Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Monitoring Avian Productivity and Survivorship and Targeted Bird Banding at LCR MSCP Conservation Areas

2016 and 2017

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

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Lower Colorado River Multi-Species Conservation Program Steering Committee Members

Federal Participant Group

Bureau of Reclamation
U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

Arizona Participant Group

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Arizona Game and Fish Department
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QuadState Local Governments Authority
Desert Wildlife Unlimited

California Participant Group

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Coachella Valley Water District
Colorado River Board of California
Bard Water District
Imperial Irrigation District
Los Angeles Department of Water and Power
Palo Verde Irrigation District
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Ducks Unlimited
Lower Colorado River RC&D Area, Inc.
The Nature Conservancy

Lower Colorado River Multi-Species Conservation Program

Monitoring Avian Productivity and Survivorship and Targeted Bird Banding at LCR MSCP Conservation Areas

2016 and 2017

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ACRONYMS AND ABBREVIATIONS

BERS	bird banding station located in the riparian portion of the Beal Lake Conservation Area on the Havasu National Wildlife Refuge between Beal Lake and Topock Marsh
BEVI	Arizona Bell's vireo (*Vireo bellii arizonae*) conservation measure
CIBO	bird banding station located in the Cibola National Wildlife Refuge Unit #1 Conservation Area Nature Trail restoration site
Cibola NWR Unit #1	Cibola National Wildlife Refuge Unit #1 Conservation Area
CM	conservation measure
ha	hectare(s)
LCR	lower Colorado River
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
m	meter(s)
MAPS	Monitoring Avian Productivity and Survivorship
Reclamation	Bureau of Reclamation
SUTA	summer tanager (*Piranga rubra*) conservation measure
USFWS	U.S. Fish and Wildlife Service
YWAR	Sonoran yellow warbler (*Dendroica petechia sonorana* = *Setophaga petechia sonorana*) conservation measure

Symbols

%	percent

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ABSTRACT

Bird banding was conducted using the Monitoring Avian Productivity and Survivorship program's protocol at two stations in Arizona (Beal Lake Conservation Area and Cibola National Wildlife Refuge Unit #1 Conservation Area) during the summer breeding season in 2016 and 2017. Four species covered under the Lower Colorado River Multi-Species Conservation Program were captured and color banded: the Sonoran yellow warbler (*Dendroica petechia sonorana = Setophaga petechia sonorana]*), Arizona Bell's vireo (*Vireo bellii arizonae*), Gila woodpecker (*Melanerpes uropygialis*), and the summer tanager (*Piranga rubra*). Attempts were made to target capture[1] covered species when passive capture[2] was not possible and to resight color-banded birds. A total of 315 birds were captured at both stations in 2016, and 256 birds were captured at both stations in 2017. Twenty-two birds that were covered species were either captured or resighted in 2016, and 11 birds that were covered species were either captured or resighted in 2017 at both stations.

[1] Target captures are birds that are captured using call-playback to draw them into a net placed outside the normal MAPS net locations

[2] Passive captures are captures of birds, during normal Monitoring Avian Productivity and Survivorship operation, in which no inducement (such as call-playback) is used to draw them into a net.

INTRODUCTION

The Lower Colorado River Multi-Species Conservation Program (LCR MSCP) is a multi-stakeholder Federal and non-Federal partnership responding to the need to balance the use of lower Colorado River (LCR) water resources and the conservation of native species and their habitats in compliance with the Endangered Species Act. This is a long-term (50-year) plan to conserve habitat for at least 27 species along the LCR from Lake Mead to the Southerly International Boundary with Mexico.

The Monitoring Avian Productivity and Survivorship (MAPS) program is a cooperative network of bird banding stations operated throughout the United States, Canada, and Mexico. All stations are operated during the summer breeding season with the principal purpose of documenting the use of breeding habitat by birds throughout North America. The data are collected and analyzed by the Institute for Bird Populations, which also establishes a set of guidelines and protocols for all MAPS stations (DeSante et al. 2015). Data from all the stations are compared to one another, and long-term trends for many bird species are monitored on a continent-wide basis.

Riparian areas of the Southwestern United States support a disproportionately high bird diversity and abundance, yet they make up less than 0.5% of all the land area (Powell and Stiedl 2000). Much of this habitat has been altered and decreased due to habitat destruction, agricultural land conversion, urban development, mining, overgrazing, river regulation, and climate change (Powell and Stiedl 2000; U.S. Fish and Wildlife Service [USFWS] 1997). Restoration of riparian habitats is an important part of the process to maintain or increase bird populations in the Southwestern United States. Monitoring of conservation areas is also an important part of understanding the effectiveness of restoration techniques in order to adaptively manage sites.

The Bureau of Reclamation (Reclamation) has operated MAPS summer banding stations since 2000. Previously, three MAPS stations were operated, but operations at the Cibola Valley Conservation Area were discontinued after 2015. Starting in 2016, Reclamation operated two stations: the Beal Lake Conservation Area and Cibola National Wildlife Refuge Unit #1 Conservation Area (Cibola NWR Unit #1).

Throughout this document, LCR MSCP covered species will be referred to by their subspecific name when discussing LCR MSCP conservation measures that call out a subspecies. When the document is referring to captured or detected birds, the subspecific common name will only be used if the bird was identified to subspecies with certainty, either based on its physical characteristics or if the subspecies can be determined by the fact it is breeding at the capture site. In almost all cases, this is not possible for the Bell's vireo (*Vireo bellii*) or yellow warbler (*Setophaga petechia*, previously *Dendroica petechia*).

The overall purposes of the mist netting and bird banding programs are to (1) monitor avian use of the LCR, (2) intensively monitor avian use of LCR MSCP conservation areas, and (3) to analyze avian use by LCR MSCP covered species. Data collected from the bird banding program are used to evaluate demographic characteristics such as survivorship, productivity, and site fidelity of covered species at LCR MSCP conservation areas. The banding program addresses the LCR MSCP conservation measures from the Habitat Conservation Plan (LCR MSCP 2004) for the Sonoran yellow warbler (*Dendroica petechia sonorana* = *Setophaga petechia sonorana*) (Conservation Measure [CM] 5.7.20.2-YWAR1), Arizona Bell's vireo (*Vireo bellii arizonae*) (CM 5.7.19.2-BEVI1), and the summer tanager (*Piranga rubra*) (CM 5.7.21.2-SUTA1). All of these species have been present at both banding sites, and survivorship, productivity, and site fidelity all relate to the breeding success of these species as is mentioned for the yellow warbler: "Created riparian forests will support breeding and migration habitats…." (CM 5.7.20.2-YWAR1). These demographic measures also relate to both the summer tanager and Arizona Bell's vireo conservation measures, which state that created habitat "…will also provide other habitat requirements for this species (e.g., habitat patch size, food requirements)" (CM 5.7.19.2-BEVI1 and CM 5.7.21.2-SUTA1). If birds are surviving and producing young, as well as remaining onsite, it stands to reason that habitat requirements for these species are being provided.

The bird banding programs also directly addresses "Section 5.11.1 System Monitoring" of the Habitat Conservation Plan. On page 5-87 of the plan, it states: "Additionally, productivity and survival for other avian species will be gathered through continued monitoring at two data Monitoring Avian Productivity and Survival (MAPS) stations," and then it further states: "If the appropriate sites are identified and become available for use, it may be feasible to establish one or more additional MAPS stations within the LCR MSCP planning area."

STUDY AREAS

Cibola NWR Unit #1 is located along the LCR south of Blythe, California, in Cibola, Arizona. Established in 1964 to offset wildlife and habitat losses due to channelization of the Colorado River, the refuge attracts more than 250 bird species (USFWS 2015a). One banding station (CIBO) is located in the Cibola National Wildlife Refuge Unit #1 Conservation Area Nature Trail restoration site and has been operating since 2003. It contains three distinct areas separated into a 13.6-acre (5.5-hectare [ha]) mixture of honey mesquite (*Prosopis glandulosa* var. *torreyana*) and screwbean mesquite (*P. pubescens*), 6.4 acres (2.6 ha) of Goodding's willow (*Salix gooddingii*), and 2.5 acres (1 ha) of Fremont cottonwood (*Populus fremontii*) (hereafter cottonwood). A total of 1,500 honey mesquite, 1,500 screwbean mesquite, 10,000 Goodding's willows,

and 2,600 cottonwoods were planted in 1999 (Reclamation 2003). In the years since the site was established, Johnsongrass (*Sorghum halapense*) has encroached as an understory. Baccharis (*Baccharis* spp.) were not planted but are now the dominant species in the shrub layer. The site is actively irrigated and maintained.

