

**Area Searches at the Cibola Nature Trail Restoration Site and  
the Pratt Restoration Site, Breeding Season 2004**



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## Introduction

The lower Colorado River (LCR) travels from Lees Ferry, south of Glen Canyon Dam to the Gulf of California in Mexico. Flowing through the Mohave and Sonoran deserts, the LCR provides a large expanse of riparian vegetation in an arid environment (American Bird Conservancy 2003). Riparian areas in the southwest support disproportionately high bird diversity and abundance yet form less than 0.5% of the land area (Powell and Stiedl 2000). Seventy eight species of passerines, classified as rare to abundant utilize the riparian habitat of the LCR; 34 are winter residents, 31 are year round residents and 14 are spring and summer breeders (Rosenberg *et al.* 1991).

Over 90% of riparian habitat has been lost to river channelization, agricultural land conversion, habitat destruction, urban development, mining, overgrazing, and invasion of salt cedar (*Tamarix sp.*). The decline of size and quality of this habitat has negatively affected the riparian specialists that breed along the LCR. In 1999, as a requirement from the 1997 Biological and Conference Opinion on Routine Operations and Maintenance of the Lower Colorado River; Reclamation established two pilot native habitat restoration sites along the LCR: the Cibola Nature Trail and the Pratt restoration sites.

The Multi Species Conservation Plan (MSCP) is a cooperative Federal-Lower Basin States-Tribal-Private effort to conserve ESA (endangered species act) listed and sensitive species and to provide regulatory relief for the operation of the LCR by the restoration of over 8000 acres of native habitat. To fulfill its duties as lead implementing agency, Reclamation plans to establish large-scale restoration projects. Reclamation's goal is restore habitat for MSCP covered species. To accomplish this, Reclamation needs to increase its understanding of restoration science through an adaptive management approach, therefore; monitoring of current restoration sites is crucial. Avian species are good indicators of ecosystem health due to their sensitivity to environmental change regarding a variety of physical and biological factors (Greg Elliot *et al.* 2004).

To gather baseline data on avian species utilizing the restoration sites, Reclamation biologists implemented an avian monitoring program. Area searches and call/playback surveys for the endangered southwestern willow flycatcher were conducted during the breeding seasons of 2002-2004 at both the Cibola Nature Trail and Pratt restoration sites. A Monitoring Avian Productivity and Survivorship (MAPS) station was conducted during the breeding seasons of 2003-2004 at the Cibola Nature Trail restoration site. Constant-effort mist-netting was conducted during the non-breeding season at the Cibola Nature Trail and Pratt restoration sites.

During the breeding season of 2002, 2003, and 2004, area searches were conducted to determine relative abundance and species composition of birds utilizing the restoration sites. The area search method was adopted from the Australian Bird Count which allows bird relationships to be determined and land management techniques to be assessed (Ralph *et al.* 1993). At the Cibola Nature Trail restoration site, the area search method was chosen to supplement constant-effort mist-netting, so that all avian species, including ones not normally captured in nets, will be censused. Constant-effort mist-netting allows Reclamation, to gather more information about bird populations, then conducting area searches alone. Due to the costly nature of the method and the additional disturbance it causes, it is not conducted at every site, which was the case with the Pratt restoration site. Area searches were conducted at the Pratt restoration site as the sole means for determining relative abundance.

## Study Area

### Cibola Nature Trail Restoration Site

Cibola National Wildlife Refuge is located along the LCR south of Interstate 10, near Blythe, California, in Cibola, Arizona. The refuge was established in 1964 to provide habitat for wildlife. More than 200 species of birds can be seen at the refuge (U.S Fish and Wildlife Service). The Cibola Nature Trail restoration site contains 3 distinct areas: (1) 5.5 ha mixture of honey mesquite (*Prosopis glandulosa*) and screwbean mesquite (*Prosopis pubescens*), (2) 2.6 ha of Goodding willow (*Salix gooddingii*), and (3) 1 ha of Fremont cottonwood (*Populus fremontii*). A total of 1,500 honey mesquite, 1,500 screwbean mesquite, 10,000 Goodding willow, and 2,600 Fremont cottonwoods were planted (Raulston 2003). Exotic Johnson grass (*Sorghum halepense*) invaded as an understory in each of the 3 areas, and serves as a ground cover reaching up to 2 m in height. Efforts are underway, by refuge staff, to eradicate the Johnson grass, and replace it with a less invasive understory. For the purpose of conducting area searches, the site was divided into 5 sections, ranging in size from 1 to 3 hectares. Refer to Appendix #1 for an aerial view of the site and area search sections.

## Pratt Restoration Site

The Pratt restoration site is located north of Interstate 8, near Yuma, AZ, on land administered by the Bureau of Land Management (BLM). The site is north of Laguna dam, south of Mitty Lake, and is surrounded by farm fields and *Tamarix sp.* In the fall of 2003, *Tamarix sp.* was removed and will be restored with native vegetation. A leaseholder farmed the 4.9 ha site since 1949. In 1999, Reclamation established six planting regimes with Fremont cottonwoods, Goodding willows, and coyote willows (*Salix exigua*) using potted plants, seeds and poles. Potted plants and poles were planted densely, from 1 to 3 m apart. Seeded areas were planted with cottonwood and willow seeds collected locally and broadcast by hand over wet soils. *Baccharis sp.* was independently established in a potted cottonwood plot and *Tamarix sp.* was established, in small numbers, in the seeded areas. The potted coyote willow has recruited new individuals independently while the cottonwoods and Goodding willows have not (U. S. Bureau of Reclamation 2003).

For the purpose of conducting area searches, the site was divided into 5 sections; ranging in size from 1 to 2 hectares. Refer to Appendix #2 for an aerial view of the site, number of trees planted in each area and area search sections.

## Methods

The area searches were conducted 10 times through out the breeding season at the Cibola Nature Trail restoration site. Due to logistical difficulties, area searches at the Pratt restoration site were only conducted nine times. Each site was split into 5 sections. One 20 minute area search session was conducted in each of the 5 sections during each survey visit

Area searches were conducted according to protocol defined in the Handbook of Field Methods for Monitoring Landbirds (Ralph *et al* 2003). Each area search was conducted by one observer starting a half an hour before sunrise and ending no later than 10:00 AM. Temperature, cloud cover and wind speed were recorded before each area search. The start and ending time were also recorded. During the twenty minutes, the observers attempted to survey all areas within each section equally. Each individual bird heard or seen was recorded on the data form along with the method of detection (visually or aurally). If the bird was detected by more than one method, the method with the highest priority was recorded. Singing has the highest priority, visually has the second highest priority and calling has the lowest priority. Behavior information recorded for each bird included foraging, carrying food, displaying, copulating, flocking, mating, nesting, and fledging. Birds seen flying over the area but not utilizing it were recorded in a separate category as “flyovers”. Refer to Appendix 3 for a copy of the data form used.

