.D., P. Warshall, and S. Jacobs. 2015. Avian richness, status, and conservation in the northwestern Neotropics in Sonora, Mexico. *Natural Areas Journal* 35(2):288-296.

APPENDIX: Status of 214 bird species observed on and around the Northern Jaguar Reserve in east-central Sonora, México, between 2007 and 2013. Abundance was classified as: A-abundant, C-common, F-fairly common, U-uncommon, R-rare, and S-sporadic. Residency status was classified as: PR-permanent resident, SR-summer resident, WR-winter resident, M-migrant, FM-fall migrant, and V-visitant. Breeding status was classified as: Co-confirmed breeder, Pr-presumed breeder, Po-possible breeder, O-nonbreeder, and U-unknown. Species of conservation concern in México (Mx) are listed as E-endangered, T-threatened, and P-subject to special protection (SEMARNAT 2010), whereas those listed in the U.S. by U.S. Fish and Wildlife Service are listed as US-CC (USFWS 2008). Avian nomenclature follows the American Ornithologists' Union.

Common name	Species	Abundance – Status	Breeding Status	Habitat ^a	Conservation status, notes
Greater White-fronted Goose	<i>Anser albifrons</i>	R-M	O	Be, Aq	
American Wigeon	<i>Anas americana</i>	U-WR and M	O	Aq	
Mallard	<i>Anas platyrhynchos</i>	R-PR	Po	Aq	Mx–T, subspecies <i>diazi</i>
Cinnamon Teal	<i>Anas cyanoptera</i>	U-WR and M	O	Aq	
Green-winged Teal	<i>Anas crecca</i>	U-WR and M	O	Aq	
Ring-necked Duck	<i>Aythya collaris</i>	U-WR and M	O	Aq	
Common Merganser	<i>Mergus merganser</i>	U-WR and M	O	Aq	
Elegant Quail	<i>Callipepla douglasii</i>	C-PR	Pr	FT, RW, Fi	
Gambel's Quail	<i>Callipepla gambelii</i>	R-PR	Pr	DS, FT, RW	lowlands
Montezuma Quail	<i>Cyrtonyx montezumae</i>	U-PR	Co	OW, Gr, FT	Mx–P, highlands
Wild Turkey	<i>Meleagris gallopavo</i>	U-PR	Co	OW, FT	
Least Grebe	<i>Tachybaptus dominicus</i>	R-PR	Co	Aq, Be	
Pied-billed Grebe	<i>Podilymbus podiceps</i>	U-WR and M	O	Aq	
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	R-M or V	O	Aq	
Great Blue Heron	<i>Ardea herodias</i>	F-PR	Po	Aq, RW, Be	
Great Egret	<i>Ardea alba</i>	R-PR	Po	Aq, Be	
Green Heron	<i>Butorides virescens</i>	R-WR	O	Aq, Be	
Black Vulture	<i>Coragyps atratus</i>	U-SR, R-WR	Po	FT, OW	
Turkey Vulture	<i>Cathartes aura</i>	C-SR, R-WR	Po	FT, OW	
Osprey	<i>Pandion haliaetus</i>	U-M, R-WR	O	Aq, Be, RW	
Bald Eagle	<i>Haliaeetus leucocephalus</i>	R-PR	Co	Aq, Be, Cl	Mx–E, US–CC
Northern Harrier	<i>Circus cyaneus</i>	R-M	O	DS, Gr	

Common name	Species	Abundance – Status	Breeding Status	Habitat ^a	Conservation status, notes
Sharp-shinned Hawk	<i>Accipiter striatus</i>	U-WR and M	O	FT, RW	Mx-P