The second banding station (BERS) is located in the riparian portion of the Beal Lake Conservation Area on the Havasu National Wildlife Refuge between Beal Lake and Topock Marsh, approximately 5 miles (8 kilometers) northwest of the town of Topock, Arizona. This station has been operating since 2009. The refuge was established in 1941 for the primary purpose of providing migratory bird habitat, and the refuge attracts more than 300 bird species (USFWS 2015b). The site was planted in cells differing in habitat type and/or planting method. It was designed as an experimental demonstration of different planting techniques. Feral pigs have introduced screwbean mesquite, which has spread across most of the site. The site has developed into a heterogeneous mix of honey and screwbean mesquite, cottonwood, Goodding's willow, coyote willow (*S. exigua*) and arrowweed (*Pluchea sericea*) and is 116 acres (47.0 ha) in size (Reclamation 2003, 2010). The site is actively irrigated and managed.

Figure 1 shows the proximate location of each banding site on the LCR.

PERMITS

Banding was conducted under Federal Banding Permit No. 22994, with Joe Kahl, Jr, as the Master Bander and Beth Sabin, Allen Calvert, Barbara Raulston, and Chris Dodge as subpermitees. At least one of the subpermitees was present during any banding effort. Arizona Scientific Collecting Permits (SP740558 and SP505281) were held by Joe Kahl, Jr., with the above-mentioned biologists as agents.

METHODS

All operations of the banding stations were conducted with bird safety as the first priority. If weather conditions, number of captures, or other circumstances were deemed to be unsafe, nets were closed immediately and banding ceased for the day or until conditions improved. Injured birds were cared for and released as soon as possible. All birds were processed in a quick and timely manner to reduce stress caused by handling. Standard protocols for bird extraction and handling as established by Ralph et al. (1993) and DeSante et al. (2015) were followed at all times.

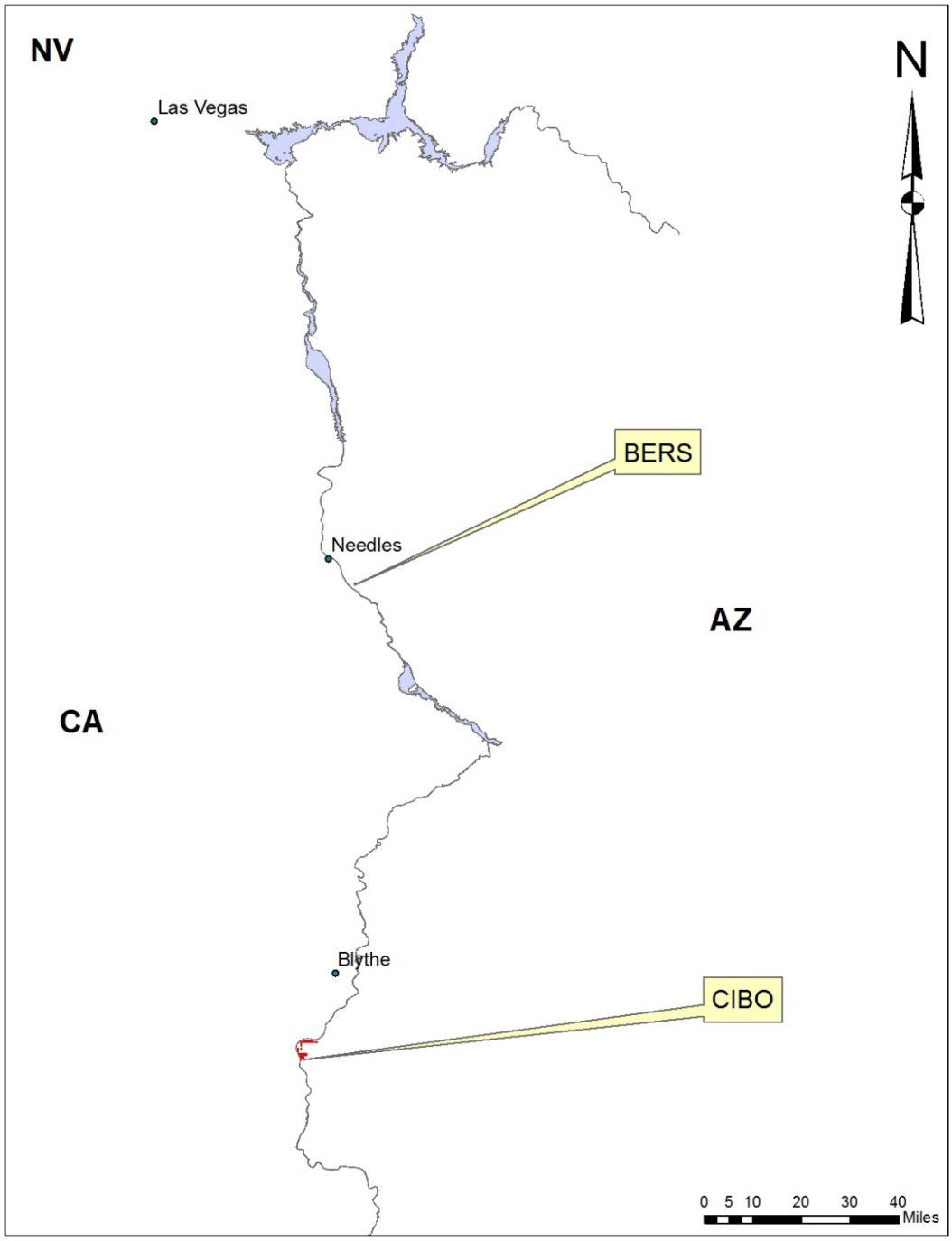

Figure 1.—Location of banding stations on the LCR.

Nets were set up 1/2 hour before sunrise and were open for 5 hours unless conditions, such as wind or temperature, exceeded protocol limits. The nets were checked every 30–50 minutes. Inclement weather (wind, temperature, etc.) often caused one or more sessions to be shortened or cancelled. A metal, numbered USFWS band was placed on the right leg of most captured birds, excluding game species and hummingbirds. Game species were not banded due to restrictions in the permit, and hummingbirds were not banded because they require special equipment, permits, and bands. Starting in 2015, white-winged doves (*Zenaida asiatica*) and mourning doves (*Zenaida macroura*) were banded, despite their status as a game species, per a request from the USFWS. Covered LCR MSCP species that were captured had a colored band placed on the leg opposite the Federal band. Some birds that were color banded had Federal bands placed on the left leg to allow a greater number of band combinations. Identification of species, age, sex, breeding condition, wing cord length, amount of body fat present, and weight were documented prior to releasing each bird. The time, date, and net location from each bird captured were recorded as well as the total hours of net operations. All birds observed at each site during banding operations were also recorded. All data were recorded on standardized data sheets (DeSante et al. 2015). Birds were identified using Pyle (1997), Dunn and Garrett 1997, Beadle and Rising (2002), and Sibley (2016).

The MAPS stations were run once during every 10-day period between the first week of May and the first week of August, for a total of 10 banding periods. The established protocol for MAPS station operations was used at all times (DeSante et al. 2015).

A resident bird is defined as one that is known to breed along the LCR. This determination is made by data summarized in Birds of the Lower Colorado River Valley (Rosenberg et al. 1991) and based on birds that have been captured and have demonstrated indications of breeding (full brood patches or cloacal protuberances). Birds not described as residents are considered to be migrants. Individual bird capture is defined as all unique individuals captured during banding operations. If a bird was recaptured several times, it would only count once toward the individual bird capture total. Passive captures are captures of birds, during normal MAPS operation, in which no inducement (such as call-playback) is used to draw them into a net. Target captures are birds that are captured using call-playback to draw them into a net placed outside the normal MAPS net locations. Unbanded birds are birds that are captured but not banded. Resights are not actual captures but are instead the confirmed resighting of the color band combination on a bird previously captured and color banded. The locations of net lanes at both sites were chosen to be in areas of high avian activity in order to allow for a greater chance of capturing birds.

In order to sample higher in the canopy, one double- or triple-high net was located in the net array at each station. Double or triple nets were used instead of stacking several 2.6-meter (m) tall nets. Nets were 12 m in length. Each section

of these nets that would represent the same height of a normal 2.6-m tall single net was numbered separately (e.g., the lower half of a double net was assigned a number and the upper half a different number, and triple nets were assigned three numbers).

