Winter Monitoring By Constant Effort Mist-Netting at the Nature Trail and Pratt Agricultural Restoration Sites.
Winter 2003-04

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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 Mojave and Sonoran deserts, the LCR provides a large expanse of riparian vegetation in an arid environment. Riparian areas in the Southwest support a disproportionately high bird diversity and abundance; yet form less than 0.5% of the land area (Powell and Stiedl 2000). The decline of size and quality of this habitat has negatively affected the avian species that utilize it (Szaro 1980, Rosenberg *et al*. 1991, Powell and Stiedl 2000). Much of this habitat has decreased due to climate change, habitat destruction, agricultural land conversion, urban development, mining, overgrazing, and river regulation (U. S. Bureau of Reclamation 1996, Powell and Stiedl 2000). A search of the literature finds very little data concerning year-round bird use in xeroriparian areas of the southwest, especially in restoration sites.

The Bureau of Reclamation (Reclamation) has established native tree restoration demonstration sites along the LCR. These plots were created to evaluate potential restoration techniques to meet objectives set forth in the LCR Multi-Species Conservation Plan (MSCP), which Reclamation will act as lead implementing agency. The MSCP is a cooperative Federal-State-Tribal-County-Private endeavor to restore over 8,000 acres of habitat along the LCR within 50 years. Anticipated implementation of the MSCP will begin in 2005. Reclamation developed the two native habitat restoration sites discussed in this paper as small, experimental plots to create and understand habitat requirements for specific species, particularly those listed as endangered and threatened. Avian species diversity and richness numbers collected from this project will be used as an indicator of what bird use may be expected in future restoration projects conducted along the LCR.

Study Areas

The Cibola Nature Trail restoration site (CIBO) in Cibola National Wildlife Refuge is located along the LCR south of Interstate 10 in Cibola, Arizona. Established in 1964 to offset wildlife and habitat losses due to channelization of the Colorado River, the refuge attracts more than 200 bird species (USFWS 2003). The restoration site contains three distinct areas: (1) 5.5 ha mixture of honey mesquite (*Prosopis glandulusa*) 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 in 1999 (USBR 2003). Exotic Johnson grass (*Sorghum halepense*) invaded as an understory in each of the three areas, and serves as a ground cover reaching up to 2 m in height. Between the first and second banding periods in the 2003-2004 season, Cibola NWR staff cut the invasive Johnson grass, within 10 m of the nets. The site is an island of habitat surrounded by farm fields on three sides and *Tamarix sp*. on the fourth. In the fall of 2003, the *Tamarix sp*. was removed and the area will be planted with native vegetation.

The Pratt restoration site (PRAT) is located north of Interstate 8, in Yuma, AZ on land administered by the Bureau of Land Management. The site is north of Laguna dam, south of Mittry 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. *Baccarus sp*. independently established in a potted cottonwood plot and *Tamarix sp* 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).

Methods

Mist-netting/bird-banding occurred at the Cibola Nature Trail restoration site and the Pratt restoration site during the winter of 2002-2003 and 2003-2004. Three 4-day periods of mist-netting/bird-banding occurred between November and February at each site. Nine, 2.6 x 12 m nets were placed in cottonwood/willow habitat, and two 2.6 x 6 m nets were placed in the mesquite habitat at the Nature Trail restoration site. Ten 2.6 x 12 m nets were placed in cottonwood/willow habitat at the Pratt restoration site. Mesh size for all nets were 30 m/m.

Nets were set up at sunrise and were open for 5 hours unless conditions such as wind or temperature could harm the birds. Nets were checked every 50 minutes. A metal, numbered USFWS band was placed on all captured birds except game species and hummingbirds. Each bird was identified to species, aged, sexed, measured for wing chord, body fat and pectoral muscle mass, weighed and released. Time, date, and net location from which each bird was captured were recorded as well as total hours of net operations. All data were recorded on a standardized data sheet (Desante *et al.* 2002). Birds were identified using Pyle (1997) and Sibley (2000).

Bird Condition Analysis

For each bird, wing chord and weight were combined in a ratio of wing chord over weight. Each bird was scored for pectoral muscle mass on a scale of 0-3 (0=concave muscle and prominent sternum, poorer health, 3= convex muscle and sternum undetectable, better health)(Latta and Faaborg 2002, and Gosler 1991). Fat was measured on an ordinal scale according to the protocol established by IBP, for the MAPS banding program (DeSante *et* al. 2002). In cases where a bird escaped or for some other reason was not measured for wing, weight, or fat, they were excluded from the bird condition analysis for that species.

