



Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Report of MAPS and Targeted Bird Banding at LCR MSCP Restoration Sites in 2013



September 2015

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

Arizona Department of Water Resources
Arizona Electric Power Cooperative, Inc.
Arizona Game and Fish Department
Arizona Power Authority
Central Arizona Water Conservation District
Cibola Valley Irrigation and Drainage District
City of Bullhead City
City of Lake Havasu City
City of Mesa
City of Somerton
City of Yuma
Electrical District No. 3, Pinal County, Arizona
Golden Shores Water Conservation District
Mohave County Water Authority
Mohave Valley Irrigation and Drainage District
Mohave Water Conservation District
North Gila Valley Irrigation and Drainage District
Town of Fredonia
Town of Thatcher
Town of Wickenburg
Salt River Project Agricultural Improvement and Power District
Unit "B" Irrigation and Drainage District
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users' Association
Yuma Irrigation District
Yuma Mesa Irrigation and Drainage District

Other Interested Parties Participant Group

QuadState Local Governments Authority
Desert Wildlife Unlimited

California Participant Group

California Department of Fish and Wildlife
City of Needles
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
San Diego County Water Authority
Southern California Edison Company
Southern California Public Power Authority
The Metropolitan Water District of Southern California

Nevada Participant Group

Colorado River Commission of Nevada
Nevada Department of Wildlife
Southern Nevada Water Authority
Colorado River Commission Power Users
Basic Water Company

Native American Participant Group

Hualapai Tribe
Colorado River Indian Tribes
Chemehuevi Indian Tribe

Conservation Participant Group

Ducks Unlimited
Lower Colorado River RC&D Area, Inc.
The Nature Conservancy



Lower Colorado River Multi-Species Conservation Program

Report of MAPS and Targeted Bird Banding at LCR MSCP Restoration Sites in 2013

Prepared by:

Chris Dodge and Joe Kahl, LC-8200

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
<http://www.lcrmscp.gov>

September 2015

Dodge, C. and J. Kahl. 2015. Report of MAPS and Targeted Bird Banding at LCR MSCP Restoration Sites in 2013. Lower Colorado River Multi-Species Conservation Program, Bureau of Reclamation, Boulder City, Nevada.

ACRONYMS AND ABBREVIATIONS

| | |
|-------------|---|
| BERS | Beal Conservation Area |
| CIBO | Cibola Nature Trail restoration site |
| CNWR | Cibola National Wildlife Refuge |
| CVCA | Cibola Valley Conservation Area |
| 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 |
| USFWS | U.S. Fish and Wildlife Service |

Symbols

| | |
|---|---------|
| % | percent |
|---|---------|

CONTENTS

| | Page |
|---|------|
| Abstract..... | iii |
| Introduction..... | 1 |
| Study Areas..... | 2 |
| Permits..... | 3 |
| Methods..... | 3 |
| Color Banding..... | 7 |
| Data Analysis..... | 8 |
| Survivorship (Annual Return Rate)..... | 8 |
| Capture Rate..... | 8 |
| Diversity Analysis..... | 9 |
| Results..... | 10 |
| Capture Rate..... | 16 |
| Diversity Analysis..... | 21 |
| Survivorship and Annual Return Rate..... | 24 |
| Color Banding and Covered LCR MSCP Species..... | 25 |
| Discussion..... | 26 |
| Literature Cited..... | 29 |

Tables

| Table | | Page |
|-------|--|------|
| 1 | All species captured and the number of individual captures per species at the CIBO site in 2013..... | 11 |
| 2 | All species captured and the number of individual captures per species at the BERS site in 2013..... | 13 |
| 3 | Species captured and the number of captures per species at the CVCA site in 2013..... | 15 |
| 4 | Annual return rate for all birds captured and re-sighted at the BERS site..... | 25 |
| 5 | Annual return rate for all birds captured and re-sighted at the CIBO site..... | 25 |
| 6 | Annual return rate for all birds captured and re-sighted at the CVCA site..... | 25 |
| 7 | Color banding and re-sight summary..... | 26 |

Figures

| Figure | | Page |
|--------|---|------|
| 1 | Location of banding stations on the LCR..... | 4 |
| 2 | The CIBO banding site with net lanes. | 6 |
| 3 | The BERS banding site with net lanes. | 6 |
| 4 | The CVCA banding site with net lanes. | 7 |
| 5 | Relative abundance of resident birds passively captured at the CIBO site in 2013. | 12 |
| 6 | Relative abundance of resident birds passively captured at the BERS site in 2013..... | 14 |
| 7 | Relative abundance of resident birds passively captured at the CVCA site in 2013. | 16 |
| 8 | Annual overall capture rate (birds per net-hour) for resident species, per year. | 17 |
| 9 | Relative percentages of all passive captures of resident birds that have occurred in each year, by species, at the CIBO site. | 18 |
| 10 | Relative percentages of all passive captures of resident birds that have occurred in each year, by species, at the BERS site..... | 19 |
| 11 | Relative percentages of all passive captures of resident birds that have occurred in each year, by species, at the CVCA site..... | 20 |
| 12 | Reyni diversity profile for the CIBO site. | 21 |
| 13 | Reyni diversity profile for the BERS site..... | 22 |
| 14 | Reyni diversity profile for the CVCA site..... | 23 |
| 15 | Reyni diversity profile for the last three years at all three sites..... | 24 |

Attachments

Attachment

- 1 Sample Data Sheets for Color Banding

ABSTRACT

Bird banding was conducted using the Monitoring Avian Productivity and Survivorship (MAPS) protocol at three sites during the summer breeding season in 2013. Three species covered under the Lower Colorado River Multi-Species Conservation Program, yellow warbler (*Setophaga petechia*), Bell's vireo (*Vireo bellii*), and summer tanager (*Piranga rubra*), were captured and color banded. Attempts were made to target capture covered species when passive capture was not possible and to re-sight color-banded birds. A total of 464 birds were captured at all sites, and a total of 17 birds that were covered species were either captured or re-sighted at all sites.

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 at least 26 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. 2012). 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 Southwest support a disproportionately high bird diversity and abundance, yet they make up less than 0.5 percent (%) of all the land area (Powell and Stiedl 2000). Much of this habitat has been altered and decreased due to climate change, habitat destruction, agricultural land conversion, urban development, mining, overgrazing, and river regulation (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 Southwest. Monitoring of restoration sites 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. In 2011, a third MAPS station was established at the Cibola Valley Conservation Area (CVCA), adding to those at the Beal Conservation Area (BERS) and Cibola National Wildlife Refuge (CNWR), bringing the current total of MAPS stations that are operated to three.

Throughout this document, LCR MSCP covered species will be referred to by their subspecific name when discussing LCR MSCP conservation measures, which 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. In almost all cases, this is not possible for the Bell's vireo and yellow warbler.

The overall purpose of the mist netting and bird banding program is to intensively monitor avian use of restoration sites and analyze avian use by LCR MSCP

Report of MAPS and Targeted Bird Banding at LCR MSCP Restoration Sites in 2013

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 restoration sites. The banding program addresses the LCR MSCP conservation measures from the Habitat Conservation Plan (LCR MSCP 2004) for the Sonoran yellow warbler (*Setophaga petechia*) (CM 5.7.20.2-YWAR1), Arizona Bell's vireo (*Vireo bellii arizonae*) (CM 5.7.19.2 – BEVI1), and summer tanager (*Piranga rubra*) (CM 5.7.21.2-SUTA1). One or more of these species are present at all three banding sites, and survivorship, productivity, and site fidelity all relate to 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 banding program 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

The CNWR 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 2012a). One banding station is located at the Cibola Nature Trail restoration site (CIBO) on the CNWR. It contains three distinct areas separated into a 13.6-acre (5.5-hectare [ha]) mixture of honey mesquite (*Prosopis glandulosa*) 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*). A total of 1,500 honey mesquite, 1,500 screwbean mesquite, 10,000 Goodding's willow, and 2,600 Fremont cottonwoods were planted in 1999 (Reclamation 2003). In the years since the site was established, Johnson grass (*Sorghum halapense*) has encroached as an understory. Volunteer willow baccharis (*Baccharis salicina*) 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 on 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. 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 2012b). 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 mesquite, cottonwood, willow, and arrowweed (*Pluchea sericea*) and is 107 acres (43.3 ha) in size (Reclamation 2003, 2010). The site is actively irrigated and maintained.