At the CIBO station in 2016, one 12-m double-high, nine 12-m, and two 6-m nets were used. Five 12-m nets were located in the Goodding's willows, four 12-m nets in the cottonwoods, two 6-m nets in the honey and screwbean mesquites, and a double-high net were placed between the mesquite and cottonwood-willow habitats (figure 2). In 2017, the double net was changed to a single net due to increased vegetative growth no longer providing space to place the double net; therefore, there was one less 12-m net of effort used in 2017.

Figure 2.—Location of net lanes at the CIBO station.

At the BERS station, nine 12-m nets, two 6-m nets, and one 12-m double net were used. The nets were located in the center of the site, where irrigation was most frequently applied. The nine 12-m nets were placed in areas originally planted with a cottonwood-willow mix, but these areas are now a mix of cottonwood, Goodding's willow, coyote willow, and honey mesquite. The two 6-m nets were located in an area dominated by honey mesquite (figure 3).

Figure 3.—Location of nets at the BERS station.

Color Banding

During the summer of 2009, a program was initiated to place color band combinations on selected LCR MSCP covered species to allow the birds to be resighted and identified to individual without needing to be recaptured. This effort continued in the summers of 2016 and 2017 at the BERS and CIBO stations. For purposes of this analysis, data from a bird that is resighted can be used in the same way data are used from a bird that has been recaptured in a net. Thus, color banding increases the sample size of covered bird species and supports the main purposes of the banding efforts – to determine demographic characteristics as described in the "Introduction." Color banding also increases the time of the year data can be collected, as birds can be resighted both before and after MAPS operations take place. Color bands were placed on the leg opposite the Federal band. The color bands were either solid colored or bicolored, aluminum bands. Two types of Federal numbered bands were placed on color-banded birds in 2016 – either the normal silver band or a purple anodized band was used. In July 2017, a third electric yellow anodized Federal numbered band was added to increase the number of possible combinations.

Birds that proved difficult to capture through passive means were target captured using call-playback methods to draw them into a net temporarily set up within their territory. A standard protocol was developed by Reclamation biologists for target capturing and resighting of birds (Dodge and Kahl 2013). A standardized data sheet was developed for color banding, resighting of color-banded birds, target captures, and for tracking existing color band combinations (attachment 1).

Surveys were conducted for color-banded birds on an opportunistic basis, and no set schedule was used. Surveys were generally conducted for color-banded birds at least twice a month. Once the first month of banding in May was complete, surveys were conducted more frequently because the location of unbanded birds or birds with unknown band combinations was better known. Color band surveys or target capture attempts were conducted beginning at sunrise until conditions became too hot (usually around 9 a.m.). The color of each band and the leg on which it was placed was recorded for each color-banded bird. The USFWS bands were recorded as being "silver," "purple ano," or "electric yellow" on the data sheets. The age, species, sex, Federal band number, capture method (passive or targeted), date, and time of capture were also recorded. For resighting, the location, color band combination, and the confidence of the observer in the accuracy of the resight were recorded (see attachment 1 for details of observer confidence levels).

Data Entry

All data were recorded while in the field on paper data sheets. Data were then entered and quality checked in MAPSPROG, and then compiled in Excel. Data were sent to the Institute for Breeding Bird Populations and the U.S. Geological Survey Bird Banding Laboratory that supplies the Federal numbered bands. All statistical analyses were completed using program R (v. 3.4.3).

Diversity Analysis

Species diversity was measured for the bird community at each site for each year. An analysis of species diversity was conducted to measure the differences in bird communities among years and sites. It is measured based on three elements: species richness, which is the number of different species captured; species abundance, which is the number of individuals captured for each species; and species evenness, which is a measure of the distribution of the total abundance among species. Traditional diversity indices, such as the Shannon or Simpson Indices, are more sensitive to either species richness or species evenness, and therefore, it was not possible to compare all aspects of diversity with one of these indices. For this reason, diversity was measured using the Renyi diversity profile, which allows all aspects of species diversity to be compared among sites and

years (Tóthmérész 1995). Renyi diversity profiles are presented as a line graph, with each profile represented by a single line on the graph. If one profile is higher at all points on the graph than another, it is said to be more diverse. If two profiles cross at any point, no determination can be made. Multiple sites or years can be compared in this manner within one graph.

The formula used to calculate the Renyi diversity profile is as follows:

$$\boldsymbol{H_\alpha = \frac{\ln(\sum_{i=1}^{s} \rho_i^\alpha)}{1-\alpha}}$$

where:

H_α = the profile value
α = the alpha diversity value, which is shown on the x axis of the profile graph
s = the number of species
i = index of summation
ρ_i = the proportions of each species abundance from the total abundance

Therefore, the proportion that each species makes up of the captures is used to determine the Renyi profile as opposed to a rate of capture based on capture effort.

The shape of each profile represents the evenness of each site or year. A horizontal profile indicates that all species are equal in abundance (maximum evenness) (Kindt and Coe 2005). The farther from horizontal the slope of the profile is, the less evenness there is among species. The horizontal axis of the graph is the scaling factor (α) that represents increasing sensitivity to rare versus abundant species for the diversity value at each point. Therefore, point "0" on the horizontal axis represents species richness since there is no sensitivity to rare or abundant species. The point represented by the infinity symbol at the other end of the horizontal axis represents the proportion of the most abundant species. In between, point 1 represents the Shannon Index, which is more sensitive to species richness, and point 2 represents the logarithm of the reciprocal of the Simpson Index, which is more sensitive to species evenness. All other points represent a gradient between these values.

RESULTS

Following are the results from the 2016 and 2017 MAPS summer seasons. For a complete list of all species captured and their corresponding scientific name, see tables 1, 2, and 3.

In 2016 at the CIBO station, 179 individual birds were captured of which 133 were resident birds. There were 164 new captures, 19 recaptures, and 21 unbanded birds. The per-net-hour capture rate was 0.37 for all birds and 0.28 for resident birds. Table 1 shows all the species captured and the number of individual captures per species in 2016. Figure 4 shows the relative percentage of resident birds passively captured at the CIBO station in 2016.

Table 1.—Species captured at the CIBO station in 2016

Common name	Scientific name	Individuals captured
Abert's towhee	*Melozone aberti*	9
Anna's hummingbird	*Calypte anna*	2
Ash-throated flycatcher	*Myiarchus cinerascens*	23
Black-chinned hummingbird	*Archilochus alexandri*	6
Brown-headed cowbird	*Molothrus ater*	4
Black-headed grosbeak	*Pheucticus melanocephalus*	2
Blue grosbeak	*Passerina caerulea*	3
Black phoebe	*Sayornis nigricans*	1
Black-tailed gnatcatcher	*Polioptila melanura*	1
Bullock's oriole	*Icterus bullockii*	7
Hammond's flycatcher	*Empidonax hammondii*	1
House finch	*Haemorhous mexicanus*	11
Indigo bunting	*Passerina cyanea*	1
Lazuli bunting	*Passerina amoena*	3
Ladder-backed woodpecker	*Dryobates scalaris*	5
Lesser goldfinch	*Spinus saltria*	1
Lucy's warbler	*Oreothlypis luciae*	41
Macgillvray's warbler	*Geothlypis tolmiei*	3
Mourning dove	*Zenaida macroura*	3
Orange-crowned warbler	*Vermivora celata*	1
Red-winged blackbird	*Agelaius phoeniceus*	2
Swainson's thrush	*Catharus ustulatus*	8
Verdin	*Auriparus flaviceps*	3
Warbling vireo	*Vireo gilvus*	3
Western flycatcher	*Empidonax difficilis/occidentalis*	11
Western kingbird	*Tyrannus verticalis*	1
Western tanager	*Piranga ludoviciana*	5
Western wood pee-wee	*Contopus sordidulus*	1
Willow flycatcher	*Empidonax traillii*	1
Wilson's warbler	*Cardellina pusilla*	7
White-winged dove	*Zenaida asiatica*	2
Yellow-breasted chat	*Icteria virens*	4
Yellow warbler	*Setophaga petechia*	3
	Total	**179**

