

Los Baños Wildlife Complex Mist-netting and Passerine Banding Report – 2005 & 2006



Yellow-breasted Chat

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Abstract

As part of the avian monitoring program at the Los Baños Wildlife Area Complex, mist-netting and banding of passerines began in the fall of 1997 at the Los Baños Wildlife Area (LBWA). In 1998 we began banding during the spring and summer breeding season as part of the Monitoring Avian Productivity and Survivorship (MAPS) program. The MAPS program was established in 1992 to gather information on songbird population demographics, and is now a continent-wide network of over 500 constant-effort mist-netting stations. In 1999 we added a second MAPS station at the O'Neill Forebay Wildlife Area (OFWA). We expanded our mist-netting program in 2000 to include fall and winter banding. We have now mist-netted for eight MAPS seasons at both LBWA and OFWA. Year-round banding was conducted at both LBWA and OFWA in 2005 and 2006. Since 1997 we have captured a total of 2,656 birds at LBWA. Of these, 612 birds were recaptured. At OFWA we have captured a total of 4,399 birds since 1999, of which 1,028 were recaptured. In 2006, at both stations combined, we caught and processed 934 songbirds of 51 species, including 261 recaptured individuals. Shannon diversity index showed significantly higher species diversity at OFWA compared to LBWA. Jaccard's similarity index illustrated that approximately 70% of the species were shared by both sites from 2000 through 2006. The difference in community composition may be related to habitat structure and landscape features of the sites. Management practices that enhance habitat may increase species diversity at LBWA. Productivity rates fluctuate from year to year at both sites, with lower productivity, although not significant, in 2006 than in 2005.

Keywords: bird banding, MAPS, mist-netting, passerine, Los Baños Wildlife Complex, O'Neill Forebay Wildlife Area.

Introduction

The California Department of Fish and Game has been conducting passerine mist-netting at the Los Baños Wildlife Area Complex since 1997, in partnership with Point Reyes Bird Observatory. In 1998 we began mist-netting at the Los Baños Wildlife Area (LBWA) during the spring and summer breeding season as part of the national Monitoring Avian Productivity and Survivorship (MAPS) program. In 1999 we added a second MAPS mist-netting site at the O'Neill Forebay Wildlife Area (OFWA). The Institute for Bird Populations (IBP), now a partner with the United States Geological Survey in the Biological Resources Division, created the MAPS program in 1989 as a long term study of landbird population demography over large areas and multiple spatial scales. Currently there are approximately 500 MAPS sites, or banding stations, in the nation. The IBP has identified three long term objectives for the MAPS program: 1) to

provide information on productivity, adult survival rates, recruitment rates, population growth rates and population estimation on a large number of resident and migratory target species, 2) to identify and describe the temporal and spatial patterns in the demographic information gathered and determine the relationships between them, and 3) to use these patterns and relationships to determine reasons for population change, suggest management strategies, and evaluate the effectiveness of management implementations (DeSante and Kaschube 2006). Results of landbird population demography studies assist in ascertaining long term environmental health, stressors, and the effects of management actions on the populations studied.

In order to understand how fall migrants and over-wintering landbirds respond to management, we expanded our mist-netting program in 2000 to include year-round banding. Management strategies to maintain habitats for breeding, migrating and wintering landbirds can then be directly implemented on the wildlife areas by utilizing data collected from the year-round mist-netting.

In 2006, we agreed to participate in an avian influenza study conducted by the IBP and the Center for Tropical Research at UCLA. Their goal was to collect 20,000 viral samples this year from approximately 250 MAPS stations in order to identify avian influenza transmission paths in North American migratory landbirds (IBP 2006). Feather samples were also taken for DNA and stable isotope analyses with the goal of understanding the connectivity between breeding and wintering grounds, which may also help to determine potential pathways for the spread of the disease. We collected and submitted both feather and cloacal samples at LBWA and OFWA this year.

On a local scale, the mist-netting program is a useful way to track and monitor landbird use of particular habitats, response to management practices, and population fluctuations. For example, we may want to compare the differences of landbird responses between young versus mature reforestation sites. Information from the mist-netting study can be useful in management of songbird habitat and in long-term comparisons of habitat quality if continued over time.

Study Area

The 5,600-acre (2,266 ha) Los Baños Wildlife Area (LBWA) is located within the Grasslands Ecological Area in the central San Joaquin Valley, three miles (5 km) north of the city of Los Baños in western Merced County, California (37° 08' 05" N; 120° 47' 57"W) (Figure 1). LBWA is composed of seasonal wetlands, annual grasslands, mixed willow riparian habitat, and shrublands. The mist-netting site at LBWA is located along the Salt Slough riparian area (Figure 2). The O'Neill Forebay Wildlife Area (OFWA) is a 705-acre (285 ha) managed riparian area located on the southwestern edge of the city of Santa Nella, California (37° 04' 50.65"N; 121° 01' 12.61"W), approximately 12 miles (19 km) southwest of LBWA (Figure 3). OFWA is composed of annual grasslands, small ponds, and mixed willow riparian areas. The riparian areas at OFWA were planted about 30 years ago to mitigate for riparian habitat loss due to the construction of the San Luis Dam.

The climate of the Grasslands Ecological Area is characterized by hot, dry summers and cool, wet winters. Precipitation averages 21 cm per year and occurs primarily between November and March (California Department of Fish & Game unpublished data 1970-2000). The terrain is flat, ranging in elevation from 29 to 33 m.