Cooper's Hawk	<i>Accipiter cooperii</i>	R-SR, U-M	Po	RW, OW	Mx-P
Common Black-Hawk	<i>Buteogallus anthracinus</i>	F-SR, R-WR	Co	RW, Be	Mx-P, C river
Gray Hawk	<i>Buteo nitidus</i>	U-SR	Co	RW, FT	
Short-tailed Hawk	<i>Buteo brachyurus</i>	R-SR?	U	FT, OW	
Swainson's Hawk	<i>Buteo swainsoni</i>	U-M	O	FT, OW, Gr	Mx-P, US-CC
Zone-tailed Hawk	<i>Buteo albonotatus</i>	R-SR	Co	OW, RW	Mx-P
Red-tailed Hawk	<i>Buteo jamaicensis</i>	U-PR	Co	FT, OW, Cl	
Golden Eagle	<i>Aquila chrysaetos</i>	R-WR?	O	Gr, OW, FT	Mx-T
American Kestrel	<i>Falco sparverius</i>	U-WR and M	O	FT, RW	
Merlin	<i>Falco columbarius</i>	R-WR and M	O	FT, Fi	
Peregrine Falcon	<i>Falco peregrinus</i>	U-PR	Co	FT, Cl, RW	Mx-P, US-CC
Killdeer	<i>Charadrius vociferus</i>	R-SR?	U	Be	
Spotted Sandpiper	<i>Actitis macularius</i>	C-WR and M	O	Be	
Solitary Sandpiper	<i>Tringa solitaria</i>	R-M	O	Be	
Greater Yellowlegs	<i>Tringa melanoleuca</i>	R-WR? and M	O	Be	
Wilson's Snipe	<i>Gallinago delicata</i>	R-WR or V	O	Be	
Band-tailed Pigeon	<i>Patagioenas fasciata</i>	R-WR or V	O	OW	
Eurasian Collared-Dove	<i>Streptopelia decaocto</i>	R-V	O	Ho	
White-winged Dove	<i>Zenaida asiatica</i>	A-SR, U-WR	Co	FT, RW	
Mourning Dove	<i>Zenaida macroura</i>	F-PR	Pr	FT, OW, RW	
Inca Dove	<i>Columbina inca</i>	U-PR	Pr	Ho, RW, Fi	
Common Ground-Dove	<i>Columbina passerina</i>	C-SR, U-WR	Pr	FT, RW, Fi	
Ruddy Ground-Dove	<i>Columbina talpacoti</i>	R-SR or V?	U	Ho, RW, Fi	
White-tipped Dove	<i>Leptotila verreauxi</i>	U-PR	Co	FT, RW	
Military Macaw	<i>Ara militaris</i>	R-SR	Co	FT, Cl	Mx-E
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	F-SR	Pr	FT, RW	US-CC
Greater Roadrunner	<i>Geococcyx californianus</i>	U-PR	Po	FT, DS, RW	
Western Screech-Owl	<i>Megascops kennicottii</i>	U-PR	Pr	FT, RW	lowlands
Whiskered Screech-Owl	<i>Megascops trichopsis</i>	U-PR	Pr	OW, RW	highlands

Common name	Species	Abundance – Status	Breeding Status	Habitat ^a	Conservation status, notes
Great Horned Owl	<i>Bubo virginianus</i>	R-PR	Po	FT, RW	
Northern Pygmy-Owl	<i>Glaucidium gnoma</i>	R-PR	Pr	OW, RW	
Elf Owl	<i>Micrathene whitneyi</i>	U-SR	Po	FT, RW	US-CC
Burrowing Owl	<i>Athene cunicularia</i>	R-M?	O	Fi	
Lesser Nighthawk	<i>Chordeiles acutipennis</i>	R-SR	Po	FT, DS	lowlands
Common Poorwill	<i>Phalaenoptilus nuttallii</i>	R-PR or WR?	O	FT, CI	
Buff-collared Nightjar	<i>Caprimulgus ridgwayi</i>	U-SR, R-WR	Pr	FT, RW, OW	
Black Swift	<i>Cypseloides niger</i>	R-M	O	Ae, CI	US-CC
White-throated Swift	<i>Aeronautes saxatalis</i>	R-SR, R-WR	Po	Ae, CI	
Broad-billed Hummingbird	<i>Cynanthus latirostris</i>	C-SR, U-WR	Co	FT, RW, OW	
White-eared Hummingbird	<i>Hylocharis leucotis</i>	R-WR	O	RW	