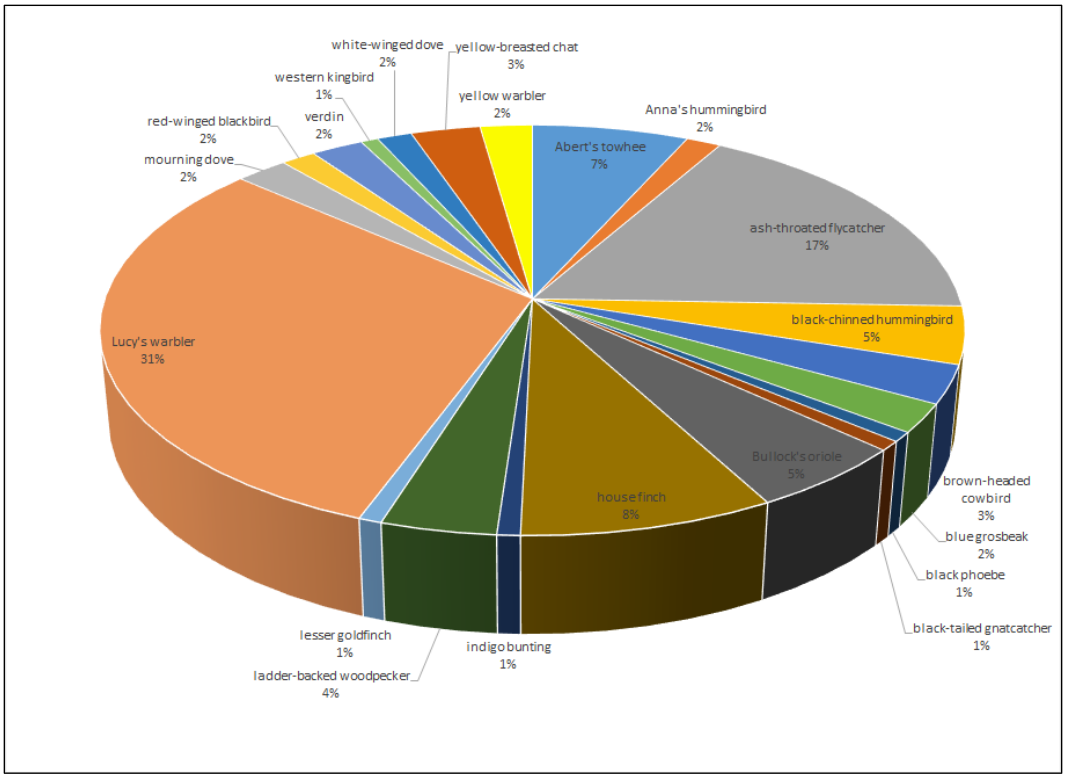

Figure 4.—Chart of the relative percentage of each resident species captured at the CIBO station in 2016.

In 2017 at the CIBO station, 139 individual birds were captured of which 106 were resident birds. There were 117 new captures, 14 recaptures, and 15 unbanded birds. The per-net-hour capture rate was 0.29 for all birds and 0.22 for resident birds. Table 2 shows all the species captured and the number of individual captures per species in 2017. Figure 5 shows the relative percentage of resident birds passively captured at the CIBO station in 2017.

Table 2.—Species captured at the CIBO station in 2017

Common name	Scientific name	Individual captures
Abert's towhee	*Melozone aberti*	12
Anna's hummingbird	*Calypte anna*	1
Ash-throated flycatcher	*Myiarchus cinerascens*	12
Black-chinned hummingbird	*Archilochus alexandri*	8
Brown-headed cowbird	*Molothrus ater*	7
Black-headed grosbeak	*Pheucticus melanocephalus*	2
Blue grosbeak	*Passerina caerulea*	3
Black phoebe	*Sayornis nigricans*	2
Black-tailed gnatcatcher	*Polioptila melanura*	1
Bullock's oriole	*Icterus bullockii*	2
Common ground-dove	*Columbina passerina*	1
Common yellowthroat	*Geothlypis trichas*	3
Crissal thrasher	*Toxostoma crissale*	4
Dusky flycatcher	*Empidonax oberholseri*	1
Gila woodpecker	*Melanerpes uropygialis*	2
House finch	*Haemorhous mexicanus*	10
House wren	*Troglodytes aedon*	1
Lazuli bunting	*Passerina amoena*	1
Ladder-backed woodpecker	*Dryobates scalaris*	3
Lesser goldfinch	*Spinus saltria*	1
Lucy's warbler	*Oreothlypis luciae*	15
Macgillivray's warbler	*Geothlypis tolmiei*	1
Mourning dove	*Zenaida macroura*	6
Pacific-slope flycatcher	*Empidonax difficilis*	1
Swainson's thrush	*Catharus ustulatus*	1
Verdin	*Auriparus flaviceps*	6
White-crowned sparrow	*Zonotrichia leucophrys*	1
Western flycatcher	*Empidonax difficilis/occidentalis*	14
Western tanager	*Piranga ludoviciana*	5
Willow flycatcher	*Empidonax traillii*	1
Wilson's warbler	*Cardellina pusilla*	5
White-winged dove	*Zenaida asiatica*	3
Yellow-breasted chat	*Icteria virens*	2
Yellow warbler	*Setophaga petechia*	1
	Total	**139**

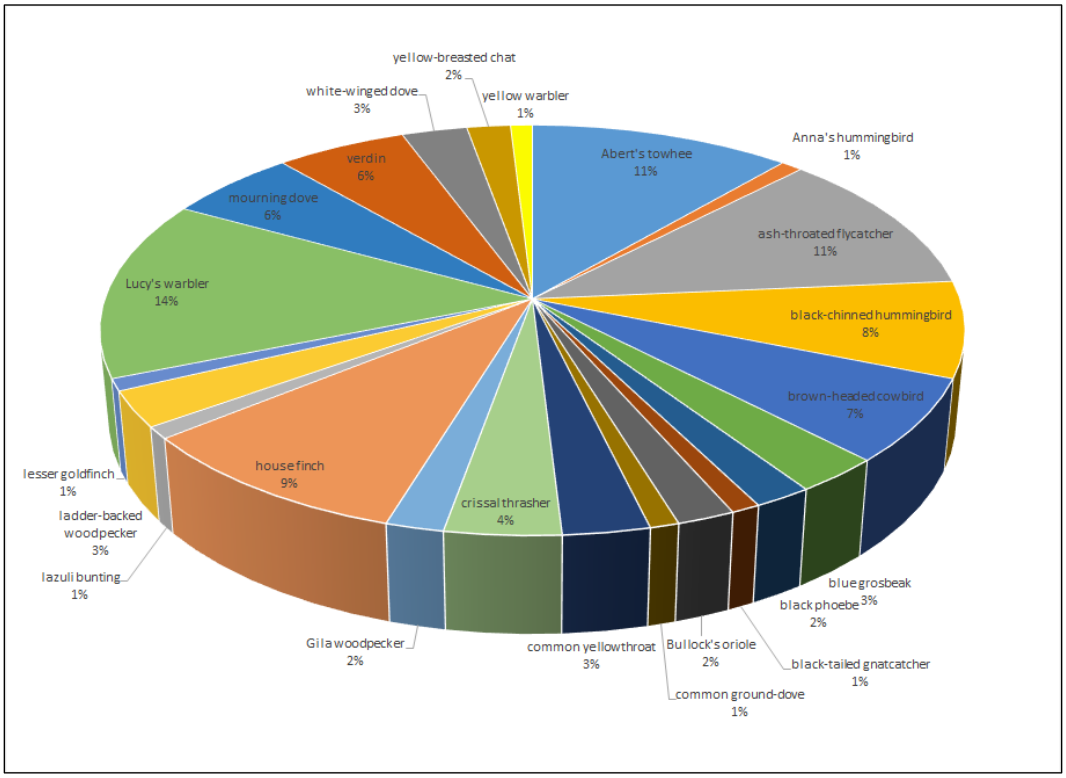

Figure 5.—Chart of the relative percentage of each resident species captured at the CIBO station in 2017.

In 2016 at the BERS station, 121 individual birds were captured of which 95 were resident birds. There were 115 new captures, 13 recaptures, and 9 unbanded birds. The per-net-hour capture rate was 0.24 for all birds and 0.19 for resident birds. Table 3 shows all the species captured and the number of individual captures per species in 2016. Figure 6 shows the relative percentage of resident birds passively captured at the BERS station in 2016.