For data analysis, species were separated into “resident” or “migrant” categories according to the Birds Of The Lower Colorado River (Rosenberg *et al.* 1991). For each site, the total number of individual birds detected per area search period was calculated by totaling individuals detected in all five sections. Mean relative abundance was calculated for total individuals and individuals per species, by dividing the total number of individuals detected by the number of surveys conducted. Migrant birds, did not occur at the site, through all ten survey periods. The number of periods that they are present varies in species, sites and years. For consistency purposes, mean relative abundance of migrant species, was determined by dividing individuals detected by the total number of surveys conducted (usually 10). Area searches are a breeding bird survey, and are not designed to count migrants. We include migrants in our count, because they are present during the breeding season, but the area search method will underestimate the number of migrants present. For this reason, Reclamation did not find it necessary, to determine the exact number of periods they occur in and divide total individuals by the exact number of periods. The standard error and standard deviation were calculated for mean relative abundance of each species. A single factor ANOVA test was used to determine significant difference of mean number of individual birds between sites and years. A single factor ANOVA test was used to determine significant difference of mean number of species observed between sites and years.

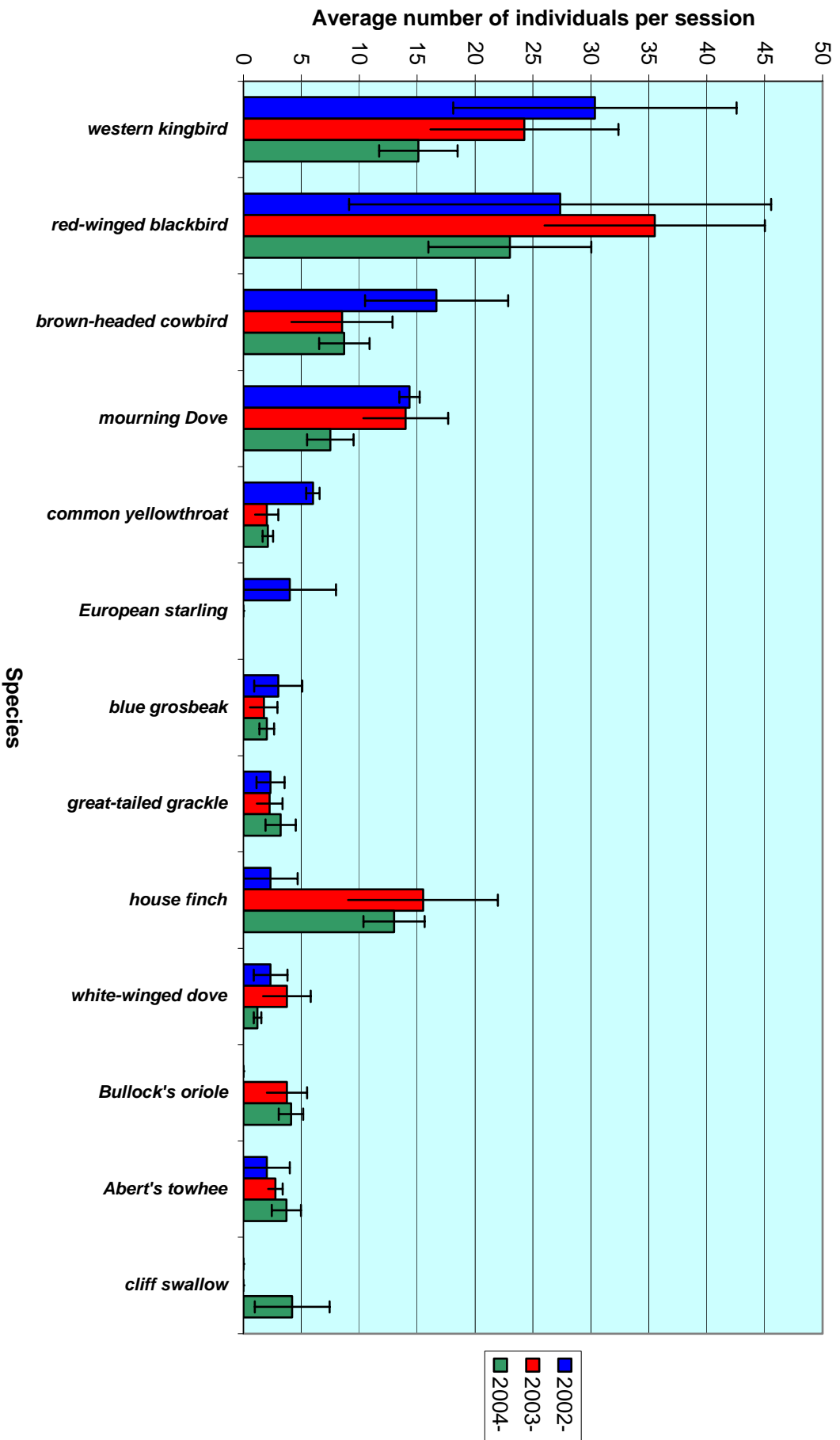


			<b>error</b>	<b>deviation</b>		<b>error</b>	<b>deviation</b>
American kestrel	<i>Falco sparverius</i>	.1	.1	.32	.11	.11	.33
great horned owl	<i>Bulbo virginianus</i>	.1	.1	.32	--	--	--
barn owl	<i>Tyto alba</i>	.1	.1	.32	--	--	--
Gambel's quail	<i>Callipepla gambelii</i>	.8	.61	1.93	1.22	.81	2.44
white-winged dove	<i>Zenaida asiatica</i>	1.2	.33	1.03	1.11	.56	1.69
mourning dove	<i>Zenaida macroura</i>	7.5	2.01	6.35	12.89	1.69	5.09
common ground-dove	<i>Columbina passerine</i>	.3	.30	.95	--	--	--
greater roadrunner	<i>Geococcyx californianus</i>	--	--	--	.11	.11	.33
lesser nighthawk	<i>Chordeiles acutipennis</i>	1.4	.75	2.37	.78	.55	1.64
black-chinned hummingbird	<i>Archilocus alexandri</i>	2.3	.78	2.45	1.22	.60	1.79
Anna's hummingbird	<i>Calypte anna</i>	.2	.13	.42	1.78	.85	2.54
ladder-backed woodpecker	<i>Picoides scalaris</i>	--	--	--	.44	.29	.89
black phoebe	<i>Sayornis nigricans</i>	--	--	--	.22	.15	.44
ash-throated flycatcher	<i>Myiarchus cinerascens</i>	1.7	.68	2.16	.44	.34	1.01
brown-crested flycatcher	<i>Myiarchus tyrannulus</i>	.5	.31	.97	.22	.15	.44
western kingbird	<i>Tyrannus verticalis</i>	15.1	3.39	10.73	4.56	2.77	8.32
loggerhead shrike	<i>Lanius ludovicianus</i>	.6	.31	.97	.11	.11	.33
Bell's vireo	<i>Vireo belli</i>	--	--	--	.11	.11	.33
northern rough-winged swallow	<i>Stelgidopteryx serripennis</i>	.7	.7	2.21	.67	.37	1.12
cliff swallow	<i>Petrochelidon pyrrhonota</i>	4.2	3.21	10.16	1.22	1.10	3.31
verdin	<i>Auriparus flaviceps</i>	.4	.27	.84	.56	.29	.88
black-tailed gnatcatcher	<i>Polioptila melanura</i>	.2	.13	.42	--	--	--
northern mockingbird	<i>Mimus polyglottos</i>	2	.39	1.25	.11	.11	.33
Lucy's warbler	<i>Vermivora luciae</i>	2	.82	2.58	--	--	--
yellow warbler	<i>Dendroica petechia</i>	.6	.27	.84	3.78	1.13	3.38
common yellowthroat	<i>Geothlypis trichas</i>	2.1	.46	1.45	1.11	.51	1.54
yellow-breasted chat	<i>Icteria virens</i>	.4	.27	.84	.78	.28	.83
Abert's towhee	<i>Pipilo aberti</i>	3.7	1.27	4.03	4.89	1.33	3.98