Berylline Hummingbird	<i>Amazilia beryllina</i>	R-WR and M	O	RW, FT	
Violet-crowned Hummingbird	<i>Amazilia violiceps</i>	F-SR, R-WR	Co	RW, FT	
Plain-capped Starthroat	<i>Heliomaster constantii</i>	R-M or SR?	U	FT, RW	
Black-chinned Hummingbird	<i>Archilochus alexandri</i>	U-M	O	RW, FT	
Anna's Hummingbird	<i>Calypte anna</i>	U-WR	Po	FT, DS	early breeder
Costa's Hummingbird	<i>Calypte costae</i>	U-WR and M	Pr	DS, FT	US-CC, early breeder
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	U-M	O	FT, RW	
Rufous Hummingbird	<i>Selasphorus rufus</i>	U-M	O	FT, RW	
Allen's Hummingbird	<i>Selasphorus sasin</i>	R-M	O	RW	US-CC
Elegant Trogon	<i>Trogon elegans</i>	F-SR, R-WR	Co	RW, OW	US-CC
Belted Kingfisher	<i>Megaceryle alcyon</i>	U-M, R-WR	O	RW, Be	
Green Kingfisher	<i>Chloroceryle americana</i>	R-PR	Pr	RW, Be	
Acorn Woodpecker	<i>Melanerpes formicivorus</i>	U-PR	Pr	OW	
Gila Woodpecker	<i>Melanerpes uropygialis</i>	C-PR	Co	FT, RW, DS	
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>	R-WR and M	O	RW	
Ladder-backed Woodpecker	<i>Picoides scalaris</i>	C-PR	Co	FT, DS, RW	
Arizona Woodpecker	<i>Picoides arizonae</i>	U-PR	Po	OW	US-CC
Northern Flicker	<i>Colaptes auratus</i>	R-SR, R-WR	Pr	OW	
Gilded Flicker	<i>Colaptes chrysoides</i>	U-PR	Co	FT, DS	

Common name	Species	Abundance – Status	Breeding Status	Habitat ^a	Conservation status, notes
White-striped Woodcreeper	<i>Lepidocolaptes leucogaster</i>	R-PR	Pr	RW	
Northern Beardless-Tyrannulet	<i>Camptostoma imberbe</i>	U-PR	Pr	RW	
Tufted Flycatcher	<i>Mitrephanes phaeocercus</i>	R-WR	O	RW	
Olive-sided Flycatcher	<i>Contopus cooperi</i>	U-M	O	RW, FT	US-CC
Greater Pewee	<i>Contopus pertinax</i>	R-WR	O	RW, FT	
Western Wood-Pewee	<i>Contopus sordidulus</i>	U-SR and M	Pr	RW, FT, OW	
Willow Flycatcher	<i>Empidonax traillii</i>	R-M	O	RW	US-CC
Hammond's Flycatcher	<i>Empidonax hammondii</i>	F-M, U-WR	O	RW, FT	
Gray Flycatcher	<i>Empidonax wrightii</i>	U-M and WR	O	RW	
Dusky Flycatcher	<i>Empidonax oberholseri</i>	F-M, U-WR	O	RW	
Pacific-slope Flycatcher	<i>Empidonax difficilis</i>	R-WR?, C-M	O	RW, OW	
Cordilleran Flycatcher	<i>Empidonax occidentalis</i>	R-WR? and M	O	RW, OW	
Buff-breasted Flycatcher	<i>Empidonax fulvifrons</i>	R-WR	O	RW	
Black Phoebe	<i>Sayornis nigricans</i>	U-PR	Co	RW, Be, Cl	A along rivers
Eastern Phoebe	<i>Sayornis phoebe</i>	R-WR or V	O	RW, Be	
Say's Phoebe	<i>Sayornis saya</i>	U-WR and M	O	Ho, Be	
Vermilion Flycatcher	<i>Pyrocephalus rubinus</i>	C-SR, R-WR	Co	RW, Be	
Dusky-capped Flycatcher	<i>Myiarchus tuberculifer</i>	C-SR, R-WR	Co	FT, OW, RW	
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>	U-PR	Pr	DS, FT, OW	