Table 3.—Species captured at the BERS station in 2016

Common name	Scientific name	Individual captures
Abert's towhee	*Melozone aberti*	11
Ash-throated flycatcher	*Myiarchus cinerascens*	8
Brown-crested flycatcher	*Myiarchus tyrannulus*	1
Black-chinned hummingbird	*Archilochus alexandri*	1
Bell's vireo	*Vireo bellii*	1
Bewick's wren	*Thryomanes bewickii*	2
Bullock's oriole	*Icterus bullockii*	17
Common yellowthroat	*Geothlypis trichas*	6
Crissal thrasher	*Toxostoma crissale*	1
Greater roadrunner	*Geococcyx californianus*	1
Great-tailed grackle	*Quiscalus mexicanus*	3
Lucy's warbler	*Oreothlypis luciae*	11
Macgillvray's warbler	*Geothlypis tolmiei*	3
Mourning dove	*Zenaida macroura*	1
Pacific-slope flycatcher	*Empidonax difficilis*	1
Red-winged blackbird	*Agelaius phoeniceus*	1
Summer tanager	*Piranga rubra*	7
Swainson's thrush	*Catharus ustulatus*	2
Verdin	*Auriparus flaviceps*	2
Western flycatcher	*Empidonax difficilis/occidentalis*	8
Western tanager	*Piranga ludoviciana*	4
Worm-eating warbler	*Helmitheros vermivorum*	1
Wilson's warbler	*Cardellina pusilla*	7
White-winged dove	*Zenaida asiatica*	2
Yellow-breasted chat	*Icteria virens*	15
Yellow warbler	*Setophaga petechia*	4
	Total	**121**

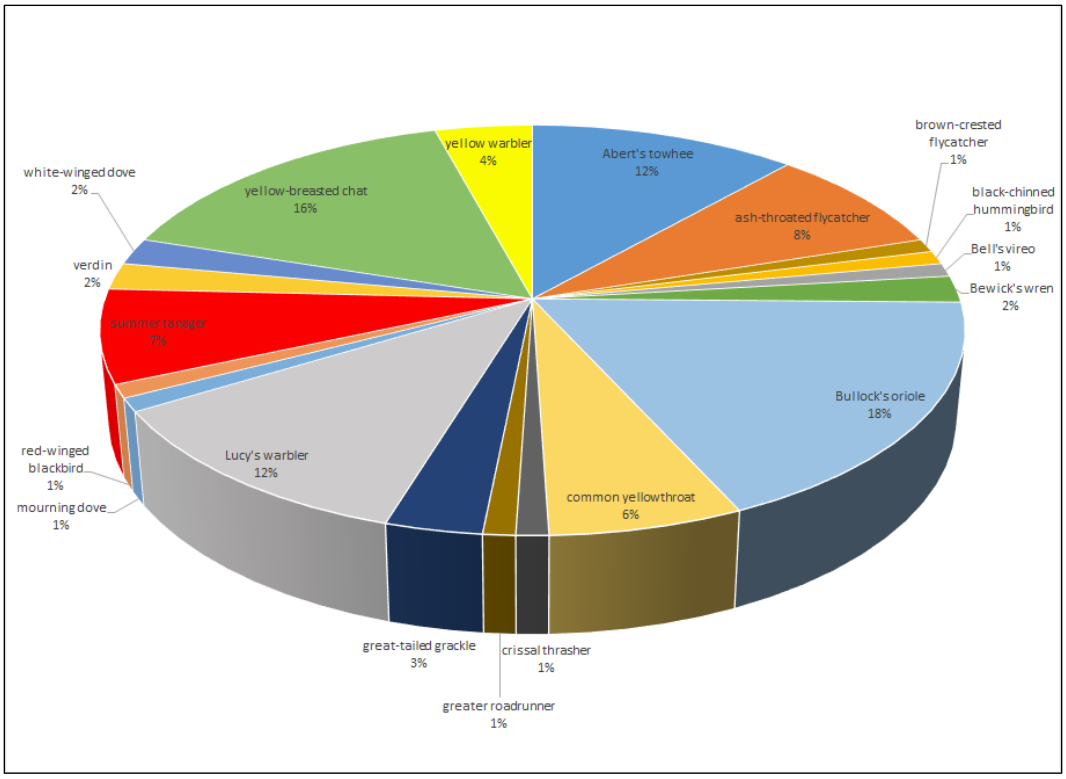

Figure 6.—Chart of the relative percentage of each resident species captured at the BERS station in 2016.

In 2017 at the BERS station, 137 individual birds were captured of which 108 were resident birds. There were 121 new captures, 16 recaptures, and 14 unbanded birds. The per-net-hour capture rate was 0.25 for all birds and 0.12 for resident birds. Table 4 shows all the species captured and the number of individual captures per species in 2017. Figure 7 shows the relative percentage of resident birds passively captured at the BERS station in 2017.

Table 4.—Species captured at the BERS station in 2017

Common name	Scientific name	Individual captures
Abert's towhee	*Melozone aberti*	4
Anna's hummingbird	*Calypte anna*	1
Ash-throated flycatcher	*Myiarchus cinerascens*	9
Black-chinned hummingbird	*Archilochus alexandri*	2
Bell's vireo	*Vireo bellii*	1
Bewick's wren	*Thryomanes bewickii*	3
Brown-headed cowbird	*Molothrus ater*	1
Blue grosbeak	*Passerina caerulea*	4
Black-tailed gnatcatcher	*Polioptila melanura*	1
Bullock's oriole	*Icterus bullockii*	18
Common yellowthroat	*Geothlypis trichas*	13
Crissal thrasher	*Toxostoma crissale*	1
Gila woodpecker	*Melanerpes uropygialis*	1
House finch	*Haemorhous mexicanus*	4
Ladder-backed woodpecker	*Dryobates scalaris*	3
Lucy's warbler	*Oreothlypis luciae*	15
Macgillivray's warbler	*Geothlypis tolmiei*	4
Mourning dove	*Zenaida macroura*	1
Nashville warbler	*Leiothlypis ruficapilla*	1
Northern mockingbird	*Mimus polyglottos*	1
Pacific-slope flycatcher	*Empidonax difficilis*	1
Red-winged blackbird	*Agelaius phoeniceus*	1
Song sparrow	*Melospiza melodia*	5
Summer tanager	*Piranga rubra*	3
Verdin	*Auriparus flaviceps*	2
Warbling vireo	*Vireo gilvus*	2
Western flycatcher	*Empidonax difficilis/occidentalis*	5
Western tanager	*Piranga ludoviciana*	5
Wilson's warbler	*Cardellina pusilla*	11
Yellow-breasted chat	*Icteria virens*	11
Yellow warbler	*Setophaga petechia*	3
	Total	**137**

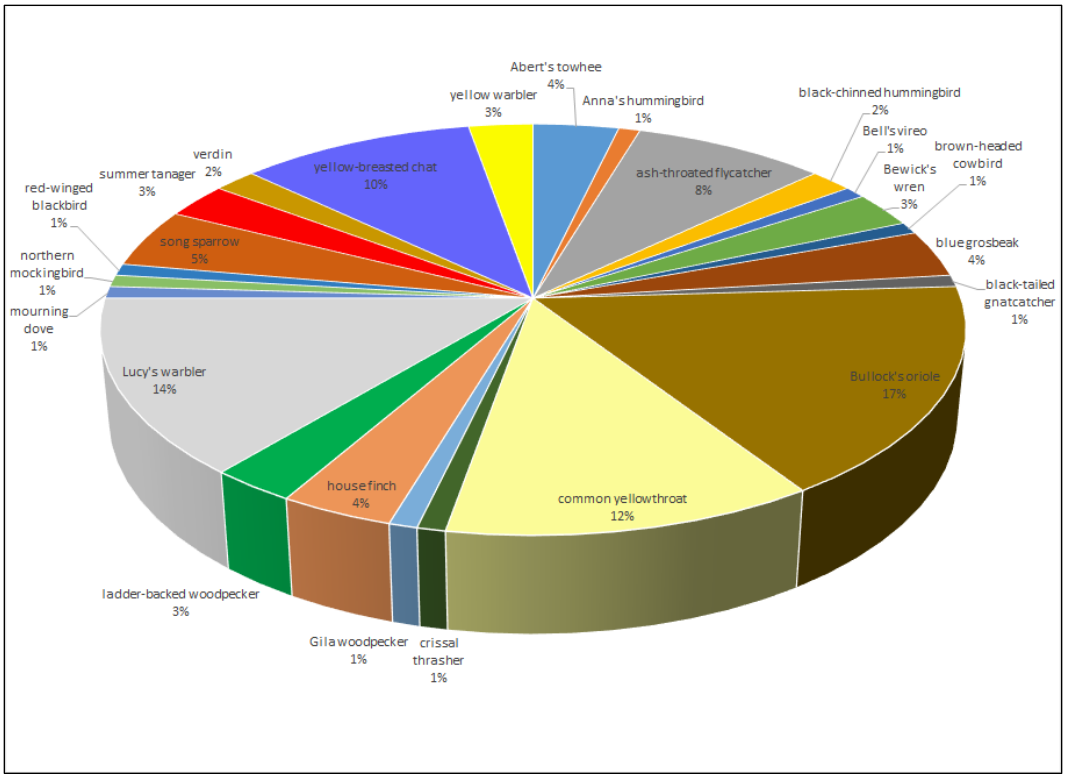

Figure 7.—Chart of the relative percentage of each resident species captured at the BERS station in 2017.