In 2011, a third banding station was added at the CVCA, an LCR MSCP habitat creation site. The site is located on land owned by the Arizona Game and Fish Department and is actively irrigated and maintained. The site is located immediately adjacent to the Colorado River and approximately 1.5 miles north of Cibola, Arizona. The banding station is located in Phases 1 and 2 of the CVCA. These phases have been planted with a mix of cottonwood, Goodding's willow, and coyote willow (*Salix exigua*).

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

PERMITS

Banding was conducted under USFWS Banding Permit No. 22994, with Joe Kahl as the Master Bander and Beth Sabin, Allen Calvert, Barbara Raulston, and Chris Dodge as subpermittees. At least one of the subpermit holders was present during any banding effort. An Arizona Scientific Collecting Permit (SP601198) is also held by Joe Kahl with the above mentioned as agents.

METHODS

All operations of the banding station 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 De Sante et al. (2012) were followed at all times.

Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013

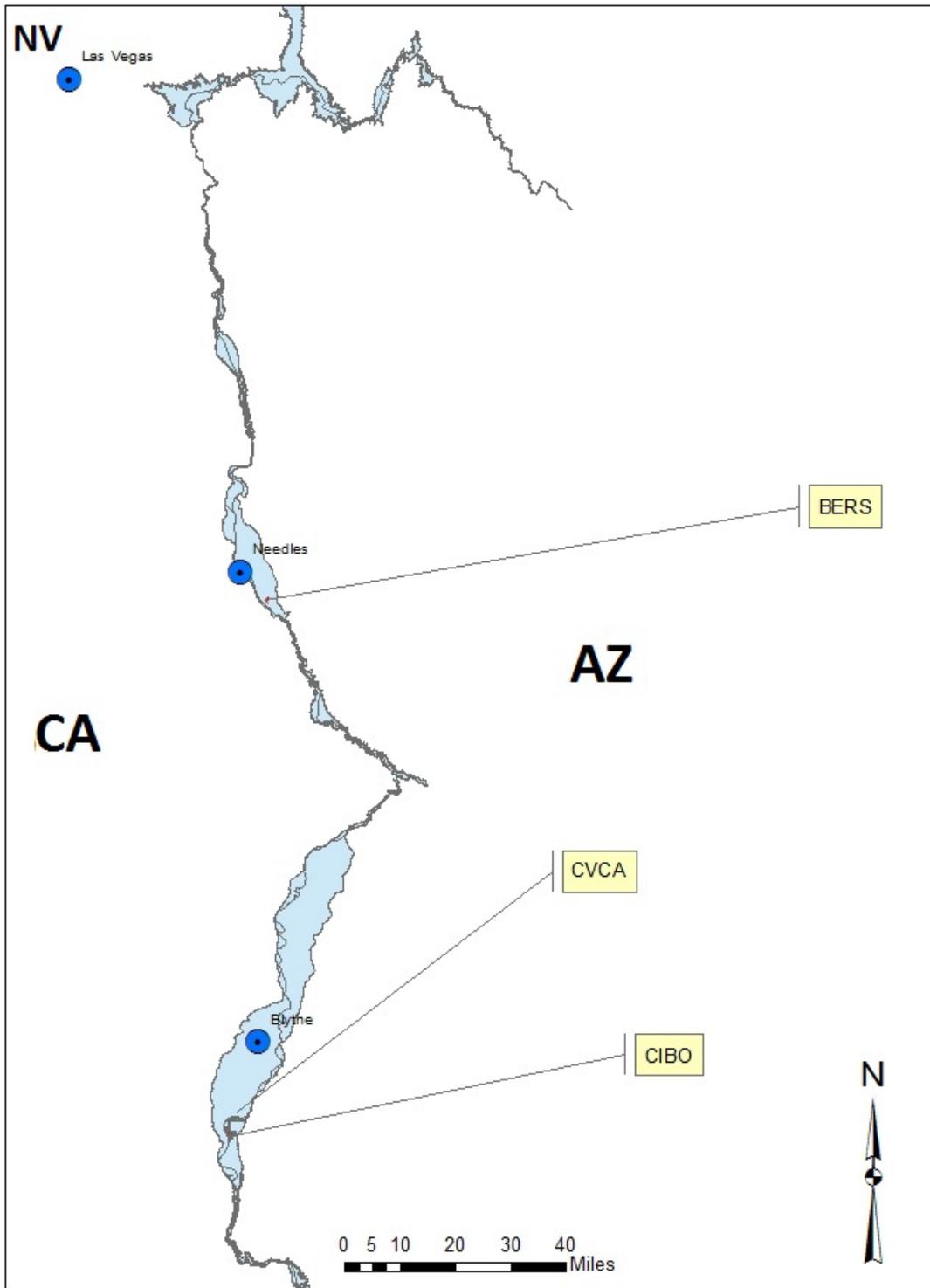


Figure 1.—Location of banding stations on the LCR.

Report of MAPS and Targeted Bird Banding at LCR MSCP Restoration Sites in 2013

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, for permit reasons. Covered LCR MSCP species that were captured had a colored band placed on the leg opposite the USFWS band. Some birds that were color banded had USFWS 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. 2012). Birds were identified using Pyle (1997), National Geographic Society (1999), and Sibley (2000).

The MAPS stations were run once during every 10-day period between May 1 and August 8, for a total of 10 banding periods. Established protocol for MAPS station operations was used at all times (De Sante et al. 2012).

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 a bird into a net. Target captures are birds that were captured using a net set up outside the normal MAPS net locations and using call-playback to draw the bird into the net. Unbanded birds are birds that were captured but were not banded. Re-sights are not actual captures but are instead the confirmed re-sighting of the color band combination on a bird previously captured and color banded. The locations of net lanes at all three sites were chosen in areas of high avian activity in order to allow greater chances of capturing birds.

In order to sample higher in the canopy, one double- or triple-high net was located in each restoration site. Double or triple nets were used instead of stacking several nets of normal height. These nets were 12 meters (m) in length. Each section of these nets that would represent the same height of a normal single net was numbered separately; for example, 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 CIBO, 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 Fremont

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

cottonwoods, two 6-m nets (nets 10 and 11) in the mesquites, and a double-high net was placed between the mesquite and cottonwood habitats (nets 12 and 13) (figure 2).



Figure 2.—The CIBO banding site with net lanes.

At the BERS site, 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.—The BERS banding site with net lanes.

At the CVCA site, nine 12-m nets and one 12-m triple-high net were located in Phases 1 and 2. Six 12-m nets and the 12-m triple-high net were placed in Phase 1, and three 12-m nets were placed in Phase 2 (figure 4). All the nets were located in cottonwood-willow habitat consisting of Fremont cottonwood, Goodding's willow, and coyote willow.



Figure 4.—The CVCA banding site with net lanes.

Color Banding

During the summer of 2009, a program was initiated to place color band combinations on selected LCR MSCP covered species. The purpose of placing unique color band combinations on each individual of a covered species captured was to allow birds to be re-sighted and identified to individual without needing to be recaptured. For purposes of this analysis, data from a bird that is re-sighted 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 re-sighted both before and after MAPS operations take place. Color bands were placed on the leg opposite the USFWS band. The color bands were either solid colored or bicolored aluminum bands. This effort continued for the fifth year in the summer of 2013.

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

Report of MAPS and Targeted Bird Banding at LCR MSCP Restoration Sites in 2013

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 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. Two types of USFWS numbered bands were placed on color-banded birds; either the normal silver band or a purple anodized band was used. These USFWS bands were recorded as being “silver,” or as “purple ano,” on the data sheets. The age, species, sex, USFWS band number, capture method (passive or targeted), date, and time of capture were also recorded. For re-sighting, the location, color band combination, and the confidence of the observer in the accuracy of the re-sight were recorded (see attachment 1 for details of observer confidence levels).

Data Analysis

The data collected from MAPS banding are used to create several indices (described below) to measure avian use of the sites. Some of these indices are then used in statistical analyses to evaluate change over time at each site or to compare sites to each other.

Survivorship (Annual Return Rate)

Annual return is an index of survivorship. This index measures the number of birds recaptured in subsequent field seasons after the field season of their initial capture. It is the number of annual return recaptures expressed as the percentage of all captures (Latta and Faaborg 2001, 2002).

A more thorough measure of survivorship can be calculated using program MARK, or RMARK, the version of program MARK that runs within Program R, based on capture/recapture history for individual species. At least three years of data are required to calculate survivorship if data are exclusively from passive captures, and if target captures and re-sighting are combined in the analysis, more years of data may be needed (Nur et al. 1999). Once sufficient data are collected, survivorship of LCR MSCP covered species will be calculated using program MARK.