Winter Site Persistence

Winter site persistence is a measure of birds captured in one of the first two periods which are subsequently re-captured in a later banding period (Latta and Faaborg 2001, 2002). This was measured by determining the percentage of birds captured in periods 2 or 3 which had been previously captured in a period of this same winter banding season. Winter site persistence is used as an index measure of habitat suitability for birds in the winter.

Site Fidelity

Data from recaptured birds was used to measure annual return rate. Annual return rate is a measure of birds recaptured in subsequent field seasons after the field season of their initial capture (Latta and Faaborg 2001, 2002). Annual return rate was measured as a percentage of birds recaptured from previous years, from the total of all individually captured birds. Site fidelity is used as a second index measure of habitat suitability for birds in the winter.

Area Searches

Area searches were conducted at each site during each of the 4-day banding sessions to account for species that may not be captured during standard mist net operations. Standard area search protocol was followed (Ralph *et al*. 1993). The Nature Trail restoration site and the Pratt Agricultural restoration site were split into five sections, which were one to three hectares in size. An area larger than three hectares could not be thoroughly surveyed in twenty minutes in such dense habitat (Ralph *et al.* 1993). One twenty minute area search was conducted in each section. 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 method of detection (visually or aurally). Birds seen flying over the area but not utilizing it were recorded in a separate category as “flyovers”.

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 in order 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.* (2002) were followed at all times.

Vegetation Monitoring

In order to gain further knowledge of how bird captures from constant effort mist-net operations may be correlated to vegetation characteristics of the banding sites a vegetation monitoring protocol was established to collect data on total vegetation volume (TVV). This information was collected once during the winter banding season. At each site measurements were taken from a starting point located at the center of each net lane. Two randomly chosen transects were established from each net lane. One transect was run on either side of the lane, at a length of 20 m. Along each transect, points were taken at every 2 m for a total of 20 points taken from each net lane. At each point, a 7.5 m pole was used to measure vegetation "hits" at every dm section of the pole. At every 10 cm section a "hit" was recorded if any vegetation fell within a 10 cm radius of the pole. This gave measured sections of 0.1m tall and 0.1m radius. For each "hit" the plant species was recorded. Hits were estimated for all vegetation over 7.5 m in height. The data was then used to estimate TVV for each meter of height, and for the entire site as a whole. The data was also broken down to the percentage of each plant species making up the total number of hits for the entire site and per meter of height. This protocol was based on Mills et al. (1991). TVV was calculated using the formula:

$TVV = h/10p$

h= the total numbered of hits recorded for all the plots measured at one site.

p= all the decameter height sections measured.

Results.

Cibola Nature Trail Restoration Site

Reclamation produced 463 net hours during the winter of 2003-2004. There were 199 individual birds captured (.430 birds per net hour) and 39 recaptured birds (.0842 birds per net hour). Twenty-two species were captured, with seven species accounting for over 80% of birds captured: Lincoln's Sparrow 26% (n=52), Chipping Sparrow 20% (n=40), Abert's Towhee 11% (n=21), Ruby-crowned Kinglet 8% (n=16), White-crowned Sparrow 7% (n=13), Orange-crowned Warbler 7% (n=13), and Audubon's Warbler 6% (n=10) (Chart 1). Overall individual captures were roughly equal to the previous year (.430 for 2003-04, .434 2002-03). If all captures are considered (unbanded, recaptures, and new captures) the birds per net hour rate increases to .561. The species composition for the commonly captured species did change noticeably. Chipping Sparrows were not captured at all in the previous year but were captured at a rate of .086 per net hour this year. Conversely, Savannah Sparrows were one of the most common species last year (28% of captures, .117 birds per net hour), and dramatically declined this year (1% of captures, .002 birds per net hour). Audobon's Warbler was the only other bird to decrease from the previous year with all the other commonly captured species increasing (Chart 2).

Chart 1. Species composition of birds captured at the CIBO site.