Capture Rate

As discussed in the "Methods" section, the per-net-hour capture rate allows equal comparisons among stations, as it takes into account the different levels of effort that are conducted at each station that may change due to inclement weather or other reasons. Data were compiled for each year since 2013. Figure 8 shows the total capture rates for resident birds for each year banding has been conducted at each station. Figures 9 and 10 show the relative percentage of captures that occurred in each year, for each species, for the last 5 years at the CIBO and BERS stations.

At the CIBO station, the capture rate from resident bird data was compared for the last 5 years. Figure 9 shows the relative percentage of resident bird passive captures that occurred in each year, for each species, at the CIBO station.

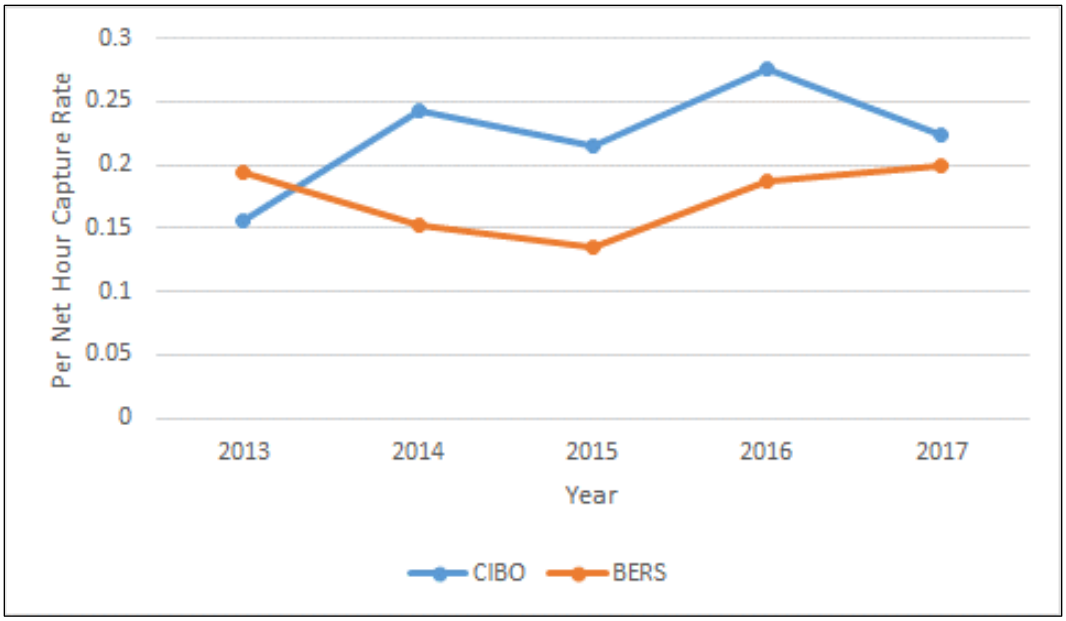

Figure 8.—Annual overall capture rate (birds per net-hour) for resident species per year.

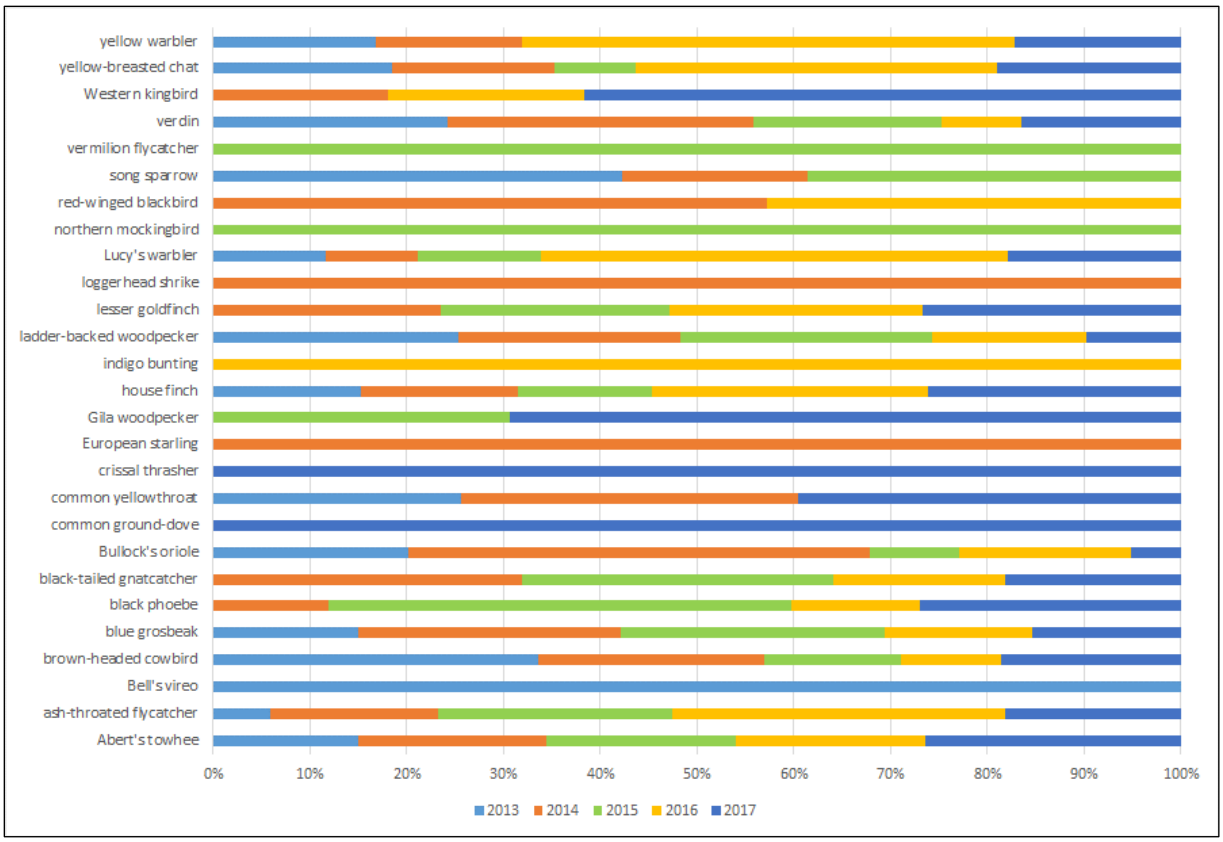

Figure 9.—Relative percentages of all passive captures of resident birds that have occurred in each year, by species, at the CIBO station.

At the BERS station, the capture rate from resident bird data was compared for the last 5 years. Figure 10 shows the relative percentage of resident bird passive captures that occurred in each year, for each species, at the BERS station.