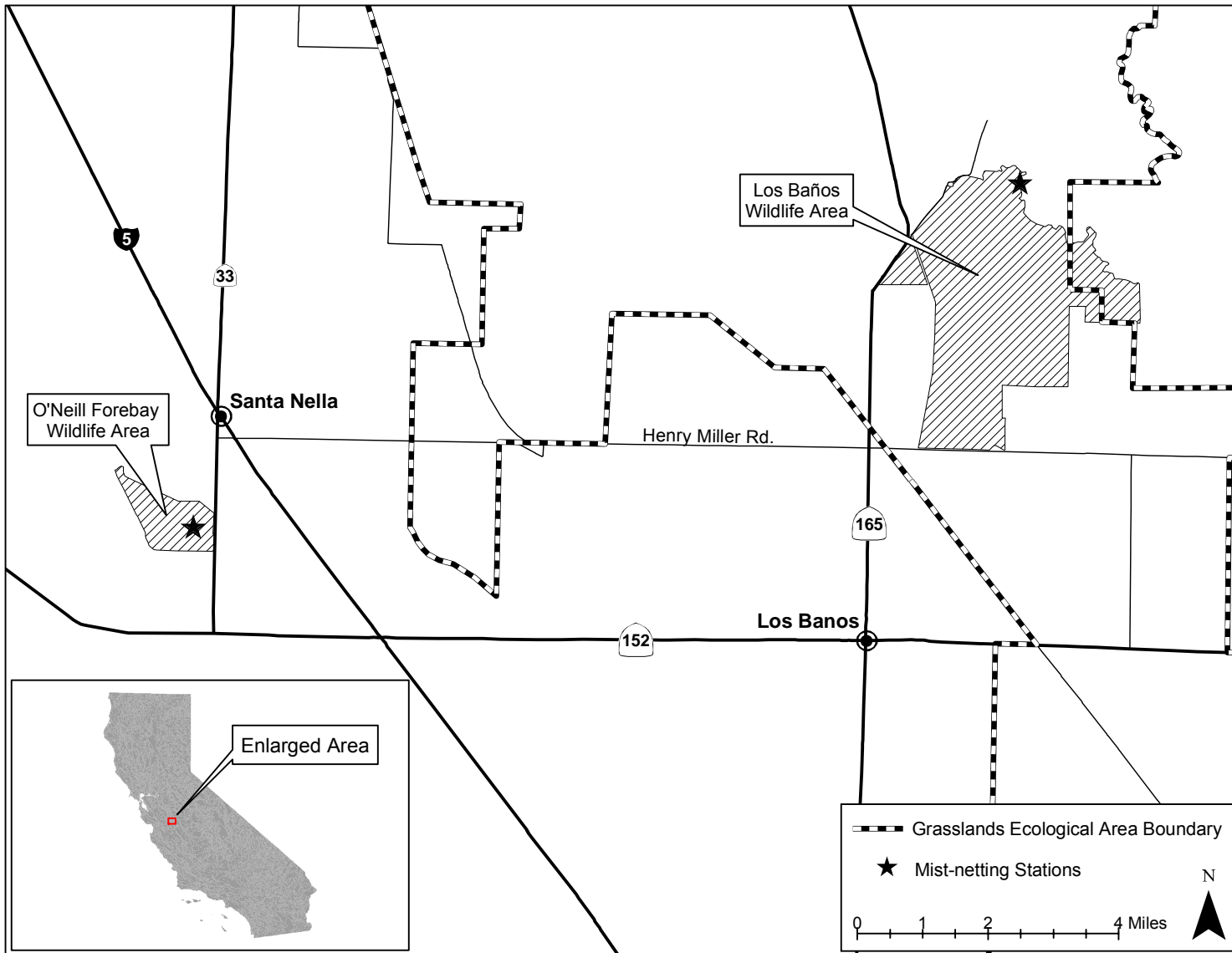


Figure 1. Locations of the Los Baños Wildlife Area and O'Neill Forebay Wildlife Area mist-netting stations, Merced County, California.

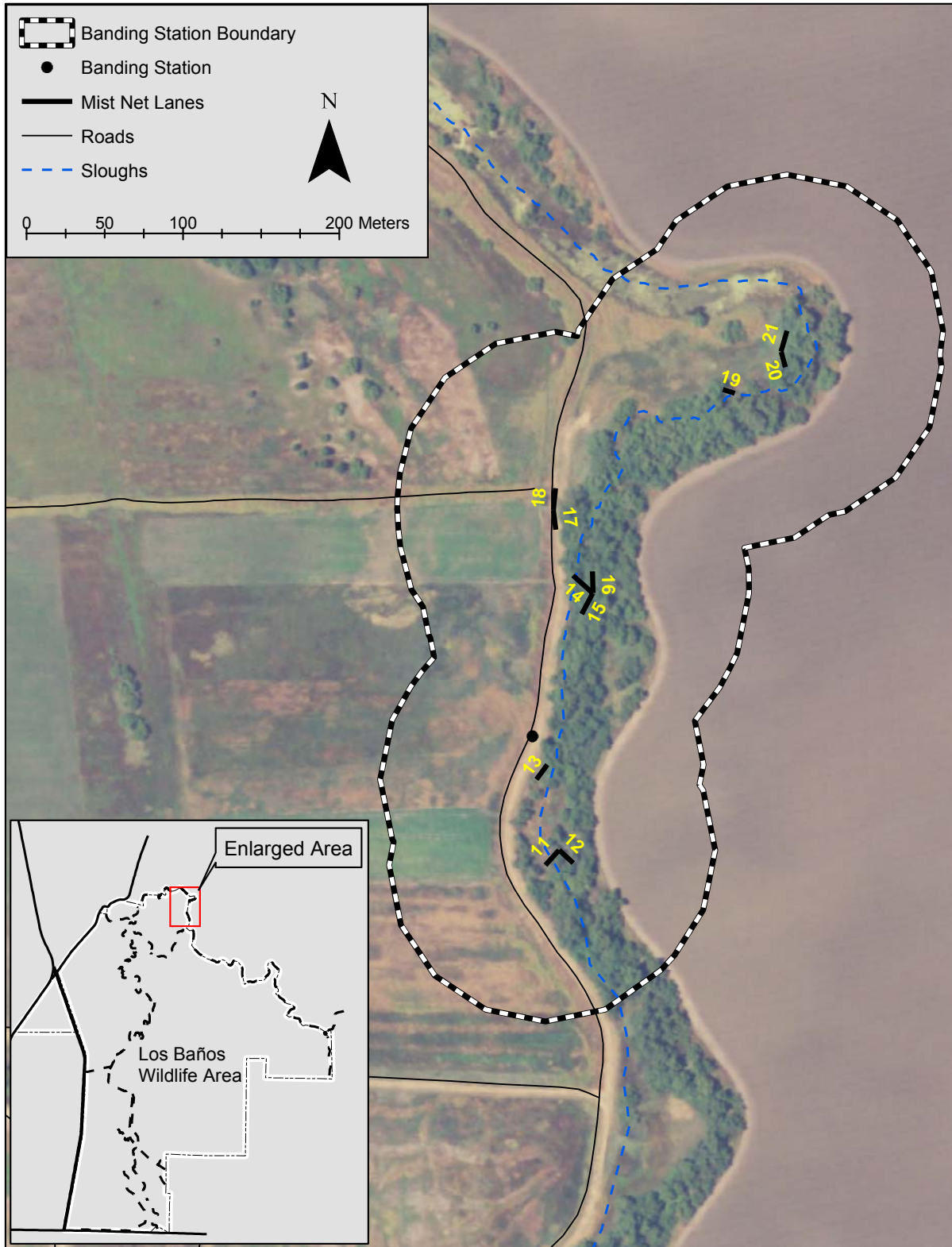


Figure 2. Location of the mist-netting station on the Los Baños Wildlife Area, Merced County, California.

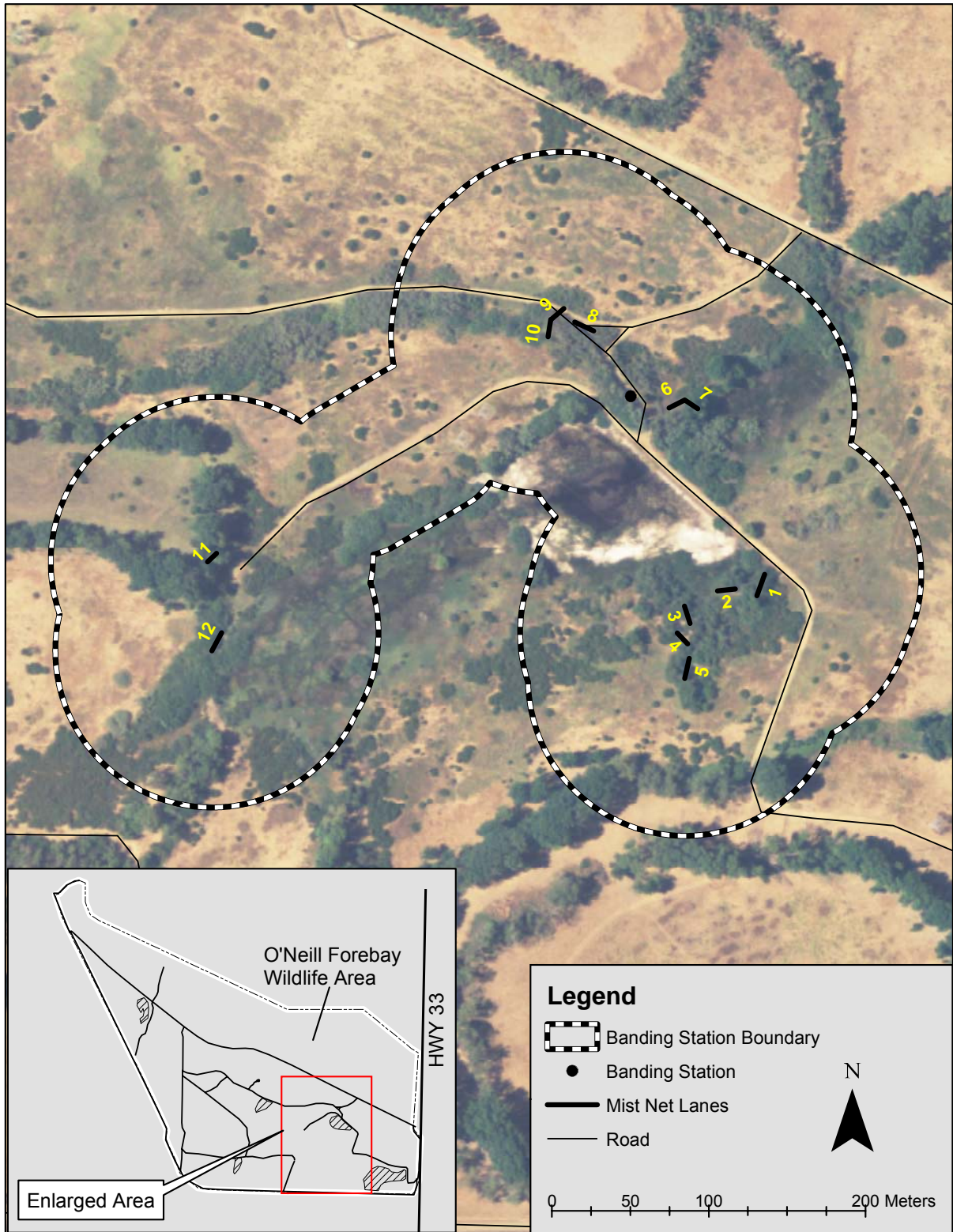


Figure 3. Location of the mist-netting station on the O'Neill Forebay Wildlife Area, Merced County, California.