Nutting's Flycatcher	<i>Myiarchus nuttingi</i>	R-SR, F-WR	Pr	RW, FT	
Brown-crested Flycatcher	<i>Myiarchus tyrannulus</i>	F-SR	Co	RW	
Sulphur-bellied Flycatcher	<i>Myiodynastes luteiventris</i>	F-SR	Co	RW	
Tropical Kingbird	<i>Tyrannus melancholicus</i>	U-SR	Pr	RW, Be	
Cassin's Kingbird	<i>Tyrannus vociferans</i>	U-M, R-WR	O	RW	
Thick-billed Kingbird	<i>Tyrannus crassirostris</i>	F-SR	Co	FT, OW, RW	
Western Kingbird	<i>Tyrannus verticalis</i>	C-M	O	FT	
Rose-throated Becard	<i>Pachyramphus aglaiae</i>	F-SR	Co	RW	
Loggerhead Shrike	<i>Lanius ludovicianus</i>	R-WR and M	O	OW, Gr	US-CC
Bell's Vireo	<i>Vireo bellii</i>	C-SR, R-WR	Co	RW	US-CC
Gray Vireo	<i>Vireo vicinior</i>	R-M	O	RW, FT	US-CC

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Plumbeous Vireo	<i>Vireo plumbeus</i>	R-WR, F-M	O	RW, OW	
Cassin's Vireo	<i>Vireo cassinii</i>	R-WR, U-M	O	RW, OW	
Hutton's Vireo	<i>Vireo huttoni</i>	U-WR and M	O	OW, RW	
Warbling Vireo	<i>Vireo gilvus</i>	C-M	O	RW, OW	
Yellow-green Vireo	<i>Vireo flavoviridis</i>	R-SR	Pr	RW, FT	
Western Scrub-Jay	<i>Aphelocoma californica</i>	R-WR	O	FT, MS	
Mexican Jay	<i>Aphelocoma wollweberi</i>	F-PR	Pr	OW, MS	
Common Raven	<i>Corvus corax</i>	U-PR	Co	RW, FT	
Tree Swallow	<i>Tachycineta bicolor</i>	U-M	O	Ae	
Violet-green Swallow	<i>Tachycineta thalassina</i>	F-M, R-WV	O	Ae	
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	U-SR and M, R-WV	Pr	Ae, Be	
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	U-SR	Po	Ae, Cl	
Barn Swallow	<i>Hirundo rustica</i>	U-M, R-WV	O	Ho, Ae	
Bridled Titmouse	<i>Baeolophus wollweberi</i>	U-PR, S-V	Pr	OW, RW	PR in OW, V in RW
Verdin	<i>Auriparus flaviceps</i>	C-PR	Co	RW, FT	
Cactus Wren	<i>Campylorhynchus brunneicapillus</i>	C-PR	Pr	FT, DS	
Rock Wren	<i>Salpinctes obsoletus</i>	U-PR	Pr	Cl, DS, TS	
Canyon Wren	<i>Catherpes mexicanus</i>	F-PR	Pr	Cl, Ho, RW	
Sinaloa Wren	<i>Thryothorus sinaloa</i>	C-SR, U-WR	Co	RW, FT	
Happy Wren	<i>Thryothorus felix</i>	R-PR	Po	RW, Be	dense thickets
Bewick's Wren	<i>Thryomanes bewickii</i>	R-WR and M	O	RW	
House Wren	<i>Troglodytes aedon</i>	F-WR and M	O	RW, FT	
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	U-SR, F-WR	Co	RW, FT	
Black-tailed Gnatcatcher	<i>Polioptila melanura</i>	U-PR	Pr	OW, MS	
Black-capped Gnatcatcher	<i>Polioptila nigriceps</i>	C-PR	Co	DS	
Ruby-crowned Kinglet	<i>Regulus calendula</i>	C-WR and M	O	FT, RW	
Western Bluebird	<i>Sialia mexicana</i>	S-WV	O	FT, OW	
Brown-backed Solitaire	<i>Myadestes occidentalis</i>	U-WR	O	RW	Mx-P
Swainson's Thrush	<i>Catharus ustulatus</i>	U-M	O	RW	