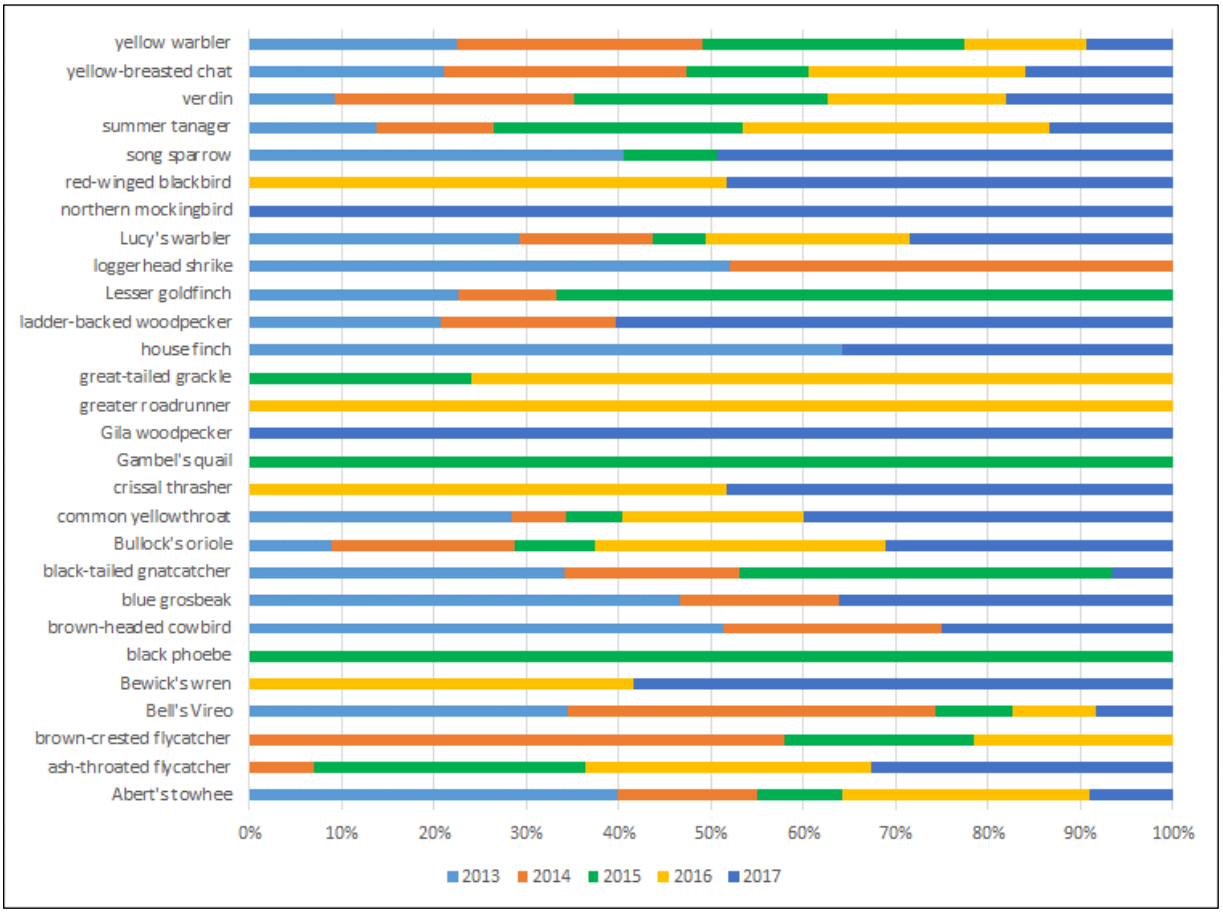

Figure 10.—Relative percentages of all passive captures of resident birds that have occurred in each year, by species, at the BERS station.

Diversity Analysis

A Renyi diversity profile analysis was conducted for each station, separately comparing each year since 2011. A Renyi diversity profile analysis was also conducted between each site for 2016 and 2017 (see figure 13).

At the CIBO station, there were no differences in diversity among the 7 years. Figure 11 shows the Renyi diversity profile graph for the CIBO station.

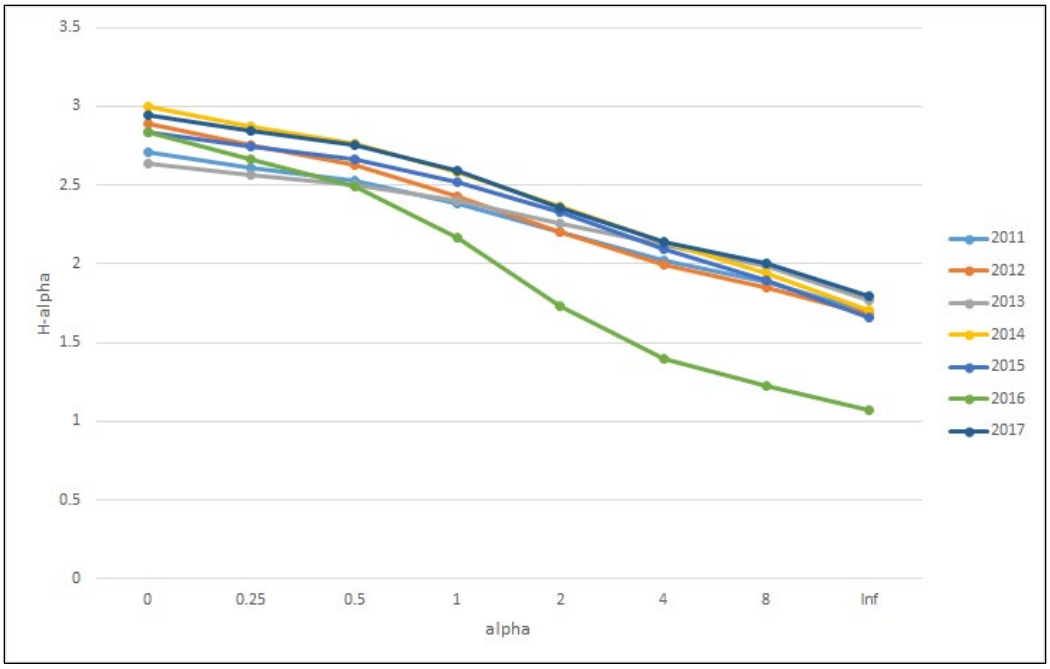

Figure 11.—Renyi diversity profile for the CIBO station.

At the BERS station, diversity was lower in 2011 as compared to all other years, except 2016. There were no differences in diversity among the subsequent years. Figure 12 shows the Renyi diversity profile graph for the BERS station.

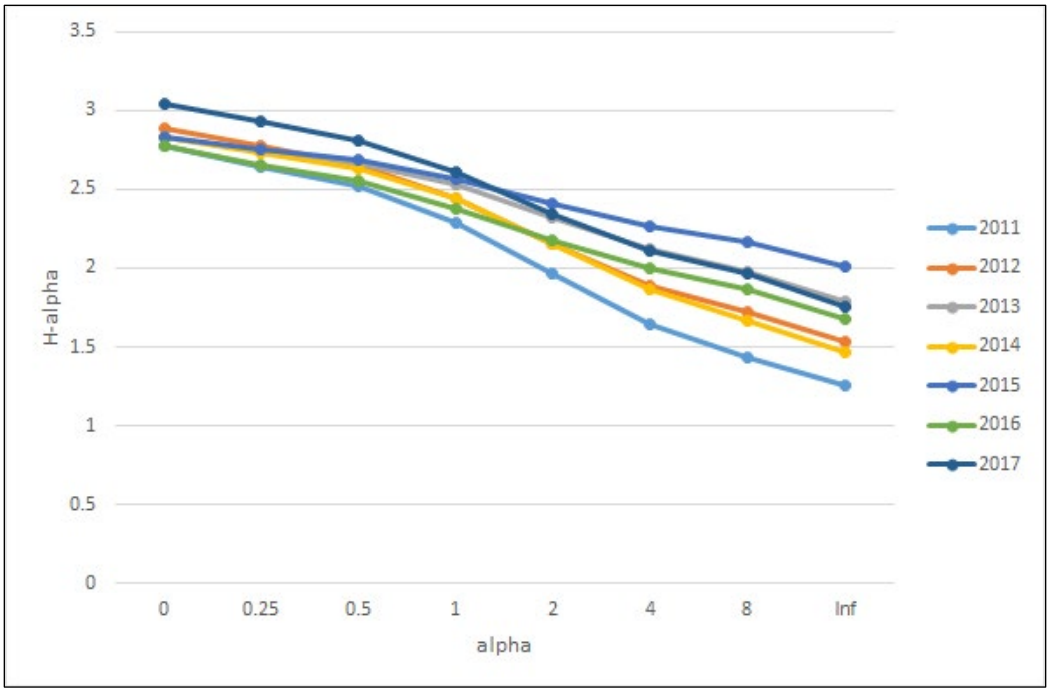

Figure 12.—Renyi diversity profile for the BERS station.