Methods

We established banding sites according to the MAPS protocol, which outlines several important factors: 1) sites should be representative of the landscape of the surrounding area, 2) sites occur in an area where the structure of the vegetation is such that birds fly low through the area, therefore, a dense understory is desirable, 3) sites contain edge habitat for capturing a large number of dispersing young and adult birds, and 4) sites are free of any disturbances such as a major road which may influence bird flight through the site (DeSante et al. 2006). We arranged net lanes opportunistically in riparian corridors, placing 12 at OFWA and 11 at LBWA. Net locations were in close enough proximity such that they could all be checked on foot in approximately 10 minutes. We used nylon mist nets (12 m long by 2.6 m tall), and operated them from one half-hour before sunrise until 5 hours after the first net was opened, checking each net at 30- to 40-minute intervals. We closed nets early if we perceived that adverse conditions (e.g. high winds or direct sunlight on the nets) could endanger the lives of captured birds. Trained technicians transported the birds to a central location and processed all individuals in the following manner: the birds were banded with the appropriately sized band (or we recorded the band number if it was a recaptured bird) and data were recorded for the time and net location of capture, species, age, sex, wing chord, breeding characteristics (a brood patch or cloacal protuberance), fat accumulation, molting patterns and any other measurements that were needed for species or sex determination (Pyle 1997).

As time permitted, we sampled captured birds for avian influenza following IBP and the Center for Tropical Research at UCLA's (CTR) protocol. All sampling materials were provided by CTR including the sampling vials, Dacron swabs, bar code stickers and feather pull envelopes. We sampled each bird by swabbing its cloaca using a 1-mm or 2-mm Dacron swab and placing the swab into a vial containing 100% ethanol. We labeled each vial with a unique bar code as well as the bird's band number. We collected feather samples by pulling an outer rectrix from one side of the tail, and an inner rectrix from the opposite side of the tail. We then placed these feathers into an envelope for each bird sampled, and labeled it with the bird's band number, species, age and sex. Finally, we released the bird after completing all identification and

measurement tasks. We released breeding birds at the locations where they were caught in order to prevent a bird from crossing through hostile territories or getting lost.

The MAPS program defined ten 10-day periods of the breeding season beginning May 1st and ending August 8th of each year (DeSante et al. 2006). We operated our sites once each period, during the second through the tenth period, from 1998 through 2006. We also operated our mist-netting stations during the fall, winter and spring months in select years (Table 1).

Table 1. Mist-netting effort by year and season for Los Baños and O’Neill Forebay Wildlife Areas. (LB = Los Baños Wildlife Area, OF = O’Neill Forebay Wildlife Area)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Spring		LB	OF	LB, OF	LB, OF	LB, OF	LB, OF	LB, OF	LB, OF	LB, OF
Summer		LB	OF	LB, OF	LB, OF	LB, OF	LB, OF	LB, OF	LB, OF	LB, OF
Fall	LB			LB, OF			OF		LB, OF	LB, OF
Winter			OF	LB, OF			OF	OF	LB, OF	LB, OF

The MAPS program requires Habitat Structure Assessment (HSA) surveys to be conducted every five years, or whenever a major change in the habitat occurs within a mist-netting station. The HSA protocol is used to describe the horizontal and vertical structure of the habitats within a MAPS station (Nott et al. 2003). We conducted HSA surveys on both LBWA and OFWA in 2001 and then again in 2006. For each survey, we delineated the different habitats within the MAPS station boundary and classified each habitat based on the National Vegetation Classification Standard provided in the HSA protocol.

Analysis

For analysis, we considered spring as April and May, summer as June through August, fall as September and October, and winter as November through March. We created these seasons according to the timing of local migration, as well as the arrival and departure of seasonal species. For analysis purposes, each year began in April, therefore, January through March of 2006 is included as winter 2005.

We computed the Shannon diversity index at both sites for all years combined to compare species diversity, based on proportional abundances (Magurran 1998).

Because the values generated by the diversity index are relative and not directly comparable, we calculated a t-test ($\alpha = 0.05$) to detect any difference in diversity between the sites. We calculated the Jaccard's similarity index for all years individually and also combined to show the similarity of bird communities between the sites (Magurran 1998). Jaccard's index values range from zero to one; a value of one indicates that all species are shared, and a value of zero indicates that no species are shared between the two sites.

We computed abundance rates for 2006, as well as recapture rates for all years, for LBWA and OFWA. For both mist-netting locations we also calculated reproductive indices, showing the ratio of adult to juvenile captures. When calculating reproductive indices, we omitted migrant and transient (non-breeding) birds in order to represent locally breeding birds only. We included migrant and transient birds in all other results, and all numbers of captured birds include both banded and unbanded birds unless otherwise specified. We will compute survival rates for individual species when we have a large enough sample size of adults ($n > 30$) captured in multiple years for 3 years or more (Nur et al. 1999). We performed simple linear regressions with a level of significance (α) of 0.05 and two-tailed hypothesis testing to determine trend data for capture rates at each site for each season. We used NCSS 2001 (Hintze 2001) for statistical testing. Data that did not meet requirements for either normality or equal variance were log transformed.

Results

Species Composition

We have processed 68 species at LBWA since 1997 (Appendix 1), and 76 species at OFWA since 1999 (Appendix 2). At both sites, species lists include two subspecies of White-crowned Sparrow (Gambel's and Puget Sound), and three subspecies of Yellow-rumped Warbler (Audubon's, Myrtle, and the hybrid of the two). Overall, we have captured 83 species, including the five individual subspecies, at both sites combined. In 2006 we captured 51 species on the two mist-netting sites, including 32 at LBWA and 46 at OFWA. New species captured for the first time at LBWA in 2005 include the California Quail, Great Horned Owl, and Red-shouldered Hawk. New

species captured in 2006 at LBWA include the Black-headed Grosbeak, Ring-necked Pheasant and Western Flycatcher. In 2005, we caught five new species at OFWA: the Blue-gray Gnatcatcher, European Starling, Red-winged Blackbird, Rufous Hummingbird and Sharp-shinned Hawk. Only one new species was captured at OFWA in 2006, the Ring-necked Pheasant.

Species Diversity and Similarity

Shannon diversity index (H') was 2.83 at LBWA and 3.26 at OFWA. OFWA had a significantly greater diversity of birds than LBWA ($t = 14.02$, $df = 4611.22$, $P < 0.001$). Jaccard's similarity indexes showed that LBWA and OFWA had a little more than half of their species in common in 2006 (Table 2). For all years combined, the two sites are more similar in species composition than on a year-to-year basis.

Table 2. Jaccard's similarity indexes for avian communities between the Los Baños and O'Neill Forebay Wildlife Areas.