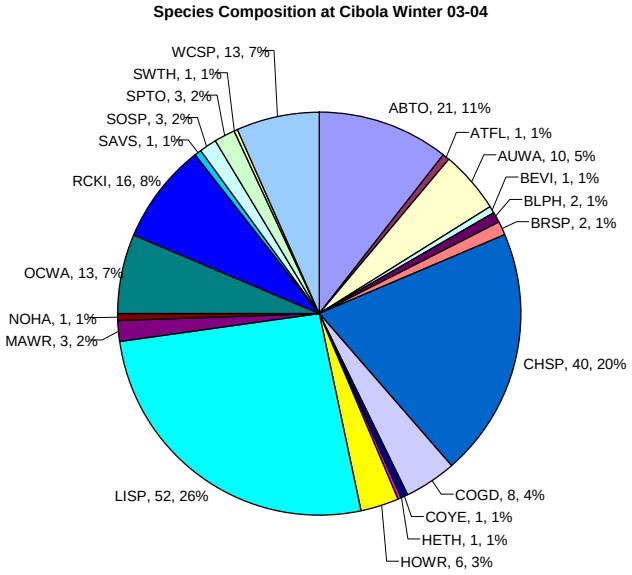
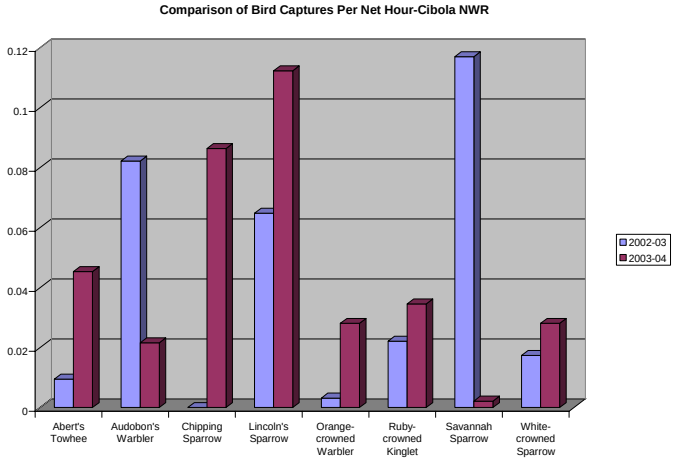


Chart 2. Birds per net hour comparison Year 1 to Year 2 CIBO site.



Pratt Restoration Site

Reclamation produced 450 net hours during the winter period. There were 179 individual birds captured (.398 birds per net hour) and 27 recaptured birds (.06 birds per net hour). Seventeen species were captured, with only three species accounting for over 80% of birds captured: Audubon's Warbler 40% (n=72), Ruby-crowned Kinglet 28% (n=50), and Orange-crowned Warbler 16% (n=28) (Chart 3). As compared to last year overall captures were down (.398 for 2003-04, .573 2002-03) and for the four most commonly captured species captures were lower for all except the Orange-crowned Warbler (Chart 4). For all captures including unbanded birds and all recaptures the birds per net hour rate increases to .483.

Chart 3. Species Composition PRAT site.

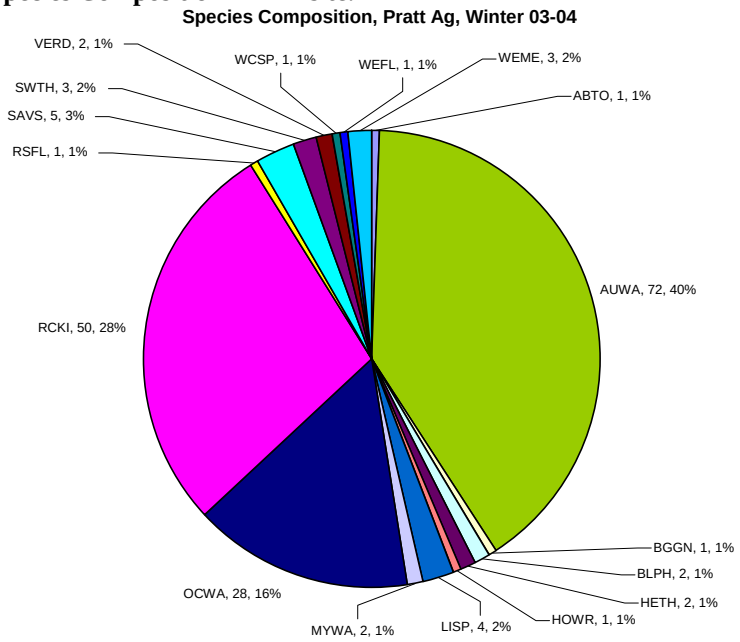
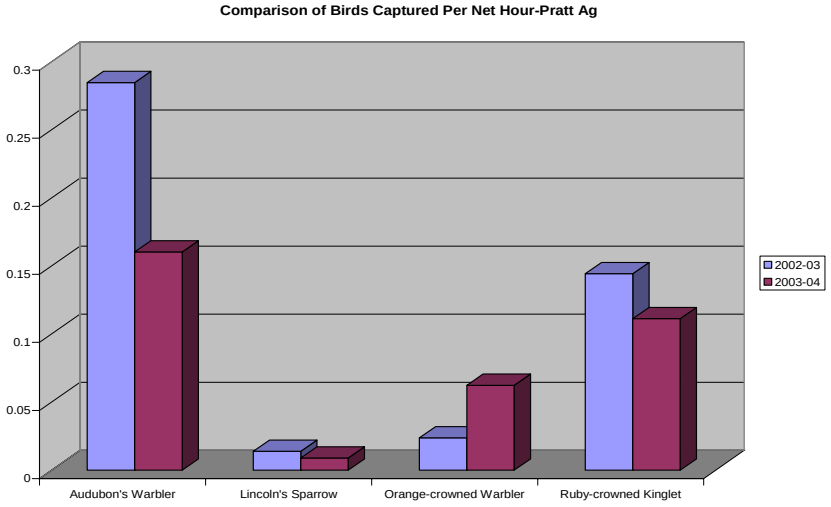


Chart 4. Birds per net hour comparison Year 1 to Year 2 PRAT site.