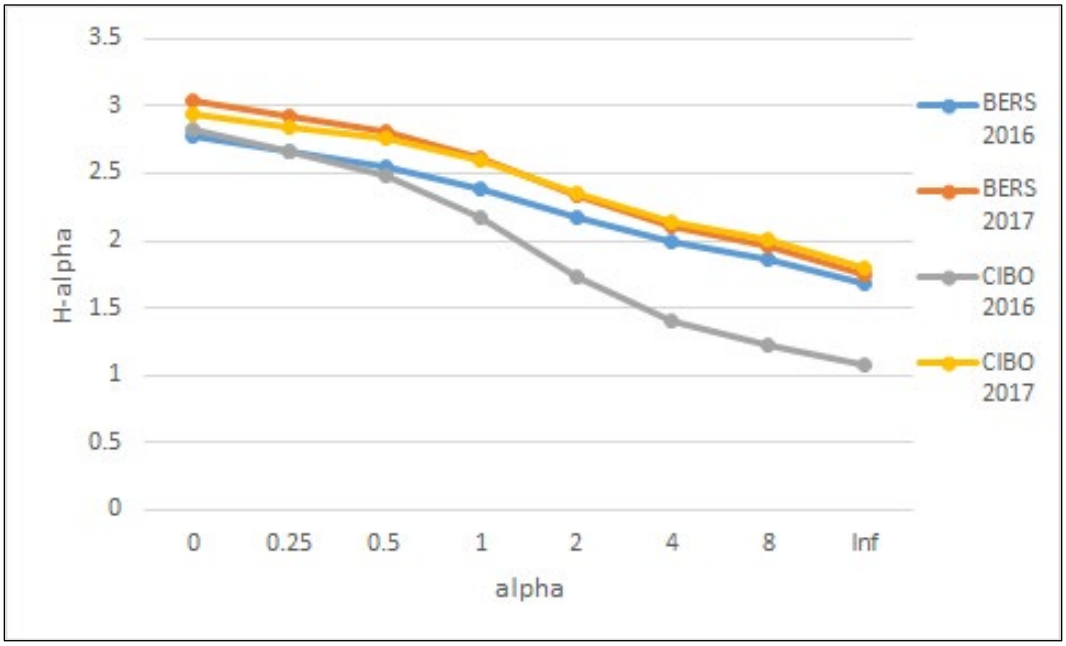

Figure 13.—Renyi diversity profile for the CIBO and BERS stations, 2016–17.

Color Banding and Covered LCR MSCP Species

Tables 5 and 6 summarize all the captures and resights of LCR MSCP covered species for 2016 and 2017, respectively. The "Total passive" category represents all captures that were passive and not targeted. The "Unique passive" category is all unique individuals (no recaptures of the same bird included). The "Total target" category represents all targeted captures. The "Unique target" category represents all unique individuals target captured. The "Recapture" category represents all recaptures. The "Total resights" category represents a total of all resightings, including separate resightings of the same bird. The "Unique resights" category represents unique individual birds resighted. Finally, the "Total birds" category is the true total of all unique individual birds that were captured or resighted by all methods combined.

Table 5.—Color banding and resight summary for 2016

Species	Site	Total passive	Unique passive	Total target	Unique target	Recapture	Total resights	Unique resights	Total birds
Bell's vireo	BERS	1	1	1	1	0	2	1	3
Summer tanager	BERS	7	7	0	0	0	4	3	10
Yellow warbler	BERS	7	4	0	0	5	2	1	5
Vermilion flycatcher	CIBO	0	0	0	0	0	1	1	1
Yellow warbler	CIBO	3	3	0	0	0	0	0	3

Table 6.—Color banding and resight summary for 2017

Species	Site	Total passive	Unique passive	Total target	Unique target	Recapture	Total resights	Unique resights	Total birds
Bell's vireo	BERS	1	1	0	0	0	1	1	2
Gila woodpecker	BERS	1	1	0	0	0	0	0	1
Summer tanager	BERS	3	3	0	0	3	0	0	3
Yellow warbler	BERS	0	0	0	0	2	0	0	2
Gila woodpecker	CIBO	2	2	0	0	0	0	0	2
Yellow warbler	CIBO	1	1	0	0	0	0	0	1

DISCUSSION

Both the sites where MAPS banding was conducted in 2016 and 2017 have been experiencing successional changes in vegetation, and this may affect the capture results. There has also been some die-off of mesquite at both sites. Screwbean mesquite have been dying along the entire LCR, possibly due to disease (Lin Piest 2017, personal communication) but nothing has been published to date to verify this. There has also been a range wide decline of screwbean mesquite in the Southwestern United States (Foldi 2014). It is important to note that most of the mesquites do remain at both sites and there is still plenty of mesquite habitat available for birds breeding at the sites.

At other areas of the BERS site the cottonwoods and willows have grown to the point that they have come together to create a denser upper canopy layer. The BERS site has seen areas of understory die-off because of shading by the upper story canopy. At the CIBO site there has been some signs of stress in the willows found in the north end of the site where nets 1, 2, 4, and 6 are located. The cause of this stress has not been determined.

The captures of song sparrows (*Melospiza melodia*) may illustrate the changes in the mesquite habitat at the BERS site. In native vegetation, song sparrows use earlier successional habitat, such as dense shrubs, and tend to move out when habitats grow beyond the early successional stages (Rosenberg et al. 1991; Corman and Wise-Gervais 2005). In 2009 there were 22 captures of song sparrows, and in 2010 there were 14 captures of song sparrows. From 2011 to 2015 there were six captures of song sparrow (Dodge and Kahl 2015, 2017) and none in 2016. In 2017 there were seven captures of song sparrows, which may be due to the opening of habitats bringing in new understory growth, especially where the mesquites have been reduced. It is also interesting that diversity was higher in 2017 than in 2016 at the BERS site (see figure 13).

LCR MSCP covered species continued to be captured in 2016 and 2017, but with lower capture rates in 2017. The area covered by the MAPS station at BERS was

not surveyed by the LCR MSCP general bird surveys, so results for 2017 cannot be compared (SWCA Environmental Consultants 2018). Part of the reason for the lower capture rates in 2017 may be due to the changing habitat conditions where some of the nets are placed. Nets 10 and 11 are placed in areas where much of the cover that was provided by mesquites is no longer present; these nets will be moved for the 2018 MAPS station.

Most of these changes at the sites are likely part of the process of continuous and dynamic change that occurs naturally on rivers in the Southwestern United States (Palmquist et al. 2018; Sankey et al. 2015; Turner and Karpiscak 1980). LCR MSCP conservation areas will likely be in a constant state of slow change over the years, and both of the banding sites have shown this. This could mean that a final successional stage or a steady state that remains relatively unchanged will not be reached. Bird abundance and species diversity should be expected to change along with the changes in vegetation. In some cases, a reduction in trees, such as was seen at the BERS site, can even be followed by an increase in bird diversity. Whether this increase was a direct result of the decrease in mesquites cannot be proven, but it can be shown that bird diversity showed no signs of adverse effects after the reduction of mesquites.

It is important to evaluate these sites over several years and avoid evaluations based on just 1 year of data. As the MAP results have shown, the bird diversity and the abundance of LCR MSCP covered species will change from year to year. Data from a single year, however, will not necessarily indicate a true change in the population of LCR MSCP covered species at the conservation areas.

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ATTACHMENT 1

Sample Data Sheets for Color Banding

Color Band Resight Data Sheet

Date:_____ **Observer(s):_____**

Wind:_____ **Temp:_____**

Site:_____

Resight #1

Species:_____ **Sex:_____**

Left Color:_____ **Right Color:_____**

Confidence Level:_____ **UTM:_____**

Notes:_____

_____

Resight #2

Species:_____ **Sex:_____**

Left Color:_____ **Right Color:_____**

Confidence Level:_____ **UTM:_____**

Notes:_____

_____

Confidence Level Codes:

A = 100% confidence. Both legs were resighted, and the color of each band was accurately identified twice. A bird was resighted, the combination was recorded, and the bird was resighted a second time. This category also applies to birds passively recaptured without any call-playback.

B = 100% confidence having resighted the full band combination only once in a visit.

C = 95–99% confidence in the resight and one or more resights in a visit.

N = 95% or lower confidence level or a bird that was resighted with a color band, but the color was not confidently identified.

P = Resight or capture using call-playback. The bird may be from another territory and cannot be reliably confirmed to be within a territory.

Target Netting Capture Attempt Data Sheet

Date_____ **Bander(s)_____**

1. Start Time (net placed)_____ End Time_____

Net Location (UTM) _____

Call Start Time_____ Call End Time_____

Notes: _____

_____

_____

_____

2. Start Time (net placed)_____ End Time_____

Net Location (UTM) _____

Call Start Time_____ Call End Time_____

Notes: _____

_____

_____

_____

Color Banding Data Sheet

Band number	Species	Size	Sex	Age	Left color	Right color	Capture type[1]	Date	Site