song sparrow	<i>Melospiza melodia</i>	.2	.13	.42	.56	.34	1.01
blue grosbeak	<i>Guiraca caerulea</i>	3	.63	2.00	3.67	1.22	3.67
red-winged blackbird	<i>Agelaius phoeniceus</i>	23	7.04	22.26	3.11	1.81	5.42
yellow-headed blackbird	<i>Xanthocephalus xanthocephalus</i>	.1	.10	.32	--	--	--
great-tailed grackle	<i>Quiscalus mexicanus</i>	3.2	1.31	4.13	1.56	.65	1.94
brown-headed cowbird	<i>Molothrus ater</i>	8.7	2.17	6.87	4.78	1.14	3.42
Bullock's oriole	<i>Icterus bullockii</i>	4.1	1.05	3.32	6.22	1.92	5.76
house finch	<i>Carpodacus mexicanus</i>	13	2.65	8.39	1.33	.65	1.93

**Table #2: Mean relative abundance of migrant birds detected during area searches, per species at the Cibola Nature Trail and Pratt Restoration Sites, breeding season 2004.**

Species	Scientific Name	Cibola Nature Trail			Pratt Agricultural		
		Mean	Standard error	Standard deviation	Mean	Standard error	Standard deviation
western wood-pewee	<i>Contopus sordidulus</i>	.7	.37	1.16	.44	.34	1.01
willow flycatcher	<i>Empidonax trailii</i>	1.7	1.01	3.20	.11	.11	.33
western flycatcher	<i>Empidonax difficilis/occidentalis</i>	1.1	1.16	3.66	1.89	1.21	3.62
warbling vireo	<i>Vireo gilvis</i>	.6	.50	1.58	--	--	--
Swainson's thrush	<i>Catharus ustulatus</i>	--	--	--	.11	.11	.33
orange-crowned warbler	<i>Vermivora celata</i>	.1	.10	.32	--	--	--
Audubon's warbler	<i>Dendroica coronata auduboni</i>	.1	.10	.32	--	--	--
black-throated gray warbler	<i>Dendroica nigrescens</i>	.1	.10	.32	--	--	--
Wilson's warbler	<i>Wilsonia pusilla</i>	.5	.34	1.08	.44	.34	1.01
western tanager	<i>Piranga ludoviciana</i>	--	--	--	.33	.24	.70
black-headed grosbeak	<i>Phuecticus melanocephalus</i>	.2	.13	.42	.11	.11	.33
rose-breasted grosbeak	<i>Phuecticus ludovicianus</i>	.2	.13	.42	--	--	--
Lazuli bunting	<i>Passerina amoena</i>	.5	.34	1.08	--	--	--

**Figure #2: Mean relative abundance of the most abundant resident species and standard error bars at the Cibola Nature Trail Restoration Site, breeding season 2002-2004**



Twelve resident species displayed male territorial singing (Table#3). Behavioral observations were recorded for 28 species (Table #4).

**Table #3: Percent of individuals singing, in resident species, that have a male territorial song at the Cibola Nature Trail Restoration Site, breeding season 2004.**

Species	Percentage of individuals singing	Species	Percentage of individuals singing
white-winged dove	41.7 %	Abert's towhee	2.7%
black-throated gnatcatcher	50.0%	blue grosbeak	33.3%
northern mockingbird	10%	red-winged blackbird	5.7%
yellow warbler	66.7%	brown-headed cowbird	12.6%
common yellowthroat	85.7%	Bullock's oriole	14.6%
yellow-breasted chat	50%	house finch	1.5%

**Table#4: Behavioral observations at the Cibola Nature Trail Restoration Site, breeding season 2004.**

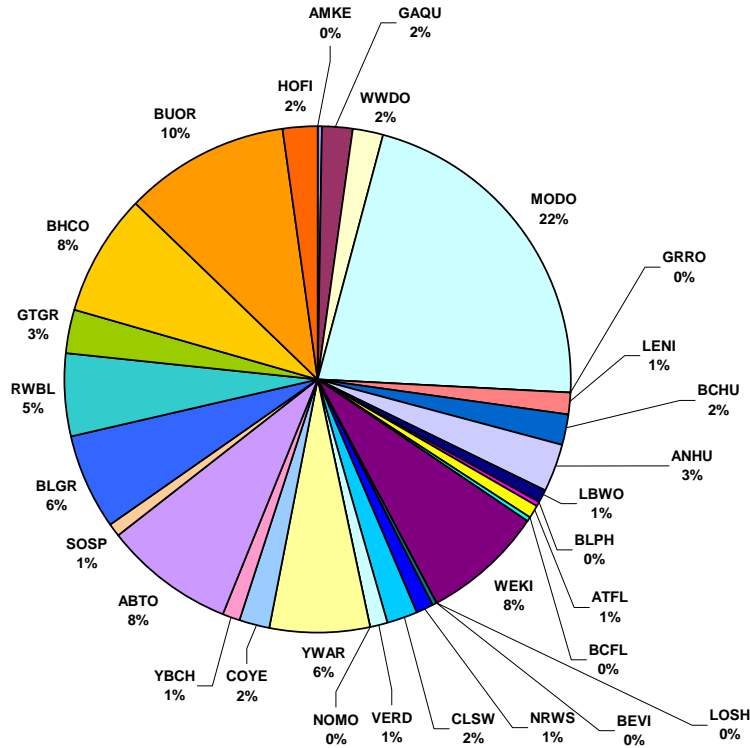
Species	Forage	Nests	Carrying Food	Pair	Displaying	Flock	Fledge
mourning dove		X		X		X	
lesser nighthawk	X						
black-chinned hummingbird	X						
Anna's hummingbird	X						
western wood-pewee	X						
willow flycatcher	X						
ash-throated flycatcher	X						
brown-crested flycatcher	X						
western kingbird	X	X	X	X	X		
loggerhead shrike	X						
warbling vireo	X						
northern rough-winged swallow	X						
cliff swallow	X					X	
verdin	X						
northern mockingbird	X						X
orange-crowned warbler	X						
Lucy's warbler	X						
black-throated gray warbler	X						
Wilson's warbler	X						
Abert's towhee	X						
song sparrow		X					
blue grosbeak	X		X	X			X
red-winged blackbird	X	X		X	X	X	
great-tailed grackle	X					X	
brown-headed cowbird	X		X				
Bullock's oriole	X		X				
house finch	X	X				X	