Bird Condition

Averages for the condition indicators were taken for those species whose capture numbers were high enough to allow an analysis to be made (>10). For all analyzed species Pectoral Muscle Mass levels were above 2.0, and for 60% of the birds analyzed were above 2.5. The 2.0 level is the minimum average for good health and a 2.5 level indicates good to excellent health.

Table 1. Average condition values for commonly captures species at CIBO site.

Species	Avg. Fat	Avg. Wt.	Avg. Wing	Avg. PMM
ABTO	0.30	43.82	87.32	2.89
AUWA	0.78	11.14	72.33	2.50
CHSP	0.64	11.91	69.60	2.63
LISP	0.84	15.40	60.20	2.61
OCWA	1.50	8.49	58.50	2.40
RCKI	1.59	5.87	57.67	2.70
WCSP	0.93	23.53	74.36	2.40

Table 2. Average condition values for commonly captured species at PRAT site.

Species	Avg. Fat	Avg. Wt.	Avg. Wing	Avg. PMM
AUWA	0.97	11.66	72.81	2.15
OCWA	1.11	8.89	60.47	2.44
RCKI	1.93	5.90	57.42	2.58

Over Winter Site Persistence

Over-winter site persistence was measured for the most commonly captured birds at both sites. As the two tables below demonstrate only two species produced no over-winter site persistence. These were the Audobon's Warbler (both sites), and White-crowned Sparrow (CIBO). All the remaining species demonstrated notable high rates of at least 11% or higher. At the CIBO site some of the commonly captured species were different from the previous year. For the species that could be compared to the previous year the site persistence increased for Lincoln's Sparrow (+3.4%), decreased for White-crowned Sparrows (-6.7%) and Ruby-crowned Kinglets (-5.17%), and maintained at 0% for Audobon's Warblers. At the PRAT site, site persistence increased for Orange-crowned Warblers (+8.13%) and Ruby-crowned Kinglets (+5.2%), and slightly decreased for Audobon's Warblers (-.7%).

Table 3. Over-winter Site Persistence for commonly captured birds at CIBO site.

Species	Captures P1-2	Intraperiod Recaps	OW %
Abert's Towhee	16	2	12.50%
Audobon's Warbler	9	0	0.00%
Chipping Sparrow	35	4	11.43%
Lincoln's Sparrow	41	5	12.20%
Orange-crowned Warbler	13	2	15.38%
Ruby-crowned Kinglet	15	5	33.33%
White-crowned Sparrow	13	0	0.00%

Table 4. Over-winter Site Persistence for commonly captured Birds at PRAT site.

Species	Captures P1-2	Intraperiod Recaps	OW %
Audobon's Warbler	58	0	0.00%
Orange-crowned Warbler	15	5	33.33%
Ruby-crowned Kinglet	31	11	35.48%