Capture Rate

The per-net-hour capture rate was calculated for each site and for each species at each site. This is a simple measure that divides the number of captures by the

number of net-hours operated at each site. Capture rate values can be used to compare sites or years, because unlike simple numbers of captures, a per-net-hour capture rate takes into account the different levels of effort that are conducted at each site. Net-hours are counted for each net of 12-m length that is operated for each hour of banding. A 1/2 net-hour is given to 6-m nets for each hour they are operated. A total of 144 m of nets are operated at each site; therefore, a total of 12 net-hours are conducted during a full hour of operation. A maximum of 60 net-hours is possible during a full day of operation. Some nets may be closed due to wind, heat, or other factors, lessening the hours of operation.

In previous years, the capture rate for resident birds was compared among years at each site using a Kruskal-Wallis Rank Sum Test. This analysis has been discontinued as it was determined that it may not be applicable to this type of data, and instead diversity analysis will be used to compare sites.

Diversity Analysis

Species diversity is 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. Species diversity 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, will be more sensitive to either species richness or species evenness, and therefore, it is 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:

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

where:

H_{α} = the profile value

α = the alpha diversity value, which is shown on the x axis of the profile graph

ρ_i = the proportions of each species abundance from the total abundance

Report of MAPS and Targeted Bird Banding at LCR MSCP Restoration Sites in 2013

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 2013 MAPS summer season. All data were recorded in the field, entered, quality checked in MAPSPROG, and then compiled in Excel. All statistical analyses were completed using program R (v. 2.9.2). A complete list of all species captured and their corresponding scientific name are presented in tables 1, 2, and 3.

At the CIBO site, 173 individual birds were captured, of which 76 were resident birds. There were 145 new captures, 20 recaptures, and 22 unbanded birds. The per-net-hour capture rate was 0.35 for all birds and 0.16 for resident birds. Table 1 shows all the species captured and the number of individual captures per species in 2013. Figure 5 shows the relative percentage of resident birds passively captured at the CIBO site in 2013.

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

Table 1.—All species captured and the number of individual captures per species at the CIBO site in 2013

| Common name | Scientific name | Captures |
|---------------------------|--|------------|
| Abert's towhee | <i>Melospiza aberti</i> | 7 |
| Anna's hummingbird | <i>Calypte anna</i> | 1 |
| Ash-throated flycatcher | <i>Myiarchus cinerascens</i> | 4 |
| Bell's vireo | <i>Vireo bellii</i> | 1 |
| Black-chinned hummingbird | <i>Archilochus alexandri</i> | 2 |
| Black-headed grosbeak | <i>Pheucticus melanocephalus</i> | 4 |
| Blue grosbeak | <i>Passerina caerulea</i> | 3 |
| Brown-headed cowbird | <i>Molothrus ater</i> | 13 |
| Bullock's oriole | <i>Icterus bullockii</i> | 8 |
| Common yellowthroat | <i>Geothlypis trichas</i> | 2 |
| Dusky flycatcher | <i>Empidonax oberholseri</i> | 1 |
| Hammond's flycatcher | <i>Empidonax hammondi</i> | 4 |
| House finch | <i>Haemorhous mexicanus</i> | 6 |
| Indigo bunting | <i>Passerina cyanea</i> | 1 |
| Ladder-backed woodpecker | <i>Picoides scalaris</i> | 8 |
| Lazuli bunting | <i>Passerina amoena</i> | 4 |
| Lucy's warbler | <i>Oreothlypis luciae</i> | 10 |
| Macgillivray's warbler | <i>Geothlypis tolmiei</i> | 2 |
| Mourning dove | <i>Zenaida macroura</i> | 5 |
| Orange-crowned warbler | <i>Oreothlypis celata</i> | 4 |
| Song sparrow | <i>Melospiza melodia</i> | 2 |
| Swainson's thrush | <i>Catharus ustulatus</i> | 9 |
| Townsend's warbler | <i>Setophaga townsendi</i> | 1 |
| Verdin | <i>Auriparus flaviceps</i> | 9 |
| Warbling vireo | <i>Vireo gilvus</i> | 7 |
| Western flycatcher | <i>Empidonax difficilis/occidentalis</i> | 26 |
| Western tanager | <i>Piranga ludoviciana</i> | 7 |
| Western wood pee-wee | <i>Contopus sordidulus</i> | 1 |
| White-winged dove | <i>Zenaida asiatica</i> | 3 |
| Wilson's warbler | <i>Cardellina pusilla</i> | 15 |
| Yellow-breasted chat | <i>Icteria virens</i> | 2 |
| Yellow warbler | <i>Setophaga petechia</i> | 1 |
| Total captures | | 173 |

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

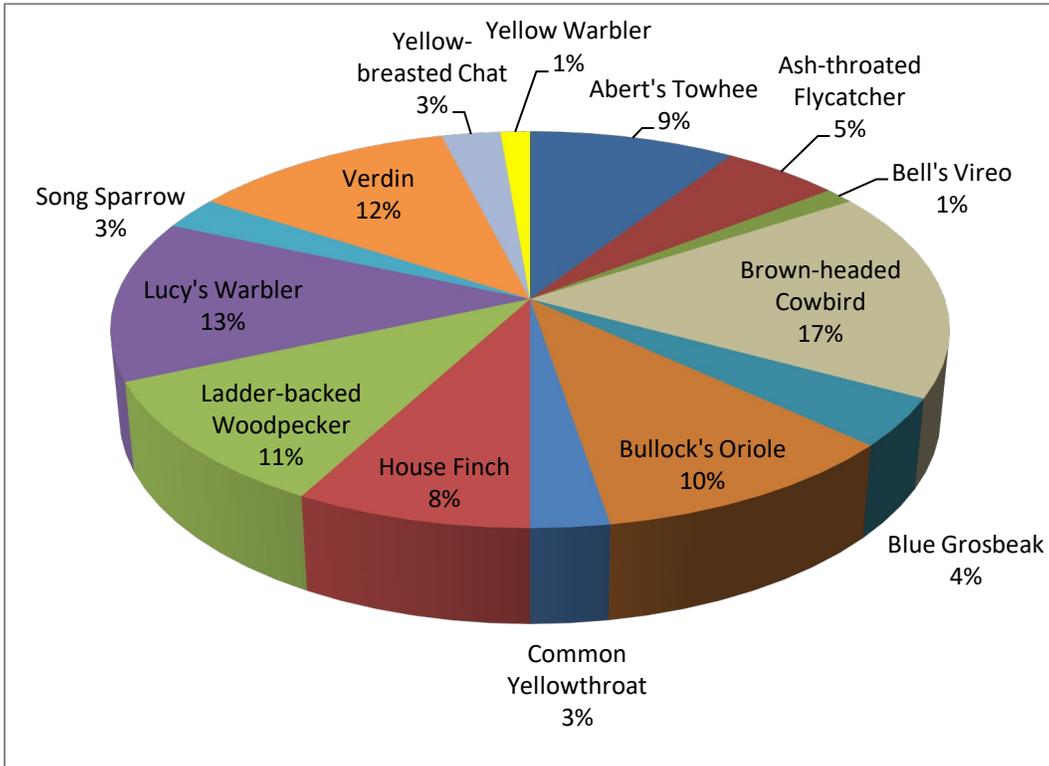


Figure 5.—Relative abundance of resident birds passively captured at the CIBO site in 2013.

At the BERS site, 162 individual birds were captured, of which 102 were resident birds. There were 150 new captures, 18 recaptures, and 12 unbanded birds. The per-net-hour capture rate was 0.31 for all birds and 0.19 for resident birds. Table 2 shows all the species captured and the number of individual captures per species in 2013. Figure 6 shows the relative percentage of resident birds passively captured at the BERS site in 2013.