***Pratt Restoration Site***

A mean of 60 individual resident birds, comprising 30 species, and a mean of 3.4 individual migrant birds, comprising 8 species, were captured at the Pratt restoration site (Figure #3; Table #1 and #2).

The most abundant resident species captured during the breeding season of 2004 were: mourning dove, Bullock's oriole, Abert's towhee, western kingbird, brown-headed cowbird, blue grosbeak, yellow warbler, red-winged blackbird, great-tailed grackle, and Anna's hummingbird (Figure #4).

**Figure #3: Mean relative abundance of resident species at the Pratt Restoration Site, breeding season 2004**



Ten resident species displayed male territorial singing (Table #5). Behavioral observations were recorded for 14 species (Table #6).

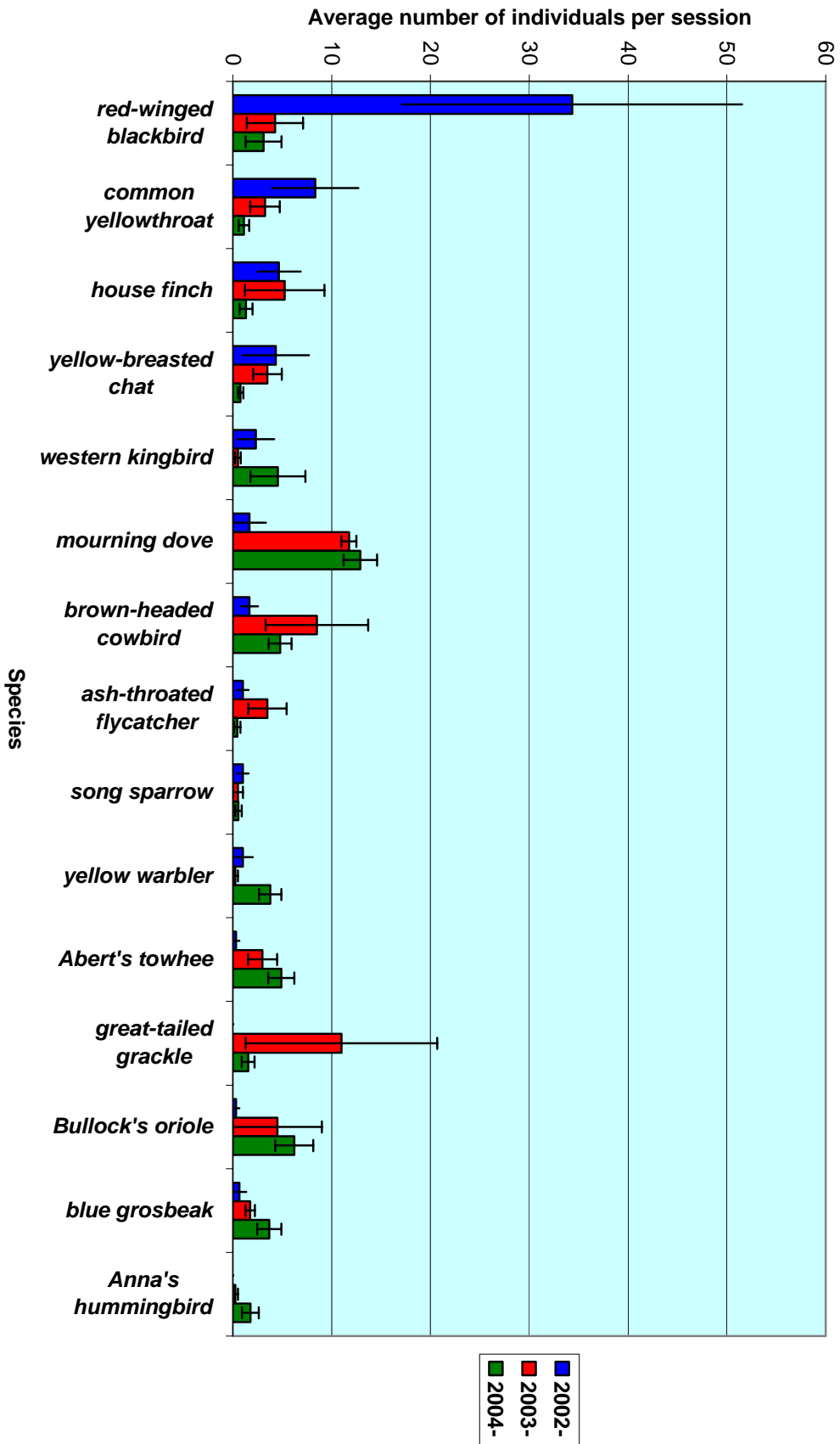
**Table #5: Percent of individuals singing, in resident species that have a male territorial song at the Pratt Restoration Site, breeding season 2004.**

Species	Percentage of individuals singing	Species	Percentage of individuals singing
white-winged dove	10%	blue grosbeak	60.6%
yellow warbler	73.6%	red-winged blackbird	3.6%
common yellowthroat	60.0%	brown-headed cowbird	7.0%
yellow-breasted chat	85.7%	Bullock's oriole	8.9%
song sparrow	60.6%	house finch	41.7%

**Table#6: Behavioral observations at the Pratt Restoration Site, breeding season 2004.**

Species	Forage	Nest	Carrying Food	Fledge	Pair
mourning dove		X		X	
black-chinned hummingbird	X				
Anna's hummingbird	X				
ash-throated flycatcher	X				
western kingbird	X				X
cliff swallow	X				
verdin	X				
Abert's towhee	X				
song sparrow	X				
blue grosbeak				X	X
brown-headed cowbird					X
Bullock's oriole			X		
house finch	X	X			





**Figure #4: Mean relative abundance of the most abundant resident species, and standard error bars, at the Pratt Agricultural Restoration Site, breeding season 2002-2004**

### *Cibola Nature Trail and Pratt Restoration Sites (breeding season 2004)*

The mean number of total resident birds observed, was significantly higher ( $p < .05$ ) at the Cibola Nature Trail restoration site than at the Pratt restoration site. The mean number of individual birds observed for the following species was significantly higher ( $p < .05$ ) at the Cibola Nature Trail restoration site than at the Pratt Agricultural restoration site: red-winged blackbird, western kingbird, house finch, northern mockingbird, and Lucy's warbler. The mean number of yellow warblers observed was significantly higher ( $p < .05$ ) at the Pratt restoration site than at the Cibola Nature Trail restoration site.