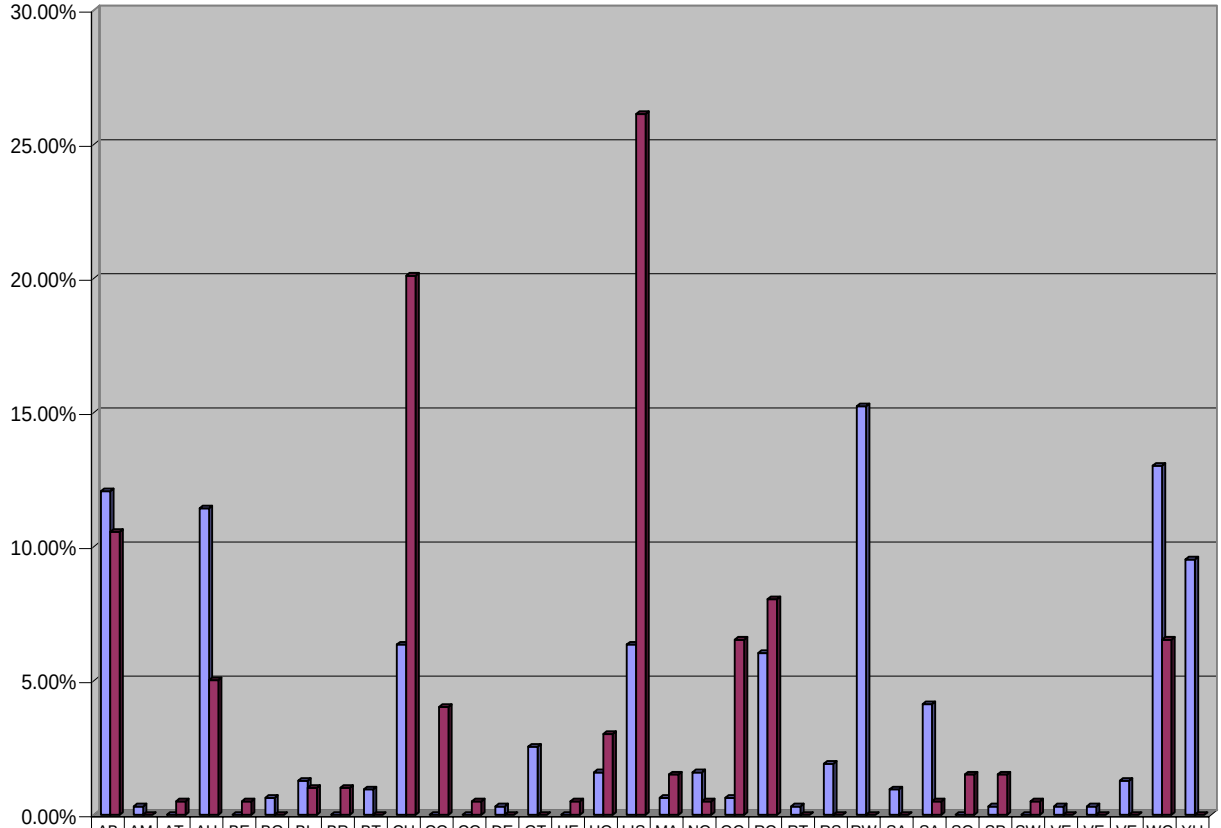
Annual Return

Very few birds were re-captured in the second year that were originally captured in the first year of operations, at both sites. At the Cibola site only one annual return bird was captured, a marsh wren, out of a total of 3 birds captured leading to an annual return rate of 33% for this species. At the Pratt site 1 orange-crowned warbler out of 28, and 4 ruby-crowned kinglets out of 50 were annual returns. This gives a 3.57% and a 8.00% annual return rate for each species respectively.

Area Searches

Area searches were conducted at both sites in conjunction with the banding efforts. At the PRAT site the third period area search was not conducted due to inclement weather conditions during both attempts to conduct the search. At the CIBO site a much larger percentage of overall detections came from the area search data for Audobon's Warbler, Red-winged Blackbirds, White-crowned Sparrow, and Yellow-headed Blackbirds. Larger percentages of birds captured come from the banding data for Chipping Sparrows, Lincoln's Sparrows, and Orange-crowned Warblers (Chart 5.). Area searches detected 26 different species, of which 13 were not captured during banding. Banding efforts captured 22 different species, of which 8 were not detected during area searches (Chart 5.)

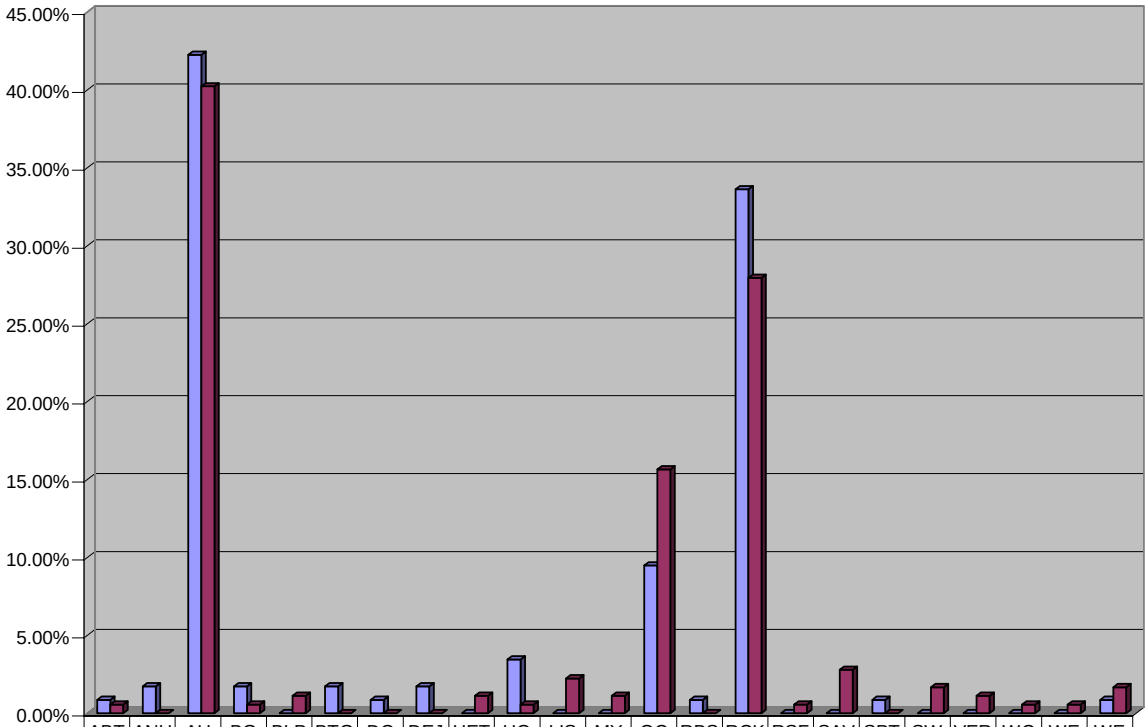
Chart 5. Comparison of the percentage of overall captures per species between area search and banding data at the CIBO site.