	2000	2001	2002	2003	2004	2005	2006	Total
Jaccard's Similarity Index	0.54	0.51	0.41	0.42	0.44	0.65	0.53	0.73

Abundance

Since 1997, we have caught 6,931 birds at both sites and in all seasons combined, including 1,609 recaptures. We have processed a total of 4,399 birds at OFWA (142 banding days; an average of 32 birds per day) and 2,656 birds at LBWA (142 banding days; an average of 19 birds per day). The highest capture rates occur in the spring for both LBWA and OFWA (Figures 4 and 5). We found no significant trends in the average number of birds caught per day at either site. We processed 934 birds at both stations combined from April 2006 through January 2007 (Table 3). Recapture rates fluctuated at both sites among years (Table 4).

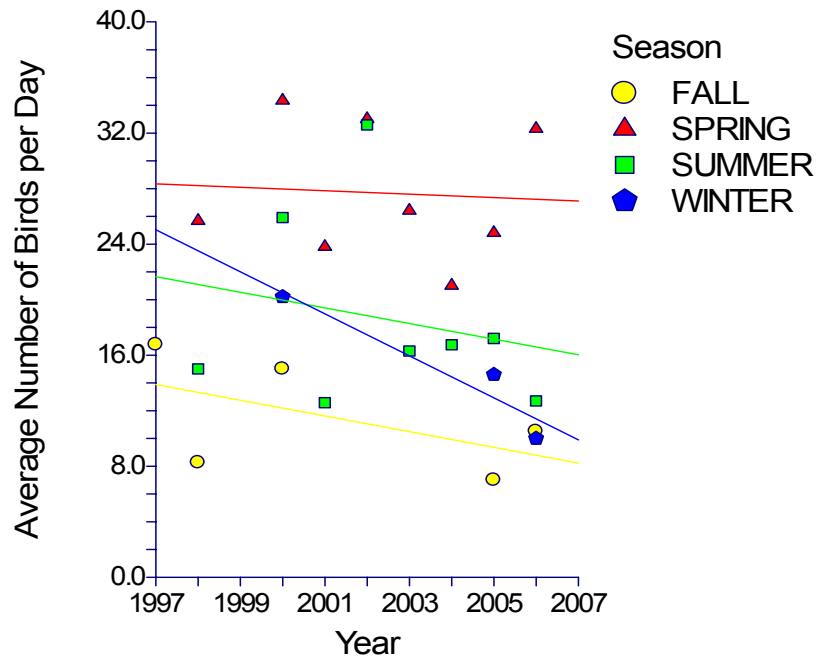


Figure 4. The average number of birds caught per banding session at the Los Baños Wildlife Area.

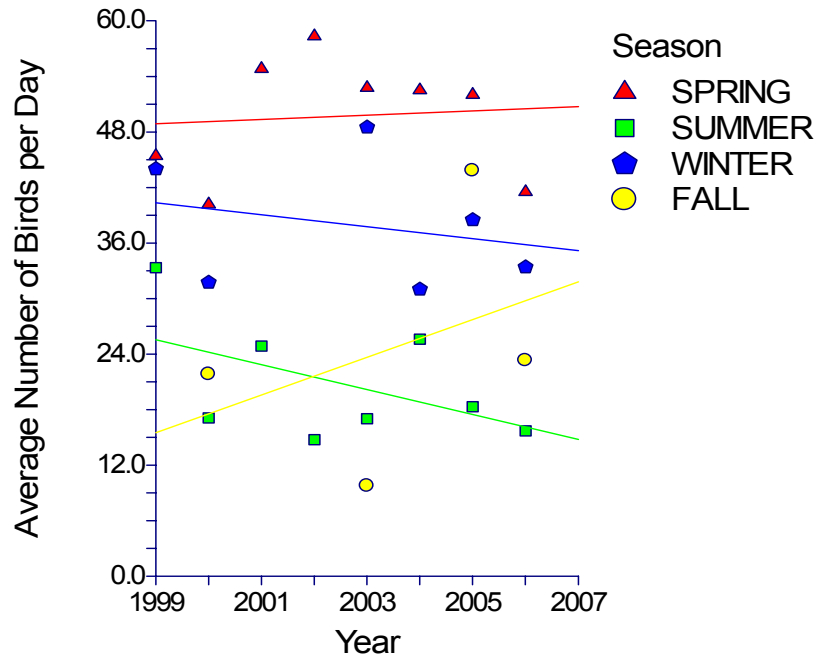


Figure 5. The average number of birds caught per banding session at the O'Neill Forebay Wildlife Area.

Table 3. Abundance data per wildlife area for the 2006 passerine banding season (April 2006 – January 2007).

<i>Wildlife Area</i>	<i>Total Birds Caught</i>	<i>Number of Banding Days</i>	<i>Average Number of Birds/Day</i>	<i>New Captures</i>	<i>Recaptures</i>
Los Baños	315	20	15.8	210	105
O'Neill	619	22	28.1	463	156

Table 4. Recapture rates for all years and all seasons combined, during passerine banding at the Los Baños and O'Neill Forebay Wildlife Areas.

<i>Wildlife Area</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2006</i>
Los Baños	0.04	0.13		0.17	0.33	0.20	0.30	0.29	0.27	0.33
O'Neill			0.12	0.29	0.25	0.22	0.18	0.19	0.26	0.25

Productivity

In 2006, juvenile birds represented 18% of the total captures at LBWA and 21% at OFWA. We have banded for eight summers at each site and overall reproductive indices at both sites fluctuated each year (Table 5 and Table 6). Of species presented in Tables 5 and 6, reproductive indices of the Spotted Towhee at LBWA has significantly declined by 4.3% annually since 1998 ($R^2=0.60$, $P=0.02$). No other significant differences in productivity existed.

Table 5. Reproductive indices (young/adult) for common breeding birds banded at the Los Baños Wildlife Area.

<i>Species</i>	<i>1998</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2006</i>
Bewick's Wren	0.50	0.75	1.33	0.67	0.00	2.50		und. ¹
Bushtit	0.33	1.50	2.00	1.25	1.00	0.00	1.00	0.00
Common Yellowthroat	und.	0.20	1.67	0.50	0.57	1.80	0.89	0.54
House Finch	2.00	0.80	0.00	0.00	0.00	0.00	2.00	0.50
House Wren	0.38	1.50	0.33	1.60	0.57	1.15	0.54	0.22
Nuttall's Woodpecker	0.33	2.00	2.00	0.67	0.25	0.50	0.50	0.00
Song Sparrow	0.53	1.69	0.53	1.48	0.91	0.33	0.57	0.27
Spotted Towhee	0.67	0.46	0.25	0.20	0.00	0.18	0.08	0.23
All Species	0.54	1.32	0.67	0.96	0.57	0.70	0.54	0.28

¹ Reproductive indices (young/adult) are undefined because no adults of this species were captured in this year.

Table 6. Reproductive indices (young/adult) for common breeding birds banded at the O'Neill Forebay Wildlife Area.

<i>Species</i>	<i>1999</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2006</i>
Bewick's Wren	1.86	1.44	1.83	1.27	1.55	0.52	2.18	1.00
Black Phoebe		1.00	4.50	und. ¹		2.00	2.00	und.
Bushtit	4.50	1.29	2.13	0.00	0.29	0.70	1.75	0.50
House Finch	0.00	0.06	0.56	0.17	0.10	0.05	0.32	0.08
House Wren	0.00	4.00	3.00	8.00	1.50	3.00	7.00	1.20
Nuttall's Woodpecker	0.00	3.50	1.50	1.25	und.	0.00	3.00	0.00
Song Sparrow	0.20	0.15	0.74	0.29	0.86	1.75	1.60	0.42
All Species	0.63	0.57	1.36	0.64	0.62	0.40	1.03	0.39

¹ Reproductive indices (young/adult) are undefined because no adults of this species were captured in this year.

Survival Rates

After seven consecutive years of banding, the only species where we have recaptured enough individuals in multiple years to be able to calculate survival rates is the Song Sparrow at LBWA (Table 7). After one more year of mist-netting, we should also be able to calculate survival rates for House Wrens at LBWA and Bewick's Wrens at OFWA. Because only one species can be analyzed thus far, we will not compute survival rates until next year. As more juvenile birds are recaptured in successive years we will also be able to calculate survival rates of individuals initially captured as juveniles. Twenty-two of the 28 Bewick's Wrens captured at OFWA in multiple years were originally captured as juveniles.