A significant difference between mean number of total resident birds, between years, was not found at either site. A significant difference between mean individuals per species, between years, was not found at either site. A significant difference between mean number of species per survey, between years, was not found at either site. A much higher number of total species was observed in 2004 than in previous years at both sites.

### *Discussion*

Species richness at the Cibola Nature Trail restoration site and Pratt restoration site are quite high compared to what would be expected during the breeding season (Rosenberg *et al.* 1991). Rosenberg *et al.* (1991) listed 31 year round resident species and 14 spring and summer resident species that utilize the riparian habitat of the LCR. Reclamation observed 24 year round resident species and 12 spring and summer species utilizing the restoration sites. Rosenberg *et al.* (1991) data includes all habitats along the LCR, whereas the area searches are concentrated on small, restored, lowland habitats in specific locations.

The Cibola Nature Trail restoration site attracted almost twice the number of individuals than the Pratt restoration site. The Cibola Nature Trail restoration site also attracted much larger populations of red-winged blackbirds, western kingbirds, house finches, northern mockingbirds and Lucy's warblers. The most probable explanation for this is the larger size and more diverse habitat of the Cibola Nature Trail restoration site. The Cibola Nature Trail restoration site contains mesquite bosques and cottonwood-willow habitat, where the Pratt restoration site only contains cottonwood-willow habitat. This site is more conducive to species that breed in riparian shrub habitat such as house finches, red-winged blackbirds and Lucy's warblers. It is not known why the Pratt restoration site attracted a much larger population of yellow warblers than the Cibola Nature Trail restoration site. Possible reasons are that the Pratt restoration site contains a larger acreage of cottonwood-willow habitat and the cottonwoods and willows are larger in size (USBR 2003). This habitat may be more conducive to the yellow warbler, which is a cottonwood-willow specialist.

There is no significant difference in relative abundance or species composition between years at either site. Avian surveys have only been conducted for three years at the sites and should continue to detect any changes or trends that maybe occurring. These two sites are the first restoration sites where avian use has been monitored. The importance of continually monitoring these sites, to see if avian composition changes as the site matures, is vital to the implementation of future larger-scale restoration sites.

The most abundant birds at both sites tended to be habitat generalists or birds that inhabit agricultural edges like the red-winged blackbird, great-tailed grackle, mourning dove, ash-throated flycatcher, and Abert's towhee (Rosenberg *et al.* 1991). A key avian component missing from both sites is moderate to high populations of cottonwood and willow specialists, which are presently declining due to lack of habitat. These species include common yellowthroats, yellow warblers, yellow-breasted chats, song sparrows, willow flycatchers, vermilion flycatchers, Bell's vireos, Gila woodpeckers and yellow-billed cuckoos. There are two potential reasons why these species may not be using these restoration sites. Water is not constantly present at these sites during the breeding season. The small patch size of the habitat may deter many individuals. A larger restoration site (approximately 80 hectares), adjacent to Beal Lake, near Needles, California, is currently in progress. Bird composition at the Beal Lake site will be compared to the Nature Trail and Pratt Agricultural restoration sites in the future.

A literature search yielded little information about the area search method, particularly the ability of the method to census the bird population with accuracy at a particular site. Dieni and Jones 2002 found that the area search method was effective in determining species composition, but underestimated species density. At the Cibola Nature Trail restoration site, Reclamation operates a constant-effort mist-netting

station in conjunction with the area searches. Constant-effort mist-netting is a reliable method to determine relative abundance of species that would be captured in the nets (Geupel 1995). In previous years, Reclamation has compared area search data to constant-effort mist-netting data, and has found that species composition is similar between the two methods. By design the area search method should provide a complete census of species, while constant-effort mist-netting does not (Nur *et al.* 1999). There are some species, due to size or foraging behavior, which will not be captured in the nets. Species composition was compared between the two methods in 2004 and as in previous years, species composition was similar (Appendix #5). There was a large population of western kingbirds, red-winged blackbirds and mourning doves that were detected in area searches but not during constant-effort mist-netting. One notable difference was that constant-effort mist-netting detected a much larger population of Bullock's orioles than area searches did. It is impossible for constant-effort mist-netting to over estimate the population of a species, therefore; it can be concluded that area searches underestimated the population of Bullock's orioles. The reason for this is not known, Bullock's orioles are not an inconspicuous species, they should be relatively easy to detect. The probable explanations are that observers are not familiar with all the vocalizations that this species makes or that orioles don't vocalize as much as other species during the breeding season.

Analyzing previous years of area search data, Reclamation observed that the standard error for mean relative abundance of individuals per species was very large for many species (Figure #2 and #4). Reclamation proposed to increase the number of surveys from four to ten surveys per season. Increasing the length of time of area searches or increasing the number of surveys would increase the accuracy of area searches (Dieni and Jones 2002). Increasing the amount of time per survey was not considered. This would increase the chance of recording a single bird more than once, because the bird may move or the observer may forget its location (Scott *et al.* 1981). Reclamation found that the standard error for mean relative abundance of individuals per species decreased when the 10 survey method was established (Figure #2 and #4). Reclamation also found that the total number of species observed at each site increased dramatically when the 10 survey method was established.

### **Recommendations**

- Continue the 10 visit protocol.
- The survey crew should become more familiar with vocalizations of the Bullock's oriole and their ability to detect this species when conducting surveys. When possible, constant-effort mist-netting and area search data should continue to be compared, so the survey crew can become aware of certain species that they may be missing during area search surveys.
- The survey crew should standardize behavioral observations to be consistent among surveyors.
- As mentioned above, very little literature is available about the accuracy of the area search method. Reclamation has and will continue to collect area search and constant-effort mist-netting data at the same site. Reclamation has an opportunity to contribute to current literature by comparing area search data collected with constant-effort mist-netting data.

### **Literature Cited**

American Bird Conservancy. "Sonoran and Mohave Deserts. Retrieved August 19<sup>th</sup>, 2003.  
[Http://www.abcbirds.org.nabci/deserts.htm](http://www.abcbirds.org.nabci/deserts.htm)

Dieni, S., and S.L Jones. 2002. A field test of the area search method for measuring breeding bird populations. *Journal of Field Ornithology* 73(3): 253-257.