	AB TO	AM KE	AT FL	AU WA	BE VI	BG GN	BL PH	BR SP	BT GN	CH SP	CO GD	CO YE	DE JU	GT GR	HE TH	HO WR	LIS P	MA WR	NO HA	OC WA	RC KI	RT HA	RS FL	RW BL	SA PH	SA VS	SO SP	SP TO	SW TH	VE FL	VE RD	VE SP	WC SP	YH BL
Area Search	12.0	0.32	0.00	11.4	0.00	0.63	1.27	0.00	0.95	6.35	0.00	0.00	0.32	2.54	0.00	1.59	6.35	0.63	1.59	0.63	6.03	0.32	1.90	15.2	0.95	4.13	0.00	0.32	0.00	0.32	0.32	1.27	13.0	9.52
Banding	10.5	0.00	0.50	5.03	0.50	0.00	1.01	1.01	0.00	20.1	4.02	0.50	0.00	0.00	0.50	3.02	26.1	1.51	0.50	6.53	8.04	0.00	0.00	0.00	0.00	0.50	1.51	1.51	0.50	0.00	0.00	0.00	6.53	0.00

At the PRAT site area search and banding data were fairly similar with little overall difference in the percentage of the total for each of the species most commonly captured or detected. There was, however, a difference in the number of total species detected with area searches when compared to the total number of species captured during banding efforts. During banding 17 species were captured, 10 of which were not detected during area searches. Area searches detected a total of 13 different species, 6 of which were not captured during banding efforts (Chart 6.).

Chart 6. Comparison of the percentage of overall captures per species between area search and banding data at the PRAT site.



	ABTO	ANHU	AUWA	BGGN	BLPH	BTGN	DCCO	DEJU	HETH	HOWR	LISP	MYWA	OCWA	RBSA	RCKI	RSFL	SAVS	SPTO	SWTH	VERD	WCSP	WEFL	WEME
Area Search	0.86	1.72	42.2	1.72	0.00	1.72	0.86	1.72	0.00	3.45	0.00	0.00	9.48	0.86	33.6	0.00	0.00	0.86	0.00	0.00	0.00	0.00	0.86
Banding	0.56	0.00	40.2	0.56	1.12	0.00	0.00	0.00	1.12	0.56	2.23	1.12	15.6	0.00	27.9	0.56	2.79	0.00	1.68	1.12	0.56	0.56	1.68

Vegetation Measurements

Total Vegetation Volume was measured once at both sites during the winter banding season. The data demonstrates the differences in habitats found at both sites. As to be expected, cottonwood and willow dominated at both sites. Johnson grass at the CIBO site was the only other living plant to exceed 10% of the vegetation measured from either site (Table 5.). Overall percentage of area occupied by vegetation within each meter level was also measured and compared between the two sites. The percentages were fairly similar between each meter level except for the first level (0 to 1 meter in height) where the percentage of vegetation at the CIBO site was more than three times that of the PRAT site (Table 6.).

Table 5. A comparison of relative percentages per plant species for all vegetation measured.

Plant Species	CIBO	PRAT
Alfalfa	0.00%	0.69%
Baccharus spp.	5.60%	8.78%
Bermuda Grass	0.57%	3.13%
Conyza Spp.	0.00%	1.53%
Castor Bean	0.07%	0.00%
Cottonwood	27.55%	43.57%
Coyote Willow	0.50%	9.93%
Dead Material	10.27%	5.19%
Goodding's Willow	22.46%	23.86%
Honey Mesquite	1.76%	0.00%
Johnson Grass	25.94%	0.00%
Screwbean Mesquite	5.28%	0.23%
Salt Cedar	0.00%	3.09%

Table 6. A comparison of the percentage of vegetation occupying each meter level of height.