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

Table 2.—All species captured and the number of individual captures per species at the BERS site in 2013

| Common name | Scientific name | Captures |
|--------------------------------|--|-----------------|
| Abert's towhee | <i>Melospiza aberti</i> | 17 |
| Anna's hummingbird | <i>Calypte anna</i> | 2 |
| Bell's vireo | <i>Vireo bellii</i> | 4 |
| Black-chinned hummingbird | <i>Archilochus alexandri</i> | 1 |
| Black-tailed gnatcatcher | <i>Poliophtila melanura</i> | 5 |
| Blue grosbeak | <i>Passerina caerulea</i> | 5 |
| Brown-headed cowbird | <i>Molothrus ater</i> | 2 |
| Bullock's oriole | <i>Icterus bullockii</i> | 5 |
| Common yellowthroat | <i>Geothlypis trichas</i> | 9 |
| House finch | <i>Haemorhous mexicanus</i> | 7 |
| Ladder-backed woodpecker | <i>Picoides scalaris</i> | 1 |
| Lazuli bunting | <i>Passerina amoena</i> | 1 |
| Lesser goldfinch | <i>Spinus saltria</i> | 2 |
| Loggerhead shrike | <i>Lanius ludovicianus</i> | 1 |
| Lucy's warbler | <i>Oreothlypis luciae</i> | 15 |
| Macgillivray's warbler | <i>Geothlypis tolmiei</i> | 2 |
| Mountain white-crowned sparrow | <i>Zonotrichia leucophrys oriantha</i> | 2 |
| Orange-crowned warbler | <i>Oreothlypis celata</i> | 1 |
| Ovenbird | <i>Seiurus aurocapilla</i> | 1 |
| Pine siskin | <i>Spinus pinus</i> | 2 |
| Ruby-crowned kinglet | <i>Regulus calendula</i> | 1 |
| Song sparrow | <i>Melospiza melodia</i> | 4 |
| Summer tanager | <i>Piranga rubra</i> | 3 |
| Swainson's thrush | <i>Catharus ustulatus</i> | 3 |
| Verdin | <i>Auriparus flaviceps</i> | 1 |
| Warbling vireo | <i>Vireo gilvus</i> | 1 |
| Western flycatcher | <i>Empidonax difficilis/occidentalis</i> | 20 |
| Western tanager | <i>Piranga ludoviciana</i> | 3 |
| Willow flycatcher | <i>Empidonax traillii</i> | 1 |
| Wilson's warbler | <i>Cardellina pusilla</i> | 19 |
| Yellow-breasted chat | <i>Icteria virens</i> | 14 |
| Yellow warbler | <i>Setophaga petechia</i> | 7 |
| Total captures | | 162 |

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

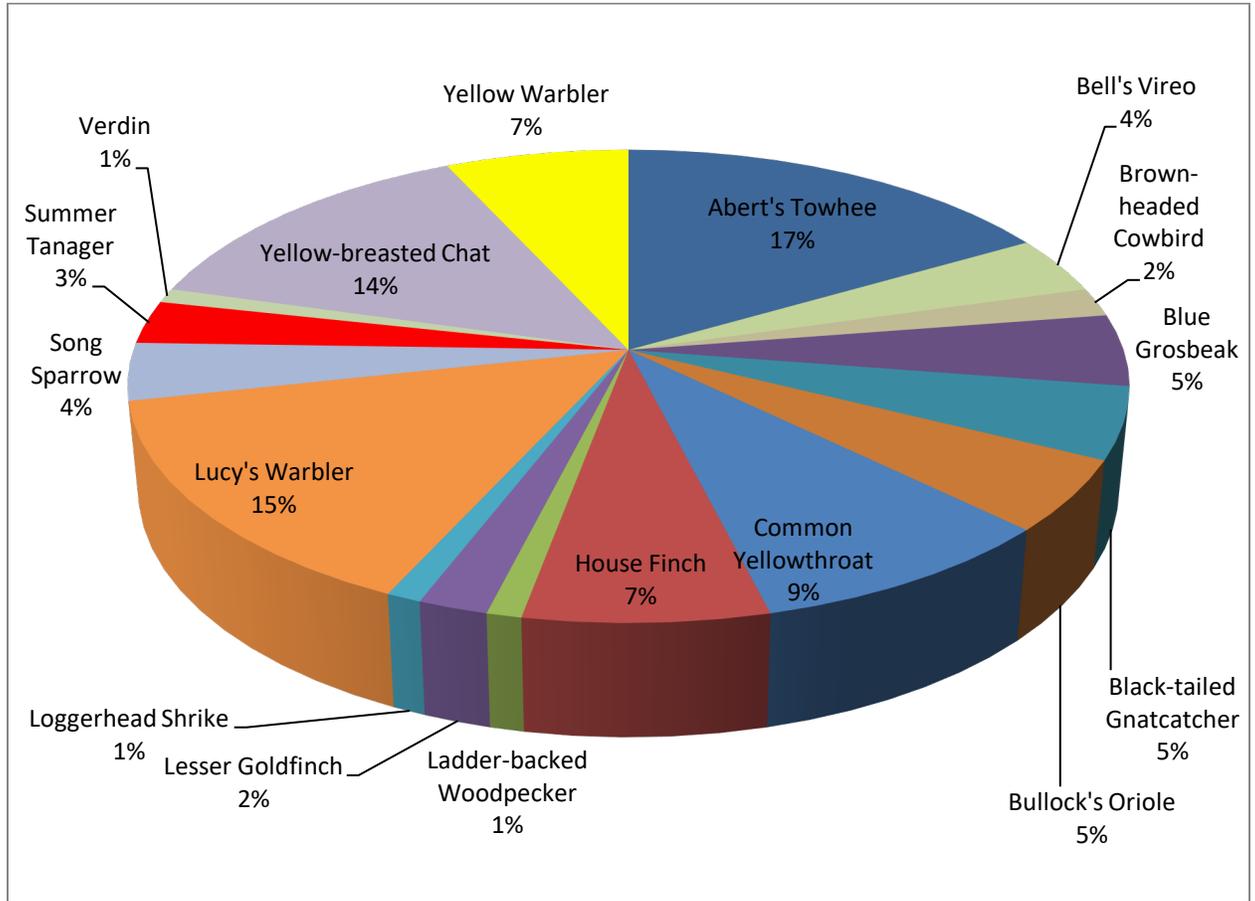


Figure 6.—Relative abundance of resident birds passively captured at the BERS site in 2013.

At the CVCA site, 93 individual birds were captured, of which 59 were resident birds. There were 81 new captures, 6 recaptures, and 10 unbanded birds. The per-net-hour capture rate was 0.18 for all birds and 0.11 for resident birds. Table 3 shows all the species captured and the number of individual captures per species in 2013. Figure 7 shows the relative percentage of resident birds passively captured at the CVCA site in 2013.

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

Table 3.—Species captured and the number of captures per species at the CVCA site in 2013

| Common name | Scientific name | Captures |
|---------------------------|--|-----------------|
| Abert's towhee | <i>Melospiza aberti</i> | 5 |
| Ash-throated flycatcher | <i>Myiarchus cinerascens</i> | 4 |
| Black-chinned hummingbird | <i>Archilochus alexandri</i> | 4 |
| Black-headed grosbeak | <i>Pheucticus melanocephalus</i> | 4 |
| Black phoebe | <i>Sayornis nigricans</i> | 2 |
| Blue grosbeak | <i>Passerina caerulea</i> | 2 |
| Brown-headed cowbird | <i>Molothrus ater</i> | 10 |
| Bullock's oriole | <i>Icterus bullockii</i> | 2 |
| Hammond's flycatcher | <i>Empidonax hammondii</i> | 2 |
| Lazuli bunting | <i>Passerina amoena</i> | 1 |
| Lesser goldfinch | <i>Spinus saltria</i> | 2 |
| Lucy's warbler | <i>Oreothlypis luciae</i> | 28 |
| Mourning dove | <i>Zenaida macroura</i> | 2 |
| Verdin | <i>Auriparus flaviceps</i> | 4 |
| Western flycatcher | <i>Empidonax difficilis/occidentalis</i> | 10 |
| Western tanager | <i>Piranga ludoviciana</i> | 2 |
| Willow flycatcher | <i>Empidonax trailii</i> | 2 |
| Wilson's warbler | <i>Cardellina pusilla</i> | 6 |
| Yellow warbler | <i>Setophaga petechia</i> | 1 |
| Total captures | | 93 |