Elliot, G., M. Chase, G. Geupel and E. Cohen. 2004. *Developing and Implementing an Adaptive Conservation Strategy: A guide for improving adaptive management and sharing the learning among conservation practitioners.* Point Reyes Bird Observatory Conservation Science, Stinson Beach, CA 94970

Lynn, S., and A. Averill 1996. *Neotropical Migratory Bird Monitoring Project in the Lower Colorado River Valley.* Wildlife and Fisheries Sciences Program, School of Renewable Natural Resources, University of Arizona, Tucson, AZ 85721

Nur, N., G. Geupel, and G. Ballard. 1995. The Use of Constant-effort Mist-netting to Monitor Demographic Processes in Passerine Birds: Annual Variation in Survival, Productivity, and Floaters. Point Reyes Bird Observatory, 4990 Shoreline Highway, Stinson Beach, CA 94970.

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, Fish and Wildlife Service, BTP-R6001-1999, Washington, D.C.

Powell, B., and R. Steidl. 2000. Nesting Habitat and Reproductive Success of Southwestern Riparian Birds. *The Condor* 102:823-831

Ralph, J.C., G. Geupel, P. Pyle, T.E Martin, and D.F DeSante. 1993. **Handbook of field methods for monitoring landbirds**. Gen. Tech. Rep. PSW-GTR-144. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S Department of Agriculture; 41 p.

Rosenberg k., Ohmart R., Hunter W., and Anderson B. "Birds of the Lower Colorado River Valley" The University of Arizona Press, Tucson Arizona 1991.

Scott, M.J., and F. Ramsey. 1981. Length of count period as a possible source of bias in estimating bird densities. *Studies in Avian Biology* 6:409-413.

Sibley, David Allen. "National Audubon Society The Sibley Guide to Birds". Chanticleer Press, Inc. 2000.

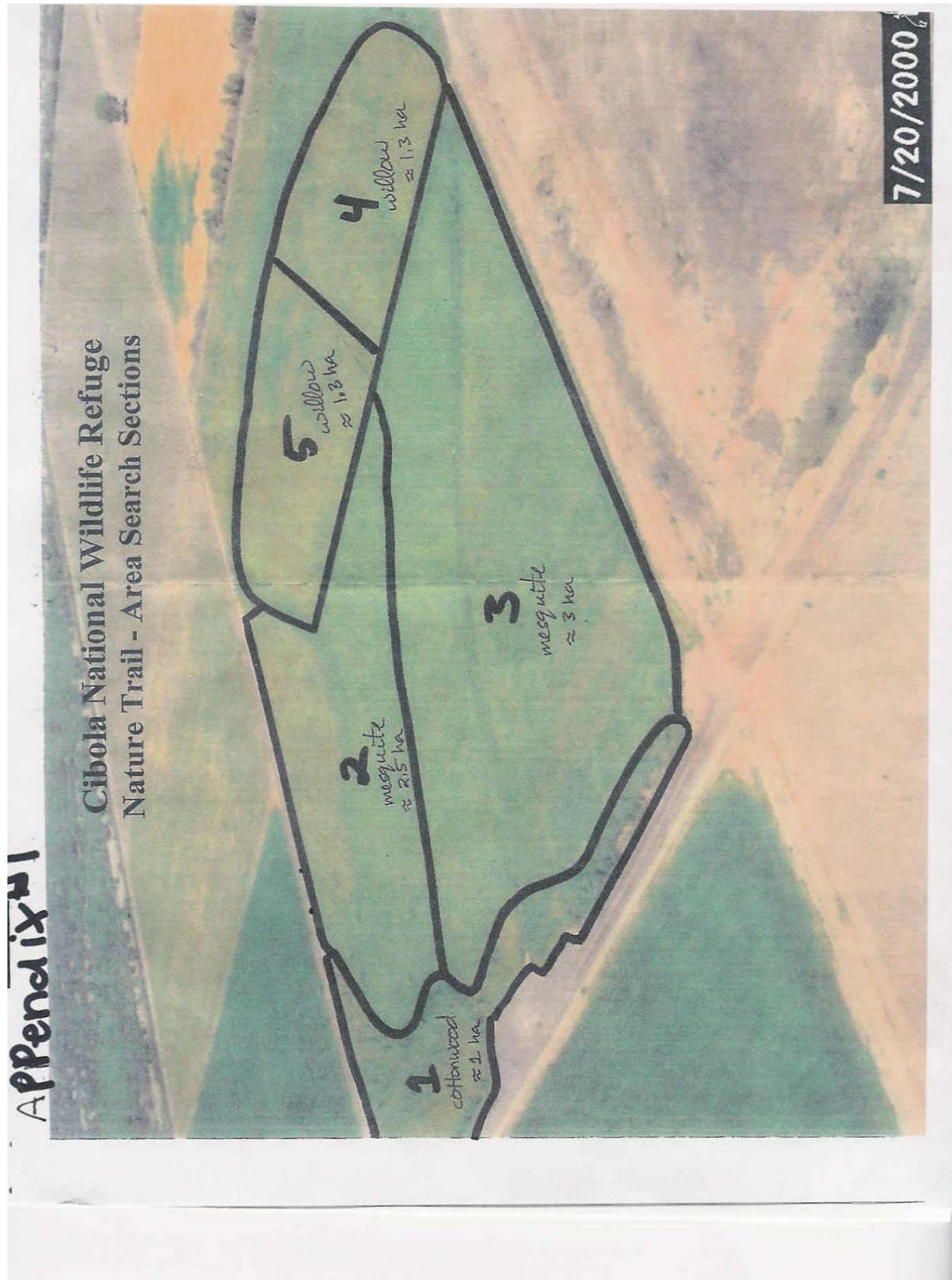
United States Bureau of Reclamation. Raulston, Barbara. 2000. "Challenges of Habitat Restoration on the Lower Colorado River and its Tributaries". Boulder City, Nevada 89006.

United States Bureau of Reclamation. 2003. Vegetation Monitoring Report. Boulder City, Nevada 89006.