Meter Level	CIBO	PRAT
0-1	67.14%	21.05%
1-2	27.00%	22.60%
2-3	27.68%	23.35%
3-4	18.95%	20.10%
4-5	13.64%	18.85%
5-6	9.00%	14.90%
6-7	5.14%	6.50%
7-8	4.36%	2.00%
8-9	3.73%	1.05%
9-10	2.77%	0.45%
10-11	2.41%	0.10%
11-12	1.50%	0.00%

Discussion

Species richness at CIBO site and the PRAT site are quite high compared to what would be expected (Rosenberg *et al* 1991, USFWS 2003) for winter residents. For the two banding seasons, 862 birds comprising 37 species were banded at both sites. Rosenberg *et al.* (1991) list 42 species of passerines that are common to fairly common winter residents. Reclamation banded 21 of those common to fairly common passerines between the two restoration sites. Rosenberg *et al.* (1991) data includes all habitats along the LCR, whereas this banding effort is concentrated on small, restored, lowland habitats. Reclamation banded Western Flycatchers, Ash-throated Flycatchers, Hermit Thrushes, Myrtle Warblers, Green-tailed Towhees, Spotted Towhees, White-throated Sparrows, Bell's Vireo, Warbling Vireo and Fox Sparrows all of which are rare in the winter months along the LCR (Rosenberg *et al.* 1991).

Individual birds per net hour were not significantly different between sites, but there was more diversity at the CIBO site. One potential reason for this may be that the CIBO site contains mesquite habitat along with the cottonwood and willow habitats, as the PRAT site does not. The dominance of new world sparrows at the CIBO sites may be contributed to the Johnson grass understory and addition of mesquite habitat with an understory of Baccharis spp.. The understory was almost three times denser with vegetation, at least in the first meter height of vegetation as evidenced by the vegetation volume data collected at both sites (Table 6). New world sparrows forage in soil, leaf litter, grass and low vegetation (Chilton *et al* 1995, Ammon 1995, Sibley 2001). Thick grass and low shrubs or trees such as Baccharis spp. and mesquite provide refuge from predators for new world sparrows (Chilton *et al* 1995, Ammon 1995, Sibley 2001). The dominance of wood warblers at the PRAT site may be due to the lack of development in the understory and a more dominant overstory of Fremont cottonwoods and Goodding willows. Wood warblers generally are found in wooded areas where they glean insects from twigs and leaves (Sogge *et al* 1994, Hunt and Flaspohler 1998, Guzy and Ritchison 1999, Sibley 2001).

The differences in three species; (1) Savannah Sparrows, (2) Chipping Sparrows, and (3) Audubon's Warblers, were highly varied between the two banding seasons at the CIBO site. It appears that the Chipping sparrows have replaced the Savannah Sparrows between years. In 2002-2003 season, 80 Savannah Sparrows were captured and in 2003-2004, 1 Savannah Sparrow was captured. No Chipping Sparrows were captured in 2002-2003, and 40 were captured in 2003-2004. Other differences were Audubon's Warblers, 54 individuals banded in 2002-2003, and 10 banded in 2003-2004. PRAT site exhibited a larger difference in birds per net hour, between years. Birds per net hour were higher in 2002-2003. The capture of 115 Audubon's Warblers in period two of 2002-2003, greatly influenced the capture rate. This banding period occurred during the only time when the PRAT site was flooded and contained standing water which may very well have influenced the number of birds captured. In general, the 2003-04 season was drier and no banding took place during even moist soil conditions. This may have influenced the lower capture numbers experienced during the second season.

Studies of winter avian activity in North America; especially along the LCR are limited. Rosenberg *et al.* is the only record of species account for the LCR in the winter (November to February). Reclamation used Rosenberg's data and general bird life history studies (Sogge *et al* 1994, Ammon 1995, Chilton *et al* 1995, Hunt and Flaspohler 1998, Guzy and Ritchison 1999) as a guide, for which species should occur in abundance at the two restoration sites. This proved difficult to do. Rosenberg's data is strictly observational (abundant, common, rare, etc.), lacks recent data (no observations after 1989) and is very general (includes all habitats along the whole stretch of the LCR). The general bird life history studies were lacking in winter habitat requirements for the majority of species. Differences in species composition cannot be accounted for. The literature lacks any qualitative wintering habitat data along the LCR for Savannah Sparrows or Chipping Sparrows, so it is difficult to determine if their occurrences were to be expected or anomalous. Our preliminary data along with anecdotal evidence indicates that species composition along the LCR may be more variable in the non-breeding season than the breeding season, but due to lack of long-term quantitative data, this unknown.

There were no drastic changes in body condition for any species between the three periods at both sites. Pectoral muscle mass levels were high, averaging 2.4 for the most abundant species. With multiple years of data, trends in species abundance and bird condition should become more evident.