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

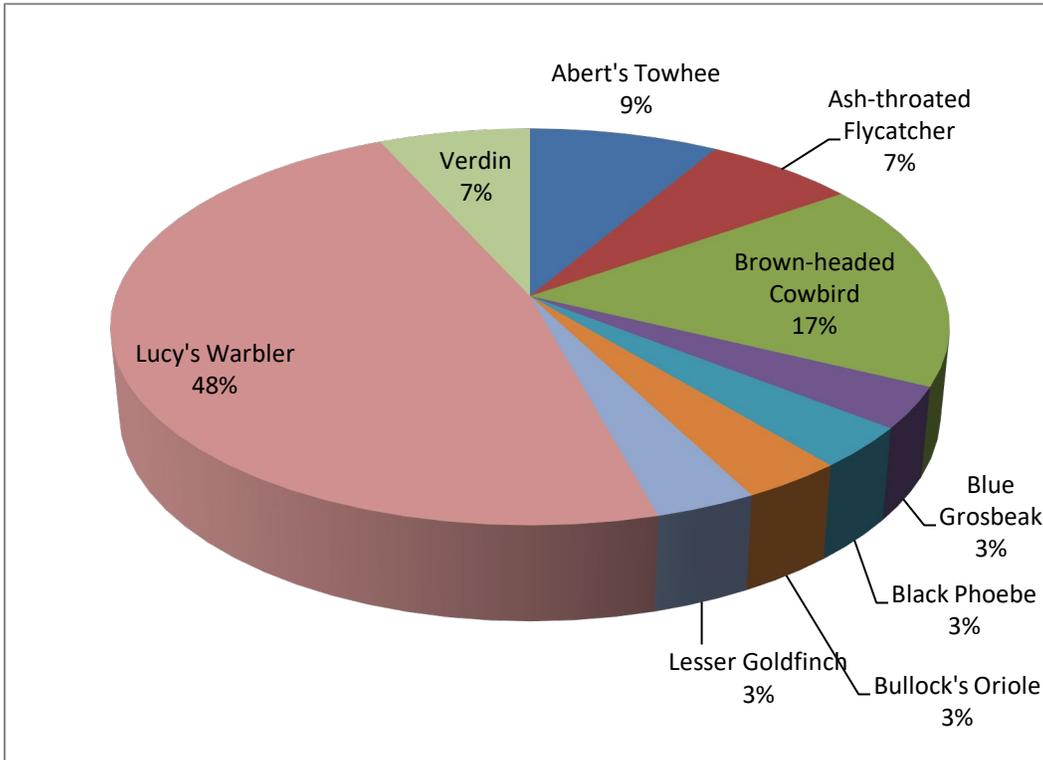


Figure 7.—Relative abundance of resident birds passively captured at the CVCA site in 2013.

Capture Rate

As discussed in the “Methods” section, the per-net-hour capture rate allows equal comparisons among sites, as it takes into account the different levels of effort that are conducted at each site that may change due to inclement weather or other reasons. Data were compiled for each year since 2009, except at the CVCA where banding began in 2011. Figure 8 shows the total capture rates for resident birds for each year banding has been conducted at each site. Figures 9, 10, and 11 show the relative percentage of captures that occurred in each year, for each species, for the last five years at the CIBO and BERS sites and for the three years of banding at the CVCA site.

Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013

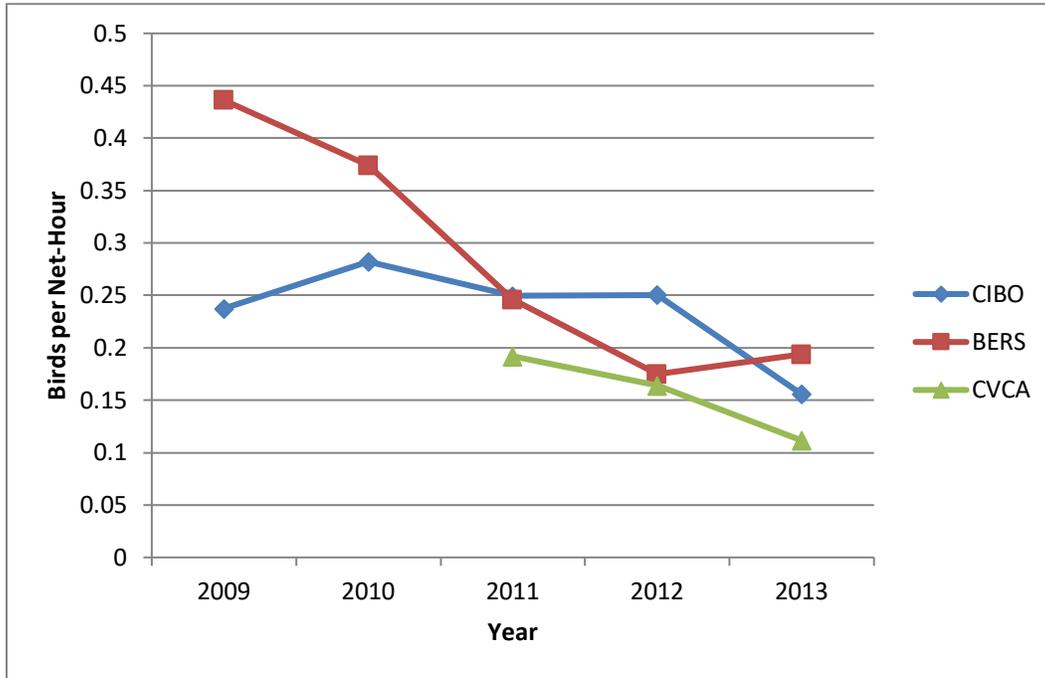


Figure 8.—Annual overall capture rate (birds per net-hour) for resident species, per year.

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

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

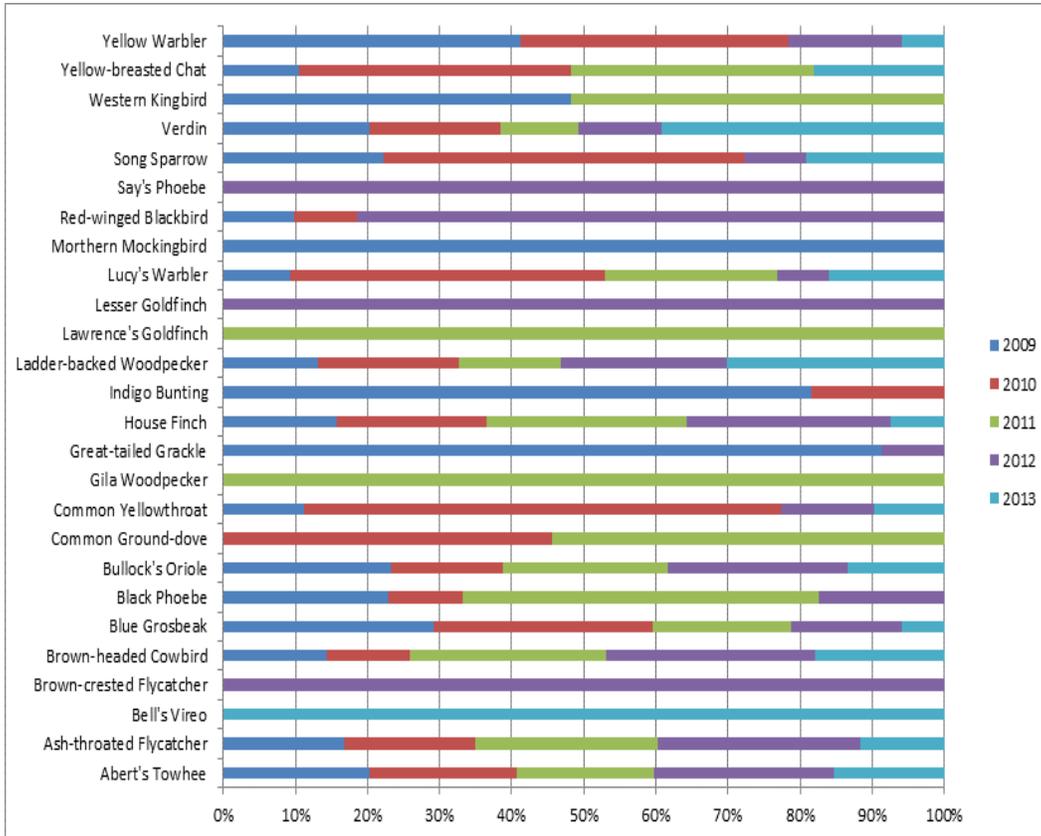


Figure 9.—Relative percentages of all passive captures of resident birds that have occurred in each year, by species, at the CIBO site.

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

At the BERS site, the capture rate from resident bird data was compared for the last five years since 2009, when banding began at the site. Figure 10 shows the relative percentage of resident bird passive captures that occurred in each year, for each species, at the BERS site.