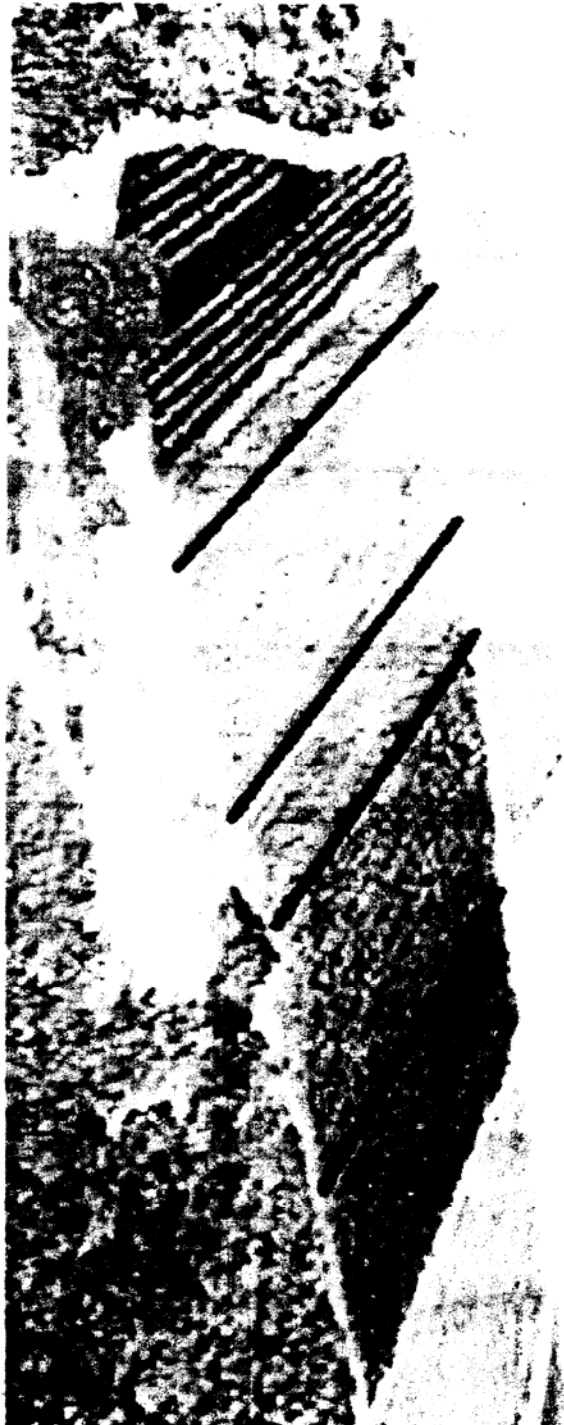
United States Fish and Wildlife Service. 1997. Biological and Conference Opinion on Lower Colorado River Operations and Maintenance-Lake Mead to Southerly International Boundary. Albuquerque, NM 87103.

United States Fish and Wildlife Service. Cibola National Wildlife Refuge. Retrieved August 19<sup>th</sup>, 2003  
[Http://southwest.fws.gov/refuges/arizona/cibola.html](http://southwest.fws.gov/refuges/arizona/cibola.html)

Appendix #1



# APPENDIX #2

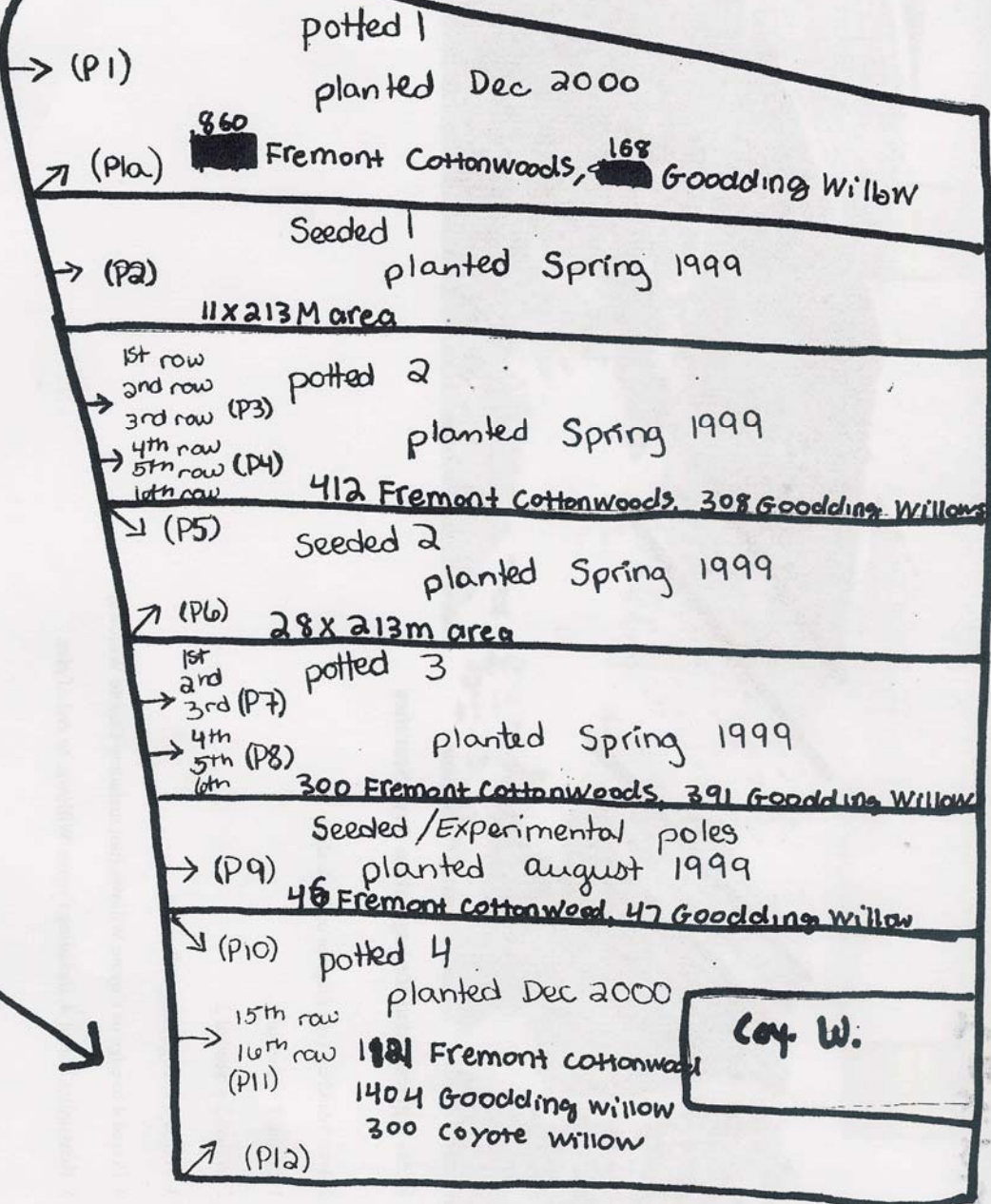


## Pratt Agricultural Re-vegetation Area Searches

5 Area Searches: (see diagram on back also)

1. Potted 1 + Seeded 1
2. Potted 2 + Seeded 2
3. Potted 3 to beginning of Potted 4
4. Potted 4 to edge of Coyote Willows (not including Coyote Willows)
5. Remaining Potted 4, including Coyote Willows, to end of plot.