Over-winter site persistence differed between years for the most abundantly captured species with Ruby-crowned Kinglets as an exception. Winter banding in the US is rare, therefore, a comparison of over-winter site persistence with other areas as to what is to be expected in not possible. Since recapture probabilities tend to be low, color banding individuals and attempting to re-sight them may lead to more accurate accounts of over-winter site persistence (Latta 2003). Over-winter site persistence for this study may be underestimated. Nevertheless, given the fact that banding without color-band re-sighting may underestimate winter site persistence it is worth noting that at CIBO 5 of the 7 commonly captured species demonstrated over-winter site persistence levels above 10%, and at PRAT two of the three commonly captured species demonstrated levels above 30%. If these levels are being underestimated, as is likely the case, then a significant portion of these bird species may spend much of the winter banding period utilizing these restoration sites for foraging and shelter. The site fidelity rate of annual returns was very low for a few species and at 0 for the majority at both sites. It is unknown why site fidelity rates are so low and winter site persistence rates are relatively so high. Further data collected in future years will be needed to understand if use of the area is predominated by one age class, or if annual returns increase.

The area search data while problematic in some ways does provide some important additional data as to the species composition and abundance of birds utilizing the restoration habitats. The use of area searches in the winter is difficult due to the lack of singing birds, and the difficulties in visually identifying small passerines within the dense vegetation of the sites. Despite these obstacles some birds are able to be identified by their chip notes (wood warblers, Ruby-crowned Kinglets, and Abert's Towhees), and some bird are visually identified. Many birds are missed and some, such as sparrows, more so than others due to their use of dense ground habitats and many times unidentifiable chip notes. With this in mind, the area search provides useful data more as a compliment to the banding data than as a stand-alone data set. When compared to the banding data the area searches did detect 13 species at CIBO and 6 species at PRAT that were not captured. Most of these species were uncommon species that missed capture in the nets; however, several species at the CIBO site were commonly detected at much higher than levels than with banding. These species were the Red-Winged Blackbird (15.24% of detections), Yellow-headed Blackbird (9.52% of detections), and the White-crowned Sparrow (13.02% of detections versus 6.53% of captures). In the case of both blackbird species none were captured in the nets, despite their relatively high abundance in the area. The lack of captures for these species may be due to the fact that they usually stay outside or high up in the habitat, unless standing water is on the ground.

Preliminary data shows that these restoration sites are important habitat to wintering and permanent avian residents. Sites showed high species diversity as well as high individual abundance. Bird condition appeared to be adequate; however, we do not have any other data sets to compare our data. Future monitoring should occur to detect trends and changes in population, diversity, over-winter site persistence, annual return rate and body condition. Both restoration sites are still maturing and data between years will be compared to detect any changes in the above-mentioned factors as the vegetation characteristics of the site change. Future analysis will include correlating vegetation data with avian diversity and richness. With the anticipated implementation of the MSCP, Reclamation will restore more sites. Data from these sites will be used to determine planting regimes. Not only does a winter banding program assist in determining health of restoration sites, it will also monitor winter avian populations along the LCR.

Appendix A. Standard AOU (American Ornithological Union) Codes used for North American Bird Species.

Code	Common Name	Scientific Name
AMKE	American kestrel	Falco parverius
GAQU	Gambel's quail	Callipepela gambelii
WWDO	white-winged dove	Zenaida asiatica
MODO	mourning dove	Zenaida macroura
COGD	common ground-dove	Columbina passerine
GRRO	greater roadrunner	Geococcyx californianus
LENI	lesser nighthawk	Chordeiles acutipennis
BCHU	black-chinned hummingbird	Archilocus alexandri
ANHU	Anna's hummingbird	Calypta 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
VERD	verdin	Auriparus flaviceps
RBNH	red-breasted nuthatch	Sitta canadensis
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
BTGN	black-throated 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 (Audobon's) warbler	Dendroica coronata audoboni
MYWA	yellow-rumped (Myrtle's) warbler	Dendroica coronata coronata

Code	Common Name	Scientific Name
BTYW	black-throated gray warbler	Dendroica nigrescens
TOWA	Towsend's warbler	Dendroica townsendi
HEWA	hermit warbler	Dendroica occidentalis
AMRE	American redstart	Setophaga ruticilla
NOWA	northern waterthrus	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	Pooecetes 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 lincolnii
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
BHGR	black-headed grosbeak	Phueciticus 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	I. bullocki
SCOR	Scott's oriole	Icterus parisorum
HOFI	house finch	Carpodacus mexicanus
LEGO	lesser goldfinch	Carduelis psaltria
HOSP	house sparrow	Passer domesticus

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