Table 7. The number of individuals of locally breeding bird species that have been captured in multiple years (April through August) for each wildlife area.

<i>Species</i>	<i>Los Baños</i>	<i>O'Neill</i>
American Goldfinch	7	4
American Robin	1	5
Ash-throated Flycatcher	3	0
Bewick's Wren	4	28
Black-headed Grosbeak	0	3
Brown-headed Cowbird	3	6
Bullock's Oriole	0	3
Bushtit	3	5
Common Yellowthroat	7	0
House Finch	1	10
House Wren	28	2
Nuttall's Woodpecker	3	5
Song Sparrow	38	15
Spotted Towhee	17	6

Habitat Structure Assessment

Habitat Structure Assessment surveys conducted in 2006 revealed minor changes in habitat composition from the 2001 surveys. We found three major habitat types within the LBWA station in 2006 (Figure 6), whereas in 2001 an additional habitat type, Creeping Wild Rye (*Leymus triticoides*) perennial grassland, covered about 9% of the station. The percentages of annual forbland and cotton habitats did not change much in the last five years, both accounting for approximately 36 – 37% of the station. The mature Black Willow (*Salix nigra*) riparian habitat did increase by about 10% since 2001, to about 28% of the station.

In 2006, the three major habitat types found on OFWA were the same as those found in 2001, however percent cover of each type has changed. The major habitats documented in 2006 were grassland-forbland, willow riparian, and wetland, comprising 51%, 31% and 18% of the station respectively (Figure 7). In 2001, perennial grassland comprised 55%, wetlands 24%, and riparian 21% of the station.

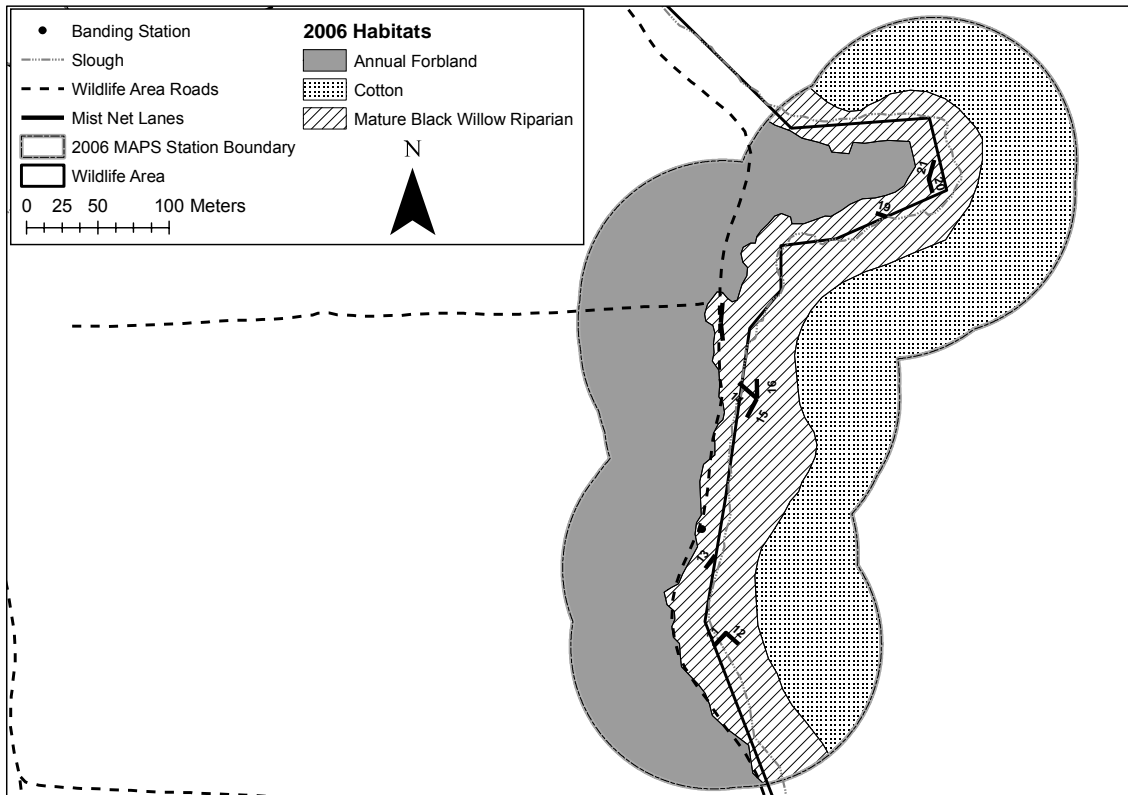


Figure 6. 2006 Habitat Structure Assessment results at the Los Baños Wildlife Area mist-netting station.

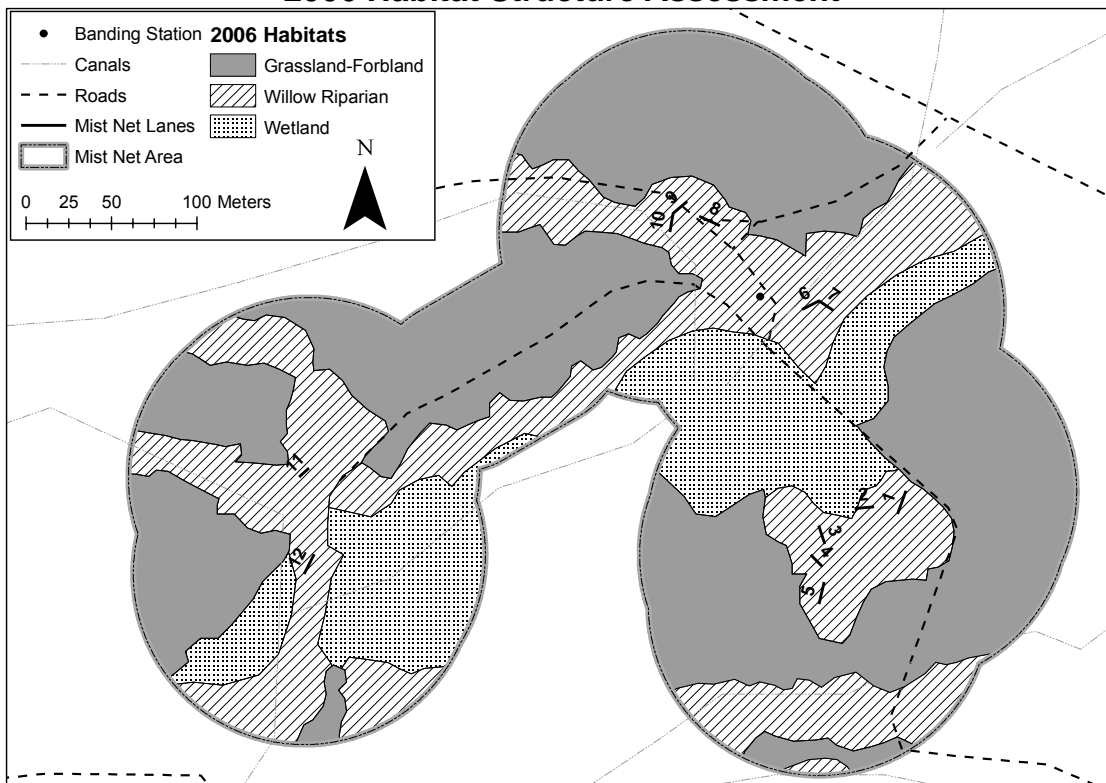


Figure 7. 2006 Habitat Structure Assessment results at the O'Neill Forebay Wildlife Area mist-netting station.