# Appendix #2







<u>Code</u>	<u>Common Name</u>	<u>Scientific Name</u>
GAQU	Gambel's quail	Callipepla gambelii
NOHA	northern harrier	Circus cyaneus
SSHA	Sharp-shinned hawk	Accipiter striatus
AMKE	American kestrel	Falco parverius
WWDO	white-winged dove	Zenaida asiatica
MODO	mourning dove	Zenaida macroura
COGD	common ground-dove	Columbina passerine
YBCU	yellow-billed cuckoo	Coccyzus americanus
GRRO	greater roadrunner	Geococcyx californianus
BAOW	barn owl	Tyto alba
GHOW	great horned owl	Bulba virginianus
LENI	lesser nighthawk	Chordeiles acutipennis
WTSW	white-throated swift	Aeronautes saxatalis
BCHU	black-chinned hummingbird	Archilocus alexandri
ANHU	Anna's hummingbird	Calypte anna
COHU	Costa's hummingbird	Calypte costae
LBBO	ladder-backed woodpecker	Picoides scolaris
NOFL	northern flicker	Colaptes auratus
WWPE	western wood pee-wee	Contopus sordidulus
WIFL	willow flycatcher	Empidonax trailii
LEFL	least flycatcher	Empidonax minimus
HAFL	Hammond's flycatcher	Empidonax hammondii
GRFL	grey flycatcher	Empidonax wrightii
DUFL	dusky flycatcher	Empidonax oberholseri
WEFL	western flycatcher	Empidonax difficilis /occidentalis
PSFL	Pacific-slope flycatcher	Empidonax difficilis
BLPH	black phoebe	Sayornis nigricans
SAPH	Say's phoebe	Sayornis saya
VEFL	vermillion flycatcher	Pyrocephalus rubinus
ATFL	ash-throated flycatcher	Myiarchus cinerascens
BCFL	brown-crested flycatcher	Myiarchus tyrannulus
CAKI	Cassin's kingbird	Tyrannus vociferans
WEKI	western kingbird	Tyrannus verticalis
LOSH	loggerhead shrike	Lanius ludovicianus
BEVI	Bell's vireo	Vireo belli
PLVI	plumbeous vireo	Vireo plumbeus
WAVI	warbling vireo	Vireo gilvus
CORA	common raven	Corvus corax
HOLA	horned lark	Eremophila alpestris
TRES	tree swallow	Tachycineta bicolor
VGSW	violet-green swallow	Tachycineta thalassina
NRWS	northern rough-winged swallow	Stelgidopteryx serripennis
CLSW	cliff swallow	Petrochelidon pyrrhonota
BARS	barn swallow	Hirundo rustica
VERD	verdin	Auriparus flaviceps
RBNH	red-breasted nuthatch	Sitta Canadensis
CACW	cactus wren	Campylorhynchus brunneicapillus
BEWR	Bewick's wren	Thryomanes bewickii
HOWR	house wren	Troglodytes aedon
MAWR	marsh wren	Cistothorus palustris
RCKI	ruby-crowned kinglet	Regulus calendula
BGGN	blue-grey gnatcatcher	Polioptila caerulea

<u>Code</u>	<u>Common Name</u>	<u>Scientific Name</u>
BTGN	black-tailed gnatcatcher	Polioptila melanura
SWTH	Swainson's thrush	Catharus ustulatus
HETH	hermit thrush	Catharus guttatus
AMRO	American robin	Turdus migratorius
NOMO	northern mockingbird	Mimus polyglottos

CRTH	crissal thrasher	Toxostoma crissale
PHAI	phainopepla	Phainopepla nitens
OCWA	orange-crowned warbler	Vermivora celata
NAWA	Nashville warbler	Vermivora ruficapilla
LUWA	Lucy's warbler	Vermivora luciae
YWAR	yellow warbler	Dendroica petechia
AUWA	yellow-rumped (Audubon's) warbler	Dendroica coronata auduboni
MYWA	yellow-rumped (Myrtle's) warbler	Dendroica coronata coronata
BTYW	black-throated gray warbler	Dendroica nigrescens
TOWA	Townsend's warbler	Dendroica townsendi
HEWA	hermit warbler	Dendroica occidentalis
AMRE	American redstart	Setophaga ruticilla
NOWA	northern waterthrush	Seiurus noveboracensis
KEWA	Kentucky warbler	Oporornis formosus
MGWA	Macgillivray's warbler	Oporornis tolmiei
COYE	common yellowthroat	Geothypis trichas
WIWA	Wilson's warbler	Wilsonia pusilla
YBCH	yellow-breasted chat	Icteria virens
SUTA	summer tanager	Piranga rubra
WETA	western tanager	Piranga ludoviciana
GTTO	green-tailed towhee	Pipilo chlorurus
SPTO	spotted towhee	Pipilo maculatus
ABTO	Abert's towhee	Pipilo aberti
CHSP	chipping sparrow	Spizella passerine
BRSP	Brewer's sparrow	Spizella breweri
VESP	vesper sparrow	Poocetes gramineus
BTSP	black-throated sparrow	Amphispiza bilenata
SAVS	savannah sparrow	Passerculus sandwichensis
FOSP	fox sparrow	Passerela iliaca
SOSP	song sparrow	Melospiza melodia
LISP	Lincoln's sparrow	Melospiza lincolni
WTSP	white-throated sparrow	Zonotrichia albicollis
WCSP	white-crowned sparrow	Zonotrichia leucophrys
GWCS	Gambel's white-crowned sparrow	Zonotrichia l. gambelii
MWCS	mountain white-crowned sparrow	Zonotrichia l. oriantha
DEJU	dark-eyed junco	Junco hyemalis
RBGR	rose-breasted grosbeak	Pheucticus ludovicianus
BHGR	black-headed grosbeak	Pheucticus melanocephalus
BLGR	blue grosbeak	Guiraca caerulea
LAZB	lazuli bunting	Passerina amoena
INBU	indigo bunting	Passerina cyanea
RWBL	red-winged blackbird	Agelaius phoeniceus
WEME	western meadowlark	Sturnella neglecta
YHBL	yellow-headed blackbird	Xanthocephalus xanthocephalus
GTGR	great-tailed grackle	Quiscalus mexicanus
BHCO	brown-headed cowbird	Molothrus ater
HOOR	hooded oriole	Icterus cucullatus
BAOR	Baltimore oriole	Icterus galbula
BUOR	Bullock's oriole	Icterus bullockii
SCOR	Scott's oriole	Icterus parisorum
HOFI	house finch	Carpodacus mexicanus
LEGO	lesser goldfinch	Carduelis psaltria
HOSP	house sparrow	Passer domesticus

## Appendix #5

**Relative abundance of species captured, during constant-effort mist-netting, Cibola Nature Trail Restoration Site, breeding season 2004.**

