BIRD INVENTORY AND MONITORING

at

LAGUNA de SANTA ROSA

Years 2004/05 & 2007–2009

Final Report

To

Sonoma County Agricultural Preservation and Open Space District

Prepared by

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INTRODUCTION

The Laguna de Santa Rosa (Laguna) is a 250 square mile Sonoma County freshwater wetland complex fed by many smaller tributary creeks originating in the surrounding hillsides. The Laguna's main stem originates in Cotati and its floodplain is located between the towns of Sebastopol and Santa Rosa. It is the largest tributary to the Russian River in nearby Forestville. The Laguna has been recognized as one of the most biologically diverse habitats in the region with a mix of open water, perennial and seasonal wetlands, riparian forests, and Valley Oak (*Quercus lobata*) savannah grasslands. It supports a number of threatened or endangered species. The Laguna drains the Santa Rosa Plain and is highly important as a floodwater basin for the lower Russian River. The vast Laguna floodplain has an important function in flood attenuation in the Russian River watershed. Important economic uses of the Laguna floodplain include sheep and cattle grazing, hay production, and treated wastewater disposal.

The Sonoma County Agricultural Preservation and Open Space District, in consultation with other entities, has developed a trail system along the Laguna to provide public access throughout the scenic Laguna floodplain area. As these trails may affect potentially sensitive wildlife habitats (e.g. wildlife corridors and important bird breeding areas; Tewksbury et al., 2002; Koenig, 2003) an important consideration of trail implementation is to assess potential trail impacts on the plants and animals of the Laguna.

This study builds on a previous study by PRBO Conservation Science (Fehring and Gardali 2005) to establish a three to four year baseline of pre-trail conditions measuring the natural fluctuations in bird populations throughout the Laguna areas where trails are proposed. Potential impacts to birds during and after trail construction can then be compared to a meaningful set of baseline data spanning across several years. The abundance, diversity and richness of birds in the Laguna, documented by the time of year present, distribution, taxonomic guild, habitat type used, breeding status, and regulatory status are useful indicators to assess the health of the Laguna ecosystem and potential negative impacts of trail construction and use. Once potential impacts are identified specific management recommendations can be implemented to address them in a timely manner to reduce their effects.

The original PRBO Conservation Science report (Fehring and Gardali 2005) describes the bird inventory and monitoring work conducted in the winter 2004/2005 and spring 2005 for the Laguna de Santa Rosa Trails project. This report includes this original work and includes data for an additional five seasons. We repeated the PRBO Conservation Science point count survey protocol in the springs of 2007, 2008 and 2009; and winters of 2007/2008 and 2008/2009. The original point count locations and survey protocol were followed in order to allow data comparisons across seasons and years.

This report so incorporates a four year/seven season analysis, applying identical standardized monitoring techniques to provide data on the distribution, abundance, richness, and diversity of songbirds breeding and wintering in the Laguna. These data can help managers identify: 1) management goals (e.g., increase the population for a target species), 2) appropriate management scales, 3) habitat types and habitat elements necessary to meet the goals, and so significantly inform management decisions (George and Zack 2001). Knowing the distribution and abundance of a species can aid in the design of wildlife corridors, help target restoration sites, and highlight those areas that need to be protected.

Our study approach, adopted from PRBO Conservation Science, is directly suitable for long-term evaluation of bird population dynamics; all of the survey locations are permanent (and randomly selected) and the protocols are consistent with national standards (Ralph et al. 1993, Fancy and Sauer 2000). Regular surveys provide a means to evaluate anthropogenic impacts, and impacts from non-native species. They help assess community diversity, species abundance and distribution over time to guide the design and implementation of appropriate management actions. Long-term standardized datasets such as this are

valuable in assessing the potential effects of immediate land use changes such as trail development, and the changing conditions due to climate change.

METHODS

Point Counts

The PRBO Conservation Science protocol utilizes standardized methods to collect bird data during the spring and winter months. The Variable Circular Plot (VCP), and 50 meter fixed radius (FR50) point count methods both include flyovers, and counts within a circular area of a 100 meter maximum radius. They provide a repeatable measure of songbird abundance and community composition at 44 randomly established survey stations throughout the Laguna floodplain. Each ~986 square meter area per station was surveyed for five minutes three times each season, six times total (see Appendix A for point count station locations and Table 1 for survey dates), during December, January, February (winter), and April, May, and June (spring). All PRBO Conservation Science surveys in 2004/05 were conducted by K. Fehring, and all 2007, 2008 and 2009 Laguna de Santa Rosa Foundation surveys were conducted by L. Hug (Table 1). Both surveyors are bird experts with intimate knowledge of the songs and calls of birds in Sonoma County.