Hermit Thrush	<i>Catharus guttatus</i>	U-WR and M	O	RW	

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Rufous-backed Robin	<i>Turdus rufopalliatus</i>	R-WR or V	O	RW	
American Robin	<i>Turdus migratorius</i>	R-WR	O	RW, FT	
Northern Mockingbird	<i>Mimus polyglottos</i>	F-PR	Pr	FT, DS	
Curve-billed Thrasher	<i>Toxostoma curvirostre</i>	U-PR	Co	FT, DS	
Blue Mockingbird	<i>Melanotis caerulescens</i>	R-SR	Pr	RW, FT	
American Pipit	<i>Anthus rubescens</i>	R-WR or V	O	Be	
Phainopepla	<i>Phainopepla nitens</i>	F-WR and M, R-SR	Po	RW	
Louisiana Waterthrush	<i>Parkesia motacilla</i>	R-WR and M	O	RW, Be	
Northern Waterthrush	<i>Parkesia noveboracensis</i>	R-M	O	RW, Be	
Black-and-white Warbler	<i>Mniotilta varia</i>	R-M	O	RW, OW	
Orange-crowned Warbler	<i>Oreothlypis celata</i>	U-WR, C-M	O	RW, FT, OW	
Lucy's Warbler	<i>Oreothlypis luciae</i>	C-SR and M	Pr	RW, FT	US-CC, spring breeder
Nashville Warbler	<i>Oreothlypis ruficapilla</i>	C-M	O	RW, FT	
Virginia's Warbler	<i>Oreothlypis virginiae</i>	U-M	O	RW, FT	US-CC
MacGillivray's Warbler	<i>Geothlypis tolmiei</i>	U-M	O	RW, FT, OW	
Common Yellowthroat	<i>Geothlypis trichas</i>	R-WR, U-M	O	RW, Be	
Northern Parula	<i>Setophaga americana</i>	R-M	O	RW	
Yellow Warbler	<i>Setophaga petechia</i>	U-M	O	RW, FT	
Yellow-rumped Warbler	<i>Setophaga coronata</i>	C-WR and M	O	RW, OW, FT	
Grace's Warbler	<i>Setophaga graciae</i>	R-M	O	OW	US-CC
Black-throated Gray Warbler	<i>Setophaga nigrescens</i>	F-WR and M	O	RW, FT, OW	
Townsend's Warbler	<i>Setophaga townsendi</i>	R-WR, U-M	O	RW, FT, OW	
Hermit Warbler	<i>Setophaga occidentalis</i>	U-M	O	RW, FT, OW	
Fan-tailed Warbler	<i>Basileuterus lachrymosa</i>	U-SR	Co	RW, Cl, FT	in wet canyons
Rufous-capped Warbler	<i>Basileuterus rufifrons</i>	F-PR	Co	RW, FT	
Wilson's Warbler	<i>Cardellina pusilla</i>	R-WR, C-M	O	RW, FT, OW	
Painted Redstart	<i>Myioborus pictus</i>	R-WR and M	O	RW	
Slate-throated Redstart	<i>Myioborus miniatus</i>	R-WR	O	RW	
Yellow-breasted Chat	<i>Icteria virens</i>	A-SR	Co	FT, RW	
Green-tailed Towhee	<i>Pipilo chlorurus</i>	U-WR and M	O	FT, RW	

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Spotted Towhee	<i>Pipilo maculatus</i>	R-WR and M	O	OW, MS, FT	
Rusty Sparrow	<i>Aimophila rufescens</i>	R-SR	Co	OW, MS	highlands
Rufous-crowned Sparrow	<i>Aimophila ruficeps</i>	U-PR	Co	OW, Gr, MS	
Canyon Towhee	<i>Melospiza fuscus</i>	C-PR	Co	FT, RW, MS	
Rufous-winged Sparrow	<i>Peucaea carpalis</i>	C-PR	Co	FT, RW	US-CC
Botteri's Sparrow	<i>Peucaea botterii</i>	R-M	O	Gr, OW	
Cassin's Sparrow	<i>Peucaea cassinii</i>	R-SR	Po	Fi, Gr	
Chipping Sparrow	<i>Spizella passerina</i>	C-WR, F-M	O	RW, FT, Gr	