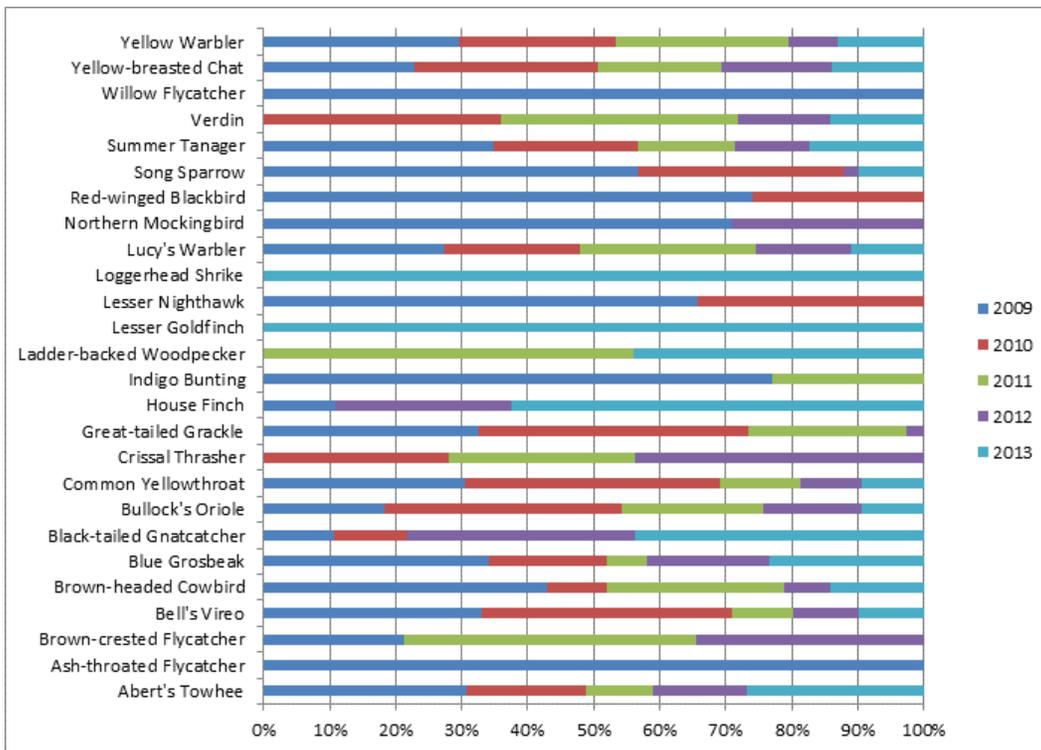


Figure 10.—Relative percentages of all passive captures of resident birds that have occurred in each year, by species, at the BERS site.

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

At the CVCA site, the capture rate from resident bird data was compared for the last three years since 2011, when banding began at the site. Figure 11 shows the relative percentage of passive resident bird captures that occurred in each year, for each species, at the CVCA site.

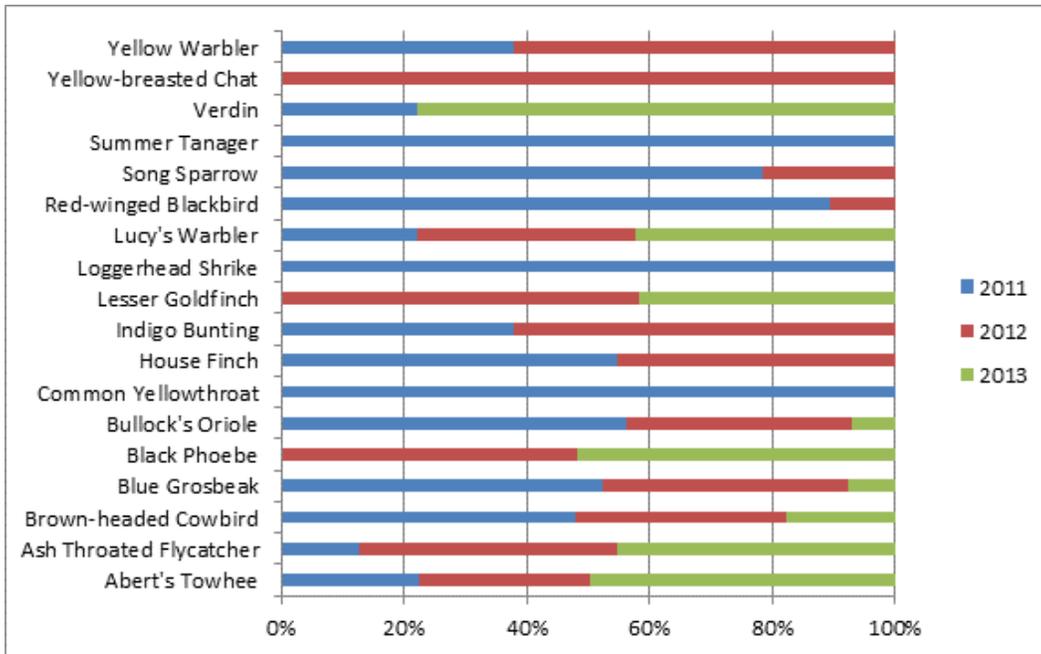


Figure 11.—Relative percentages of all passive captures of resident birds that have occurred in each year, by species, at the CVCA site.

Diversity Analysis

A Renyi diversity profile analysis was conducted for each site, separately comparing each year since 2009. The Renyi analysis was also used to compare all three sites together for each year that banding has been conducted at all three sites (since 2011) (see figure 15.)

At the CIBO site, site diversity was higher in 2009 as compared to all other years. There were no differences in diversity among the subsequent years. Figure 12 shows the Renyi diversity profile for the CIBO site.

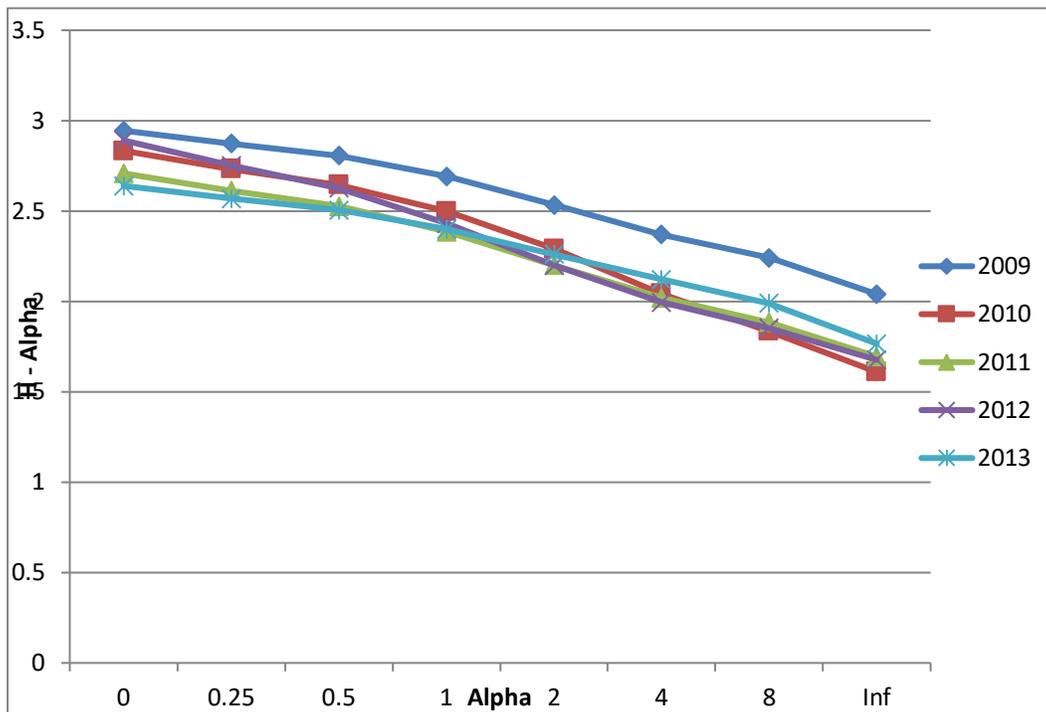


Figure 12.—Renyi diversity profile for the CIBO site.

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

At the BERS site, diversity was higher in 2009 as compared to all other years. There were no differences in diversity among the subsequent years. Figure 13 shows the Renyi diversity profile graph for the BERS site.