Discussion

Avian Species Composition

Habitat composition of the LBWA mist-net station is different than that of the OFWA station, which could explain much of the differences in avian species diversity. The site at LBWA is located within mature riparian habitat composed of Black Willows and some scattered Fremont Cottonwoods (*Populus fremontii*). The riparian corridor is a fairly narrow strip, approximately 50 m wide, with an agricultural field on the eastern side which varies with crop rotation from cotton, to tomatoes or alfalfa. The western side of the riparian corridor is a managed upland field providing dense herbaceous cover. The willow riparian habitat has increased by 10% since 2001, mainly due to the existing trees growing larger and the crowns of the trees covering more area. Despite the increase in area covered, there is no tree regeneration within this riparian zone, and there are numerous downed trees and snags. Over the years tree planting has occurred nearby, but not within the mist-net station itself. The site at OFWA is located within a younger riparian habitat. OFWA is a riparian restoration site that was planted over 30 years ago. Additional tree plantings have occurred over time on the property, however not within the mist-net station. The riparian habitat is more diverse than LBWA and includes Black Willows, Red Willows (*Salix laevigata*), Sandbar Willows (*Salix sessilifolia*) and Fremont Cottonwoods, many of which are regenerating. There is also a shrub layer component to OFWA composed of Coyote Bush (*Baccharis pilularis*) and some limited Saltbushes (*Atriplex lentiformis*). These differences in habitat composition could explain some of the variations between avian species at the two sites. For example, House Wrens, more frequently caught at LBWA than OFWA, typically breed along the edges of forests and within more open woodlands (Johnson 1998). Conversely, Bewick's Wrens, more frequently caught at OFWA, are typically found in more brushy locations and areas with thickets (Kennedy and White 1997), reminiscent of the habitat at OFWA.

Another factor that could influence species composition at LBWA and OFWA is geographic location. OFWA is located at the base of the coastal foothills near the Pacheco Pass, and might therefore be used by birds as a migration corridor. This could help explain a higher number of migrant songbirds captured at OFWA as compared with

LBWA. Within the vicinity of OFWA, there are few other wooded areas, thus OFWA provides ideal habitat for songbirds to use during migration. For example, migrants such as warblers use stopover sites to refuel during long distance migrations.

Productivity

Banding data provides estimates of productivity at our mist-net locations. Overall productivity fluctuated from year to year at both LBWA and OFWA. Individual species' productivity also fluctuated from year to year, with some years as high as eight juvenile birds per one adult. It is not precisely known what causes productivity to be high one year and quite low the next. With just eight summers to analyze, we are likely only seeing a small window into the trend. For example, the last eight years of data show a slight decrease in productivity, but over the course of ten to twenty years the trend could actually be rather stable. The North American Breeding Bird Survey (BBS), which has been conducted since 1966, provides insight into how our population trends compare with those throughout the Central Valley of California. For example, the productivity of the Spotted Towhee at LBWA has significantly declined by 4.3% annually since 1998. The BBS trend for Spotted Towhees in the Central Valley from 1966-2006 shows a non-significant ($P=0.55$), 2.3% annual decreasing trend, as well as a non-significant ($P=0.76$), 0.7% annual increasing trend from 1980-2006 (Sauer et al. 2007). During the 1998 through 2006 period however, there is a non-significant ($P=0.25$), 16.32% annual increase in the Spotted Towhee population for the Central Valley (Sauer et al. 2006). This is just one example of how variable population trends can be, and how different snap shots in time can produce different results.

Habitat Assessment

The overall composition of habitat types within the banding stations on the Los Baños and O'Neill Forebay Wildlife Areas have not changed too dramatically since 2001. Much of the changes in habitat type percentages could be a result in differences in mapping techniques between years and among personnel. The most notable change occurred on LBWA with the reduction of the Creeping Wild Rye perennial grassland habitat. In 2001, there was a significant amount of Creeping Wild Rye located in the

northern part of the banding station between Mud Slough and the riparian corridor (Figure 8). Since that time, an increasing amount of different annual and perennial forbs began growing in this area. Perennial Pepperweed (*Lepidium latifolium*), a highly invasive species, has encroached from the levee and appears to be spreading further east into this section each year. Bristly Ox-tongue (*Picris echioides*) and Poison Hemlock (*Conium maculatum*) densities also appear to have increased through the years. However, there still continues to be a fair amount of *Juncus* spp. and some Creeping Wild Rye in the eastern most section of this area, near nets 19, 20 and 21. Other than this one change, there have not been any other major differences at either banding station from 2001 to 2006.



Figure 8. 2001 Habitat Structure Assessment results at the Los Baños Wildlife Area mist-netting station.

Management Implications

Our mist-netting data at OFWA show that restored riparian habitat contains a diversity of breeding and migrating avian species. Increasing habitat diversity at LBWA by planting trees, shrubs, as well as an herbaceous understory, could also increase the

avian diversity at that location. Planting young trees among the mature trees at LBWA will also help ensure that the riparian corridor will persist as the mature trees senesce. Also, it is critical that the Perennial Pepperweed be actively controlled in an effort to prevent its expansion into the area once dominated by Creeping Wild Rye. Continuing to manage the area adjacent to the LBWA site for upland gamebirds will provide important nesting habitat for species such as the Spotted Towhee and Song Sparrow, and provide foraging habitat for tree-nesting species such as the Ash-throated Flycatcher and American Goldfinch. At OFWA, the riparian habitat should be allowed to mature, leaving snags and downed trees to provide habitat for cavity nesters such as the Ash-throated Flycatcher and Nuttall's Woodpecker.

Other Recommendations

After nine years of banding at LBWA, we believe we have sufficiently determined our avian species diversity, particularly in relation to the locally breeding species. However, to truly monitor population trends over time, we would need to continue our mist-netting efforts for many more years. To calculate survival rates at LBWA for not only the Song Sparrow, but also the House Wren, mist-netting should continue for at least one more year. By mist-netting for an additional year, it is more than likely that we will have recaptured enough individuals to perform this analysis. However, it is highly unlikely that we would be able to calculate survival rates for any other species at LBWA unless we band for at least 5–10 more years. If any habitat restoration occurs adjacent to or within the LBWA mist-net station, such as tree or understory plantings or invasive weed control, banding should continue in order to monitor avian response. However, if we are interested in relative bird abundance and habitat associations rather than survivorship, productivity or recruitment, avian point counts can be utilized in lieu of constant-effort mist-netting. Funding and personnel availability can also play a role in determining the level of monitoring possible once habitat restoration occurs. Point counts require far less effort than mist-netting. For example, one experienced field technician can conduct point counts on a typical schedule of one survey per month. We would need a minimum of approximately 176 person-hours annually to accomplish field work, data entry and analysis, and report writing associated with this survey method.

However, a minimum of two experienced technicians would be required to mist-net anywhere from once per month up to once every ten day period, depending on the time of year. If we account for field work, data entry and analysis, and report writing, a minimum of approximately 600 person-hours would be required on an annual basis. Preferably, as long as funding allows, we recommend conducting constant-effort mist-netting if restoration occurred within the mist-net station. This would allow us to monitor any changes in the distribution of the locally breeding birds, as well as any changes in their productivity.

We recommend that banding continue at OFWA in order to obtain enough data to calculate survival rates for the Bewick's Wren. A minimum of five more years of banding may also allow us to calculate survival rates for the Song Sparrow. Maintaining our banding effort can help us monitor any changes in avian diversity as the habitat at OFWA continues to senesce. Additional years of banding may also allow us to observe any effects that urban development in the Santa Nella area may have on the avian community.

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Appendix 1. The number of each species captured per year during passerine banding at the Los Baños Wildlife Area.