Clay-colored Sparrow	<i>Spizella pallida</i>	R-WR and FM	O	RW, Gr	
Brewer's Sparrow	<i>Spizella breweri</i>	U-WR	O	RW, FT, MS	US-CC
Black-chinned Sparrow	<i>Spizella atrogularis</i>	R-WR	O	FT, MS	US-CC
Vesper Sparrow	<i>Pooecetes gramineus</i>	R-WR	O	Gr, MS, Fi	
Lark Sparrow	<i>Chondestes grammacus</i>	U-WR and M	O	Fi, Gr	
Five-striped Sparrow	<i>Amphispiza quinquestriata</i>	A-SR, R-WR	Co	FT, RW, MS	US-CC
Black-throated Sparrow	<i>Amphispiza bilineata</i>	U-WR	O	DS, FT	
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	R-WR	O	Gr	
Lincoln's Sparrow	<i>Melospiza lincolni</i>	U-WR and M	O	RW, Be, FT	
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	C-WR and M	O	RW, FT	
Dark-eyed Junco	<i>Junco hyemalis</i>	U-WR	O	MS, Gr, OW	
Hepatic Tanager	<i>Piranga flava</i>	U-SR, U-WR	Po	OW, RW	OW in S, RW in W
Summer Tanager	<i>Piranga rubra</i>	C-SR	Co	RW, FT	
Western Tanager	<i>Piranga ludoviciana</i>	F-M	O	RW, FT, OW	
Northern Cardinal	<i>Cardinalis cardinalis</i>	C-PR	Co	FT, RW	
Pyrrhuloxia	<i>Cardinalis sinuatus</i>	U-PR	Pr	DS, FT	
Yellow Grosbeak	<i>Pheucticus chrysopheplus</i>	R-SR or V?	U	FT, RW	
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	C-SR, R-WR	Co	FT, OW, RW	
Blue Grosbeak	<i>Passerina caerulea</i>	C-SR	Co	FT, RW, OW	
Lazuli Bunting	<i>Passerina amoena</i>	C-M, U-WR	O	RW, FT	
Varied Bunting	<i>Passerina versicolor</i>	C-SR	Co	FT, RW	US-CC
Painted Bunting	<i>Passerina ciris</i>	U-FM	O	FT, RW	Mx-P, US-CC

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Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	R-M	O	Be	
Bronzed Cowbird	<i>Molothrus aeneus</i>	U-SR	Co	Ho, Be	
Brown-headed Cowbird	<i>Molothrus ater</i>	U-SR	Co	FT, RW, OW	
Black-vented Oriole	<i>Icterus wagleri</i>	U-SR, R-WR	Co	RW, Pa	
Orchard Oriole	<i>Icterus spurius</i>	R-FM	O	RW, FT	
Hooded Oriole	<i>Icterus cucullatus</i>	A-SR, R-WR	Co	RW, Pa, FT	A in palms
Streak-backed Oriole	<i>Icterus pustulatus</i>	U-SR, R-WR	Co	RW, FT	
Bullock's Oriole	<i>Icterus bullockii</i>	U-M	O	RW, FT	
Scott's Oriole	<i>Icterus parisorum</i>	U-SR, R-WR	Pr	MS, OW	in <i>Yucca</i>
House Finch	<i>Carpodacus mexicanus</i>	C-PR	Co	FT, RW	
Pine Siskin	<i>Spinus pinus</i>	R-M	O	OW, Fi	
Lesser Goldfinch	<i>Spinus psaltria</i>	C-SR, F-WR	Pr	RW, FT, Fi	

^a Habitat types: foothills thornscrub (FT), riparian woodland (RW), oak woodland (OW), grassland (Gr), desert-scrub (DS), mountain scrub (MS), beachfronts and emergent vegetation (Be), aquatic (Aq), palm groves (Pa), cliffs and rocky outcrops (Cl), fields and man-made vegetation openings (Fi), houses or other developed areas (Ho), and aerial (Ae).