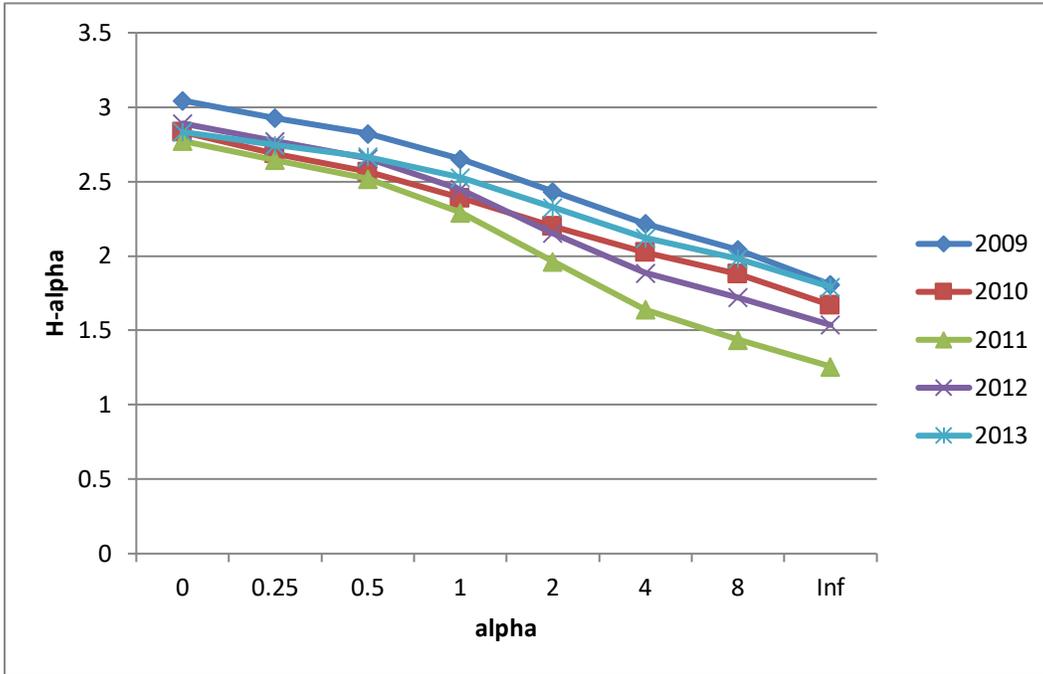


Figure 13.—Renyi diversity profile for the BERS site.

At the CVCA site, diversity was considerably lower in 2013 than in the previous two years (figure 14). There was no difference in diversity between 2011 and 2012.

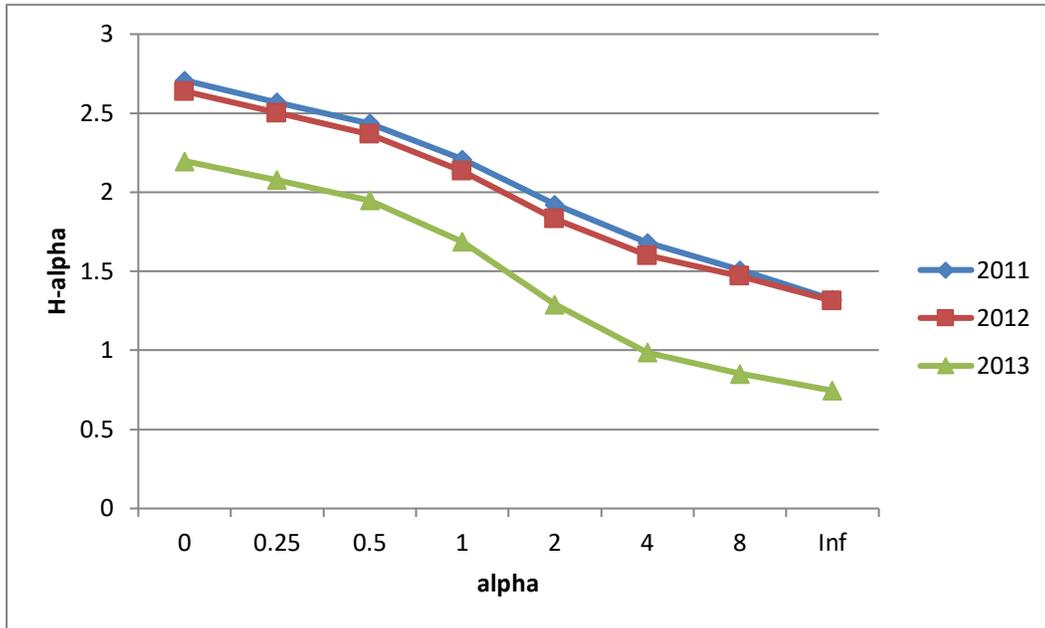


Figure 14.—Renyi diversity profile for the CVCA site.

Report of MAPS and Targeted Bird Banding at LCR MSCP Restoration Sites in 2013

The comparison of all sites since banding began at the CVCA in 2011 showed similar results to those for the CVCA site. Diversity from the CVCA in 2013 was considerably lower than any year from the other sites and for the previous years at the CVCA (figure 15).

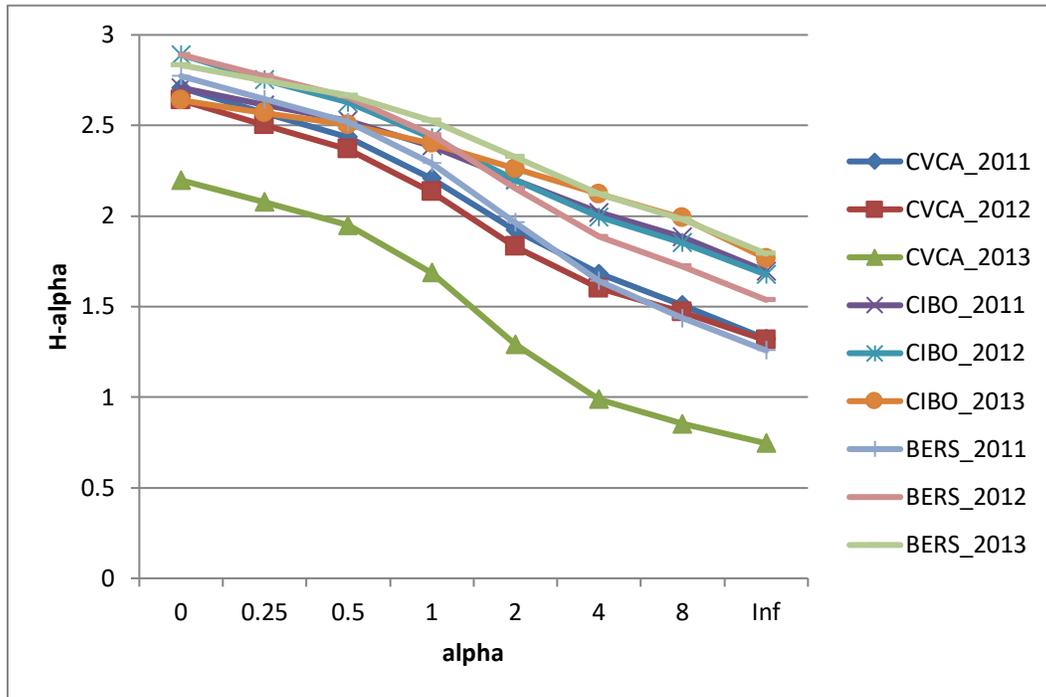


Figure 15.—Renyi diversity profile for the last three years at all three sites.

Survivorship and Annual Return Rate

An initial attempt to calculate survivorship based on recapture and re-sight data was made using RMark. It was determined that the sample size was insufficient and that more years of data would be required to use this method.

The annual return rate was calculated for all resident species representing at least 5% of total resident individuals captured or re-sighted and experiencing at least one annual return-recapture or re-sight. The 5% threshold was used to avoid calculating annual return rates for species with captures rates too low to be meaningful. The annual return rate was also calculated for any LCR MSCP covered species. Tables 4, 5, and 6 demonstrate the total individuals captured, the number of annual return recaptures, and the annual return rate for the BERS, CIBO, and CVCA sites, respectively.

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

Table 4.—Annual return rate for all birds captured and re-sighted at the BERS site

| Species | Total Individual captures | Annual return captures | Annual return rate (%) |
|----------------------|----------------------------------|-------------------------------|-------------------------------|
| Abert's towhee | 17 | 2 | 11.8 |
| Bell's vireo | 5 | 1 | 20.0 |
| Yellow-breasted chat | 14 | 1 | 7.1 |
| Yellow warbler | 8 | 2 | 25.0 |

Table 5.—Annual return rate for all birds captured and re-sighted at the CIBO site

| Species | Total Individual captures | Annual return captures | Annual return rate (%) |
|--------------------------|----------------------------------|-------------------------------|-------------------------------|
| Abert's towhee | 7 | 2 | 28.6 |
| Brown-headed cowbird | 13 | 7 | 53.8 |
| Ladder-backed woodpecker | 8 | 2 | 25.0 |

Table 6.—Annual return rate for all birds captured and re-sighted at the CVCA site

| Species | Total Individual captures | Annual return captures | Annual return rate (%) |
|----------------------|----------------------------------|-------------------------------|-------------------------------|
| Abert's towhee | 4 | 1 | 25.0 |
| Brown-headed cowbird | 10 | 3 | 30.0 |

Color Banding and Covered LCR MSCP Species

Table 7 summarizes all the captures and re-sights of LCR MSCP covered species. 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 “Recap” category represents all recaptures. The “Total re-sights” category represents a total of all re-sightings, including separate re-sightings of

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

Table 7.—Color banding and re-sight summary

| Species | Site | Total passive | Unique passive | Total target | Unique target | Recap | Total re-sights | Unique re-sights | Total birds |
|----------------|------|---------------|----------------|--------------|---------------|-------|-----------------|------------------|-------------|
| Bell's vireo | BERS | 5 | 3 | 1 | 1 | 2 | 1 | 1 | 5 |
| Summer tanager | BERS | 2 | 2 | 0 | 0 | 1 | 1 | 0 | 2 |
| Yellow warbler | BERS | 9 | 7 | 0 | 0 | 3 | 1 | 1 | 8 |
| Bell's vireo | CIBO | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Yellow warbler | CIBO | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |

the same bird. The “Unique re-sights” category represents unique individual birds re-sighted. Finally, the “Total birds” category is the true total of all unique individual birds that were captured or re-sighted by all methods combined.