SPECIES	1997	1998	2000	2001	2002	2003	2004	2005	2006
American Goldfinch <i>Carduelis tristis</i>	6	17	24	15	22	20	6	16	8
American Robin <i>Turdus migratorius</i>		4	10	3	4	5	3	1	15
Anna's Hummingbird <i>Calypte anna</i>						2	0	0	0
Ash-throated Flycatcher <i>Myiarchus cinerascens</i>		6	4	5	14	5	3	1	2
Audubon's Warbler <i>Dendroica coronata auduboni</i>	10	0	24	14	0	0	0	5	0
Bewick's Wren <i>Thryomanes bewickii</i>	6	11	14	12	5	8	7	0	3
Black Phoebe <i>Sayornis nigricans</i>	2	3	2	1	8	3	4	4	4
Black-chinned Hummingbird <i>Archilocus alexandri</i>			2	0	0	0	0	1	0
Black-headed Grosbeak <i>Pheucticus melanocephalus</i>									2
Black-throated Gray Warbler <i>Dendroica nigrescens</i>			1	0	0	0	0	0	0
Blue Grosbeak <i>Passerina caerulea</i>		2	3	0	0	0	0	1	1
Brown-headed Cowbird <i>Molothrus ater</i>		3	4	5	6	2	3	1	5
Bullock's Oriole <i>Icterus bullockii</i>					1	4	2	5	0
Bushtit <i>Psaltriparus minimus</i>	13	13	43	10	11	6	2	7	5
California Quail <i>Callipepla californica</i>								2	5
California Towhee <i>Pipilo crissalis</i>			3	0	1	1	0	0	0

Appendix 1 continued. The number of each species captured per year during passerine banding at the Los Baños Wildlife Area.

SPECIES	1997	1998	2000	2001	2002	2003	2004	2005	2006
Chipping Sparrow <i>Spizella passerina</i>					1	0	0	0	0
Common Yellowthroat <i>Geothlypis trichas</i>	3	16	16	19	38	28	15	30	37
Downy Woodpecker <i>Picoides pubescens</i>			2	0	0	2	0	1	0
Fox Sparrow <i>Passerella iliaca</i>	2	2	1	0	0	1	0	3	0
Gambel's White-crowned Sparrow <i>Zonotrichia leucophrys gambelii</i>	6	3	6	1	0	0	0	2	1
Golden-crowned Kinglet <i>Regulus satrapa</i>			3	0	0	0	0	0	0
Golden-crowned Sparrow <i>Zonotrichia atricapilla</i>	5	2	8	2	0	1	0	7	1
Gray Flycatcher <i>Empidonax wrightii</i>			1	0	0	0	0	0	0
Great Horned Owl <i>Bubo virginianus</i>								1	0
Hermit Thrush <i>Catharus guttatus</i>	1	7	0	0	0	0	0	5	7
Hermit Warbler <i>Dendroica occidentalis</i>			1	0	0	0	0	0	0
House Finch <i>Carpodacus mexicanus</i>	2	7	9	5	4	2	1	4	3
House Wren <i>Troglodytes aedon</i>	14	47	68	44	40	44	38	106	66
Lazuli Bunting <i>Passerina amoena</i>				1	0	0	0	0	0
Lincoln's Sparrow <i>Melospiza lincolni</i>	11	4	25	2	0	3	0	20	6
Loggerhead Shrike <i>Lanius ludovicianus</i>				1	0	0	0	0	0

Appendix 1 continued. The number of each species captured per year during passerine banding at the Los Baños Wildlife Area.

SPECIES	1997	1998	2000	2001	2002	2003	2004	2005	2006
MacGillivray's Warbler <i>Oporornis tolmiei</i>	2	1	0	0	0	1	0	0	2
Marsh Wren <i>Cistothorus palustris</i>		1	0	0	0	7	2	3	3
Mourning Dove <i>Zenaida macroura</i>					1	0	0	0	0
Myrtle Warbler <i>Dendroica coronata coronata</i>			3	0	0	0	0	4	0
Nashville Warbler <i>Vermivora ruficapilla</i>	1	0	0	1	0	0	0	2	0
Northern Mockingbird <i>Mimus polyglottos</i>			1	0	0	0	0	1	0
Northern Rough-winged Swallow <i>Stelgidopteryx serripennis</i>			1	1	0	0	0	0	0
Nuttall's Woodpecker <i>Picoides nuttallii</i>	1	9	3	5	6	5	3	3	1
Orange-crowned Warbler <i>Vermivora celata</i>	5	4	4	0	0	0	0	5	5
Oregon Junco <i>Junco hyemalis oregonus</i>		1	0	0	0	0	0	0	0
Pacific-slope Flycatcher <i>Empidonax difficilis</i>	1	2	3	0	0	0	2	2	0
Puget Sound White-crowned Sparrow <i>Zonotrichia leucophrys pugetensis</i>			1	0	0	0	0	0	0
Red-shafted Flicker <i>Colaptes auratus cafer</i>	1	2	1	2	0	0	1	3	1
Red-shouldered Hawk <i>Buteo lineatus</i>								1	0
Red-winged Blackbird <i>Agelaius phoeniceus</i>					1	2	0	1	1
Ring-necked Pheasant <i>Phasianus colchicus</i>									1

Appendix 1 continued. The number of each species captured per year during passerine banding at the Los Baños Wildlife Area.

SPECIES	1997	1998	2000	2001	2002	2003	2004	2005	2006
Ruby-crowned Kinglet <i>Regulus calendula</i>	8	6	73	1	0	0	0	37	19
Sharp-shinned Hawk <i>Accipiter striatus</i>	1	0	1	0	0	0	0	0	0
Song Sparrow <i>Melospiza melodia</i>	21	61	174	35	90	61	35	89	63
Spotted Towhee <i>Pipilo maculatus</i>	5	12	50	9	13	11	16	33	23
Swainson's Thrush <i>Catharus ustulatus</i>		3	28	4	13	8	6	5	13
Townsend's Warbler <i>Dendroica townsendi</i>				1	0	0	0	0	0
Tree Swallow <i>Tachycineta bicolor</i>		3	3	1	0	2	0	1	0
Unidentified Empidonax Flycatcher <i>Empidonax spp.</i>		1	0	0	0	0	0	0	0
Unknown Hummingbird <i>Trochilidae gen.</i>						1	0	0	0
Unknown Yellow-rumped Warbler <i>Dendroica coronata</i>			3	0	0	0	0	0	0
Warbling Vireo <i>Vireo gilvus</i>		1	1	0	1	0	0	0	1
Western Flycatcher <i>Empidonax difficilis/occidentalis</i>									1
Western Kingbird <i>Tyrannus verticalis</i>							1	0	0
Western Scrub-jay <i>Aphelocoma californica</i>				1	1	0	0	0	0
Western Tanager <i>Piranga ludoviciana</i>		3	0	0	0	0	0	0	0
Western Wood-pewee <i>Contopus sordidulus</i>				1	1	0	0	0	0

Appendix 1 continued. The number of each species captured per year during passerine banding at the Los Baños Wildlife Area.

<i>SPECIES</i>	1997	1998	2000	2001	2002	2003	2004	2005	2006
White-crowned Sparrow <i>Zonotrichia leucophrys</i>	5	0	0	0	0	0	0	0	0
Willow Flycatcher <i>Empidonax traillii</i>		1	1	0	3	0	0	1	0
Wilson's Warbler <i>Wilsonia pusilla</i>	1	3	7	2	4	6	0	9	3
Yellow Warbler <i>Dendroica petechia</i>	1	2	1	2	0	1	0	1	7
TOTAL	134	263	633	206	289	242	150	424	315
Net Hours	169.34	414.67	1498.00	614.33	495.00	655.00	439.33	1275.82	959.85
Birds per 100 Net Hours	79	63	42	34	58	37	34	33	33
Number of Banding Days	8	19	27	12	9	12	9	26	20
Birds per Banding Day	16.75	13.84	23.44	17.17	32.11	20.17	16.67	16.31	15.75

Appendix 2. The number of each species captured per year during passerine banding at the O'Neill Forebay Wildlife Area.