DISCUSSION

In 2013, the captures of LCR MSCP covered species and total captures at the BERS site remained similar to those from 2012. At both the CIBO and CVCA sites, total captures and the captures of LCR MSCP covered species were lower. The decrease was especially noticeable at the CVCA site where no LCR MSCP covered species were captured.

At the BERS site in 2013, the total captures and the captures of LCR MSCP covered species were similar to the numbers at the site in 2012 (Dodge and Kahl 2013b). The relatively large proportion of Lucy’s warblers and the fact that many were captured in May and early June with indications of breeding (such as brood patches and cloacal protuberances) may indicate that the mesquite habitat at the site has matured and is providing nest cavities or crevices for this species. This species has been captured at other sites, such as the CVCA, but later in the year, after breeding. The same three LCR MSCP covered species (Bell’s vireo, summer tanager, and yellow warbler) that have been captured every year of MAPS operations were captured again in 2013 in roughly similar numbers to those from 2012.

At the CIBO site in 2013, there was some decline in capture rate as compared to previous years, but the decrease was not statistically significant. This site is the oldest site of the three where MAPS banding is conducted and both the cottonwood and mesquite habitats are mature. The preponderance of Lucy’s warblers in the capture results is likely due to the presence of mature mesquites, much like what was seen at the BERS site. Bell’s vireos were present and

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

breeding at the site and are found exclusively within the areas with mesquite in the center of the site. One yellow warbler was captured on May 1, but the bird did not show signs of being in breeding condition. Afterward, no more captures of yellow warblers were made, and singing males were only heard up to May 14.

No breeding pairs of yellow warblers were detected by the general bird surveys, and there may not have been and breeding activity by this species in 2013 (Great Basin Bird Observatory 2014).

At the CVCA site, there were no captures of any LCR MSCP species. There were no detections of these species during MAPS operations, and no breeding territories were detected by the general bird surveys (Great Basin Bird Observatory 2014). There was also a lower overall total resident capture rate, the lowest seen in three years of banding at the site. The capture rate in 2013 was not significantly different than the rate for the two previous years, but the diversity at the site was calculated to be lower than the previous years by the Renyi analysis. All of these data indicate a possible decrease in the abundance and number of species in 2013. There are many potential reasons for a possible decline, and more years of data would be needed to document a permanent decline. There is not enough data currently available on the habitat and abiotic conditions at the site to compare with the bird data; therefore, it is not possible to determine exact causes and if there is a decline being driven by on-site conditions.

LITERATURE CITED

- Bureau of Reclamation (Reclamation). 2003. Habitat Restoration on the Lower Colorado River Demonstration Projects: 1995–2002. U.S. Department of the Interior, Bureau of Reclamation, Lower Colorado Regional Office, Boulder City, Nevada.
- _____. 2010. Beal Riparian and Marsh Restoration Development and Monitoring Plan: Overview, March 2010, Lower Colorado River Multi-Species Conservation Program, Bureau of Reclamation, Boulder City, Nevada.
- DeSante, D.F., K.M. Burton, P. Velez, D. Froehlich, and D. Kaschube. 2012. MAPS Manual 2012 Protocol Instructions for the Establishment and Operation of Constant-Effort Bird-Banding Stations as Part of the Monitoring Avian Productivity and Survivorship (MAPS) Program. The Institute for Bird Populations. Point Reyes Bird Observatory, Bolinas, California.
- Dodge, C. and J. Kahl. 2013a. Color Banding Protocol for the LCR MSCP. Protocol for the Lower Colorado River Multi-Species Conservation Program. Boulder City, Nevada.
- _____. 2013b. Report of MAPS and Targeted Bird Banding at LCR MSCP Restoration Sites in 2012. Report for the Lower Colorado River Multi-Species Conservation Program. Boulder City, Nevada.
- Great Basin Bird Observatory. 2014. Annual Report on the Lower Colorado River Riparian Bird Surveys, 2013. Annual report submitted to the Bureau of Reclamation as part of Contract R11PS30133. Great Basin Bird Observatory, Reno, Nevada.
- Kindt, R. and R. Coe. 2005. Tree diversity analysis: A manual and software for common statistical methods for ecological and biodiversity studies. <http://worldagroforestry.org/resources/databases/tree-diversity-analysis>
- Latta, S.C. and J. Faaborg. 2001. Winter site fidelity of prairie warblers in the Dominican Republic. *The Condor* 103(3):455–468.
- _____. 2002. Demographic and population responses of Cape May warblers wintering in multiple habitats. *Ecology* 83(9):2502–2515.

**Report of MAPS and Targeted Bird Banding at
LCR MSCP Restoration Sites in 2013**

- Lower Colorado River Multi-Species Conservation Program (LCR MSCP). 2004. Lower Colorado River Multi-Species Conservation Program, Volume II: Habitat Conservation Plan, Final. December 17 (J&S 00450.00). Sacramento, California.
- National Geographic Society. 1999. Field Guide to the Birds of North America, Third edition. National Geographic Society, Washington D.C. 457 p.
- Nur, N., S.L. Jones, and G.R. Geupel. 1999. A Statistical Guide to Data Analysis of Avian Monitoring Programs. U.S. Department of the Interior, U.S. Fish and Wildlife Service, BTP-R6001-1999, Washington, D.C.
- Powell, B.F. and R.J. Stiedl. 2000. Nesting habitat and reproductive success of southwestern riparian birds. *The Condor* 102:823–831.
- Pyle, P. 1997. Identification Guide to North American birds. Slate Creek Press, Bolinas, California.
- Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. Desante. 1993. Handbook of Field Methods for Monitoring Landbirds. U.S. Department of Agriculture, General Technical Report PSW-GTR-144. Pacific Southwest Research Station, Albany, California.
- Rosenberg, K.V., R.D. Ohmart, W.C. Hunter, and B.W. Anderson. 1991. Birds of the Lower Colorado River Valley. The University of Arizona Press, Tucson, Arizona. 416 p.
- Sibley, D.A. 2000. The Sibley Guide to Birds. Alfred A. Knopf, New York.
- Tóthmérész, B. 1995. Comparison of different methods for diversity ordering. *Journal of Vegetation Science* 6:283–290.
- U.S. Fish and Wildlife Service (USFWS). 1997. Biological and conference opinion on lower Colorado operations and maintenance – Lake Mead to southerly international border. Biological opinion issued to the Bureau of Reclamation.
- _____. 2012a. Cibola National Wildlife Refuge.
<http://www.fws.gov/refuge/cibola/>
- _____. 2012b. Havasu National Wildlife Refuge.
<http://www.fws.gov/refuge/Havasus/about.html>.

ATTACHMENT 1

Sample Data Sheets for Color Banding

Color Band Re-Sight Data Sheet

Date: _____

Observer(s): _____

Wind: _____

Temp: _____

Site: _____

Re-Sight #1

Species: _____

Sex: _____

Left Color: _____

Right Color: _____

Confidence Level: _____

UTM: _____

Notes: _____

Re-Sight #2

Species: _____

Sex: _____

Left Color: _____

Right Color: _____

Confidence Level: _____

UTM: _____

Notes: _____

Confidence Level Codes:

- A = 100% confidence. Both legs were re-sighted, and the color of each band was accurately identified twice. A bird was re-sighted, the combination was recorded, and the bird was re-sighted a second time. This category also applies to birds passively recaptured without any call-playback.
- B = 100% confidence having re-sighted the full band combination only once in a visit.
- C = 95–99% confidence in the re-sight and one or more re-sights in a visit.
- N = 95% or lower confidence level or a bird that was re-sighted with a color band, but the color was not confidently identified.
- P = Re-sight 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: _____