SPECIES	1999	2000	2001	2002	2003	2004	2005	2006
Allen's Hummingbird <i>Selasphorus sasin</i>		1	0	0	0	0	0	0
American Goldfinch <i>Carduelis tristis</i>	31	52	17	17	5	5	5	20
American Kestrel <i>Falco sparverius</i>					1	0	0	0
American Robin <i>Turdus migratorius</i>	30	16	6	9	10	1	16	8
Anna's Hummingbird <i>Calypte anna</i>	5	7	1	2	1	0	16	6
Ash-throated Flycatcher <i>Myiarchus cinerascens</i>			3	0	0	2	2	0
Audubon's Warbler <i>Dendroica coronata auduboni</i>	9	17	3	0	6	15	21	17
Bewick's Wren <i>Thryomanes bewickii</i>	40	75	54	47	57	59	132	82
Black Phoebe <i>Sayornis nigricans</i>		10	12	5	0	3	9	5
Black-chinned Hummingbird <i>Archilocus alexandri</i>	1	3	1	0	2	2	7	2
Black-headed Grosbeak <i>Pheucticus melanocephalus</i>	2	8	4	9	3	6	6	8
Blue Grosbeak <i>Passerina caerulea</i>		4	2	2	0	0	0	0
Blue-gray Gnatcatcher <i>Polioptila caerulea</i>							1	0
Brown-headed Cowbird <i>Molothrus ater</i>	14	7	6	4	5	4	4	7
Bullock's Oriole <i>Icterus bullockii</i>	4	8	4	10	15	2	7	3
Bushtit <i>Psaltriparus minimus</i>	21	74	36	6	24	27	112	45

Appendix 2 continued. The number of each species captured per year during passerine banding at the O'Neill Forebay Wildlife Area.

SPECIES	1999	2000	2001	2002	2003	2004	2005	2006
California Towhee <i>Pipilo crissalis</i>					1	0	3	0
Cassin's Vireo <i>Vireo cassinii</i>					1	0	0	0
Cliff Swallow <i>Petrochelidon pyrrhonota</i>					1	0	0	0
Common Yellowthroat <i>Geothlypis trichas</i>	5	12	16	1	8	7	17	12
Downy Woodpecker <i>Picoides pubescens</i>		1	0	0	0	0	0	0
European Starling <i>Sturnus vulgaris</i>							1	0
Fox Sparrow <i>Passerella iliaca</i>	5	6	2	0	15	7	18	10
Gambel's White-crowned Sparrow <i>Zonotrichia leucophrys gambelii</i>	8	87	4	0	26	7	55	26
Golden-crowned Kinglet <i>Regulus satrapa</i>		1	0	0	1	0	0	0
Golden-crowned Sparrow <i>Zonotrichia atricapilla</i>	17	34	18	0	6	13	58	23
Gray Flycatcher <i>Empidonax wrightii</i>				1	0	0	0	0
Hammond's Flycatcher <i>Empidonax hammondii</i>					1	0	0	0
Hermit Thrush <i>Catharus guttatus</i>	17	17	3	0	4	13	47	32
Hermit Warbler <i>Dendroica occidentalis</i>		1	0	0	0	0	0	0
House Finch <i>Carpodacus mexicanus</i>	18	49	16	43	41	44	59	57
House Wren <i>Troglodytes aedon</i>	2	16	9	10	16	9	15	14

Appendix 2 continued. The number of each species captured per year during passerine banding at the O'Neill Forebay Wildlife Area.

SPECIES	1999	2000	2001	2002	2003	2004	2005	2006
Hutton's Vireo <i>Vireo huttoni</i>		2	0	0	0	0	0	0
Lawrence's Goldfinch <i>Carduelis lawrencei</i>		4	0	0	0	0	0	1
Lazuli Bunting <i>Passerina amoena</i>			1	0	0	0	0	0
Lincoln's Sparrow <i>Melospiza lincolenii</i>	6	32	4	0	0	4	20	10
Loggerhead Shrike <i>Lanius ludovicianus</i>	4	1	1	1	1	0	0	0
MacGillivray's Warbler <i>Oporornis tolmiei</i>	6	1	7	4	5	3	3	3
Marsh Wren <i>Cistothorus palustris</i>		1	0	0	0	0	2	0
Mourning Dove <i>Zenaida macroura</i>	2	0	3	5	1	2	0	1
Myrtle Warbler <i>Dendroica coronata coronata</i>			1	0	0	1	8	2
Nashville Warbler <i>Vermivora ruficapilla</i>	1	1	1	0	1	1	1	1
Northern Bobwhite <i>Colinus virginianus</i>				1	0	0	0	0
Northern Mockingbird <i>Mimus polyglottos</i>		4	1	2	2	1	6	2
Nuttall's Woodpecker <i>Picoides nuttallii</i>	2	13	6	11	6	5	11	8
Orange-crowned Warbler <i>Vermivora celata</i>	16	32	7	3	11	11	30	19
Pacific-slope Flycatcher <i>Empidonax difficilis</i>	4	4	1	2	0	0	2	2
Puget Sound White-crowned Sparrow <i>Zonotrichia leucophrys pugetensis</i>		5	1	0	7	3	6	2

Appendix 2 continued. The number of each species captured per year during passerine banding at the O'Neill Forebay Wildlife Area.

SPECIES	1999	2000	2001	2002	2003	2004	2005	2006
Red-shafted Flicker <i>Colaptes auratus cafer</i>		3	0	1	2	0	2	6
Red-tailed Hawk <i>Buteo jamaicensis</i>		1	0	0	0	0	0	0
Red-winged Blackbird <i>Agelaius phoeniceus</i>							1	0
Ring-necked Pheasant <i>Phasianus colchicus</i>								1
Ruby-crowned Kinglet <i>Regulus calendula</i>	28	95	9	0	33	28	106	61
Rufous Hummingbird <i>Selasphorus rufus</i>							1	0
Savannah Sparrow <i>Passerculus sandwichensis</i>				1	0	0	0	0
Sharp-shinned Hawk <i>Accipiter striatus</i>							2	1
Song Sparrow <i>Melospiza melodia</i>	23	51	59	20	26	22	53	32
Spotted Towhee <i>Pipilo maculatus</i>	10	24	15	5	5	4	11	18
Swainson's Thrush <i>Catharus ustulatus</i>	31	22	31	19	33	12	40	21
Townsend's Warbler <i>Dendroica townsendi</i>		1	0	0	0	0	0	0
Tree Swallow <i>Tachycineta bicolor</i>					2	0	3	3
Tricolored Blackbird <i>Agelaius tricolor</i>	2	0	0	0	0	0	0	0
Unknown Empidonax Flycatcher <i>Empidonax spp.</i>					2	0	0	0
Unknown Hummingbird <i>Trochilidae gen.</i>			1	3	5	5	1	8

Appendix 2 continued. The number of each species captured per year during passerine banding at the O'Neill Forebay Wildlife Area.

SPECIES	1999	2000	2001	2002	2003	2004	2005	2006
Unknown Yellow-rumped Warbler <i>Dendroica coronata</i>			1	0	1	0	0	0
Warbling Vireo <i>Vireo gilvus</i>	1	0	2	0	1	0	2	2
Western Flycatcher <i>Empidonax difficilis/occidentalis</i>					1	0	0	1
Western Kingbird <i>Tyrannus verticalis</i>		1	1	0	3	3	0	2
Western Scrub-jay <i>Aphelocoma californica</i>		1	2	0	1	0	0	0
Western Tanager <i>Piranga ludoviciana</i>	1	0	1	1	0	0	0	0
Western Wood-pewee <i>Contopus sordidulus</i>		2	0	0	0	0	0	0
White-crowned Sparrow <i>Zonotrichia leucophrys</i>	2	2	0	0	0	0	2	3
Willow Flycatcher <i>Empidonax traillii</i>	2	1	0	0	3	1	5	4
Wilson's Warbler <i>Wilsonia pusilla</i>	33	32	58	34	36	15	48	18
Yellow-breasted Chat <i>Icteria virens</i>	1	0	0	0	0	0	0	1
Yellow Warbler <i>Dendroica petechia</i>	9	6	4	5	9	6	23	9
TOTAL	413	848	435	284	447	353	1000	619
Net Hours	476.16	1891.40	718.50	585.00	910.86	620.33	1762.53	1308.32
Birds per 100 Net Hours	86.74	44.83	60.54	48.55	49.07	56.91	56.74	47.31
Number of Banding Days	10	32	12	11	17	11	27	22
Birds per Banding Day	41.30	26.50	36.25	25.82	26.29	32.09	37.04	28.14