The 44 surveys stations were randomly generated by PRBO Conservation Science using the random point generator in the Alaska Pak extension for ArcView 3.2a (Fehring and Gardali 2005) and mapped on Stone, Kelly, Balletto, Brown, Alpha Farms as well as the Laguna Wetlands Park and the California Department of Fish and Game (CDFG) property just south of Alpha Farm (Appendix A). Survey stations sampled a variety of habitat types including oak savannah, oak woodland, grassland, riparian, wetland, and vineyard (Balletto only; Table 2). All birds seen or heard at each point were recorded during the five minute sampling period. For all species, each individual bird was recorded as a separate observation. Distances were estimated to the nearest 10-meter interval, and observers used range-finders and binoculars. Additional detail of the VCP and FR50 methods can be found at http://data.prbo.org/cadc2/index.php?page=songbird-point-counts.

We calculated relative abundance, species richness, and species diversity, totaled across station visits within each season for all birds. Bird abundance is the total number of birds recorded per station over three visits and species richness is the total number of species detected on average at all stations within a specific habitat type. Species diversity is the number of species detected, weighted by the number of individuals of each species. Known as the Shannon-Weiner index, this widely used diversity index reflects both the species richness as well as the evenness of distribution among species (USFWS 1999). All point count data are stored online at the California Avian Data Center (http://data.prbo.org/cadc2/)

Point Count Vegetation Assessment

PRBO Conservation Science assessed vegetation parameters around each point count location using the relevé method (Ralph et al. 1993). We estimated percent cover of each vegetation class (trees, shrubs, and herbaceous plants) over a 50-meter radius circle (Table 2). Vegetation classes were defined by height (tree > 5 meters, shrub = 50 centimeters to 5 meters, and herbaceous < 50 centimeters), and all plant species within each class were recorded. All vegetation measurements were completed in May, prior to mechanical harvest on City of Santa Rosa Farms. Vegetation variables were not analyzed here, but may be examined in

the future. In 2007/2008/2009 we judged the structure of the habitat within 50 meters of the point by assessing tree height, number of trees, density of bushes and area of grassland. Points were assigned one of eleven categories of habitats (Table 2).

Wetland/Pond Surveys

In 2004-05, PRBO Conservation Science conducted area surveys at the Brown Farm pond and the two ponds on the Kelly Farm. The demonstration wetland is referred to as Kelly Farm Pond North and we also surveyed the smaller pond just to the south. These surveys were also completed over the winter and spring months and were conducted about once a month (Table 3). We utilized visual scan methodology and all species seen or heard were recorded. We also noted any evidence of breeding status. The Brown Farm Pond and Kelly Farm Pond South both allow clear lines of sight and were surveyed from one respective observation point. Kelly Farm Pond North was surveyed in a standardized pattern, walking south along the fence, then back north along the trail that bisects the wetland. This same route was followed each survey.

In 2007-09, the three ponds Kelly and Brown same ponds were surveyed. In addition, the two adjoining ponds on Alpha Farm were also surveyed. Because these ponds are right next to each other, separated by a short dam, they are referred to together as Alpha Pond. In January of 2008, the Balletto property pond was added to the survey. Each pond was observed for a period between 3 to 20 minutes. All water bird species seen or heard were recorded using the visual scan method.

Inclusive Bird List

In addition to formal surveys, we noted all bird species observed while on the study sites and summarized these by location and season (Appendix B). This list includes species detected during point counts, wetland surveys, and any additional species documented on or over the study area.

Data Analysis

We conducted analysis of variance (ANOVA) to assess annual differences of overall bird species richness and target species abundance across habitat types and years, and to determine yearly variations in relative species abundance and diversity across point count stations.

RESULTS

Point Counts

Special Status Species

There are 27 species of local management concern in the Laguna de Santa Rosa (Honton & Sears 2006). No Federally Endangered or Threatened species were documented during the point count surveys in any of the seven seasons that point counts were conducted. In all, a total of 27 species of special regulatory or management status were encountered during point counts. Seven of these are species listed on the

California Bird Species of Special Concern list (Shuford and Gardali, 2008): Loggerhead Shrike, Northern Harrier, American White Pelican, Vaux's Swift, Yellow Warbler, Grasshopper Sparrow, and Short-eared Owl. In addition, the data from thirteen focal species from the Riparian Bird Conservation Plan (RHJV 2004), the Oak Woodland Bird Conservation Plan (CPIF 2002) and the Grassland Bird Conservation Plan (CPIF 2000) were selected to demonstrate seasonal population trends (Table 4). Two of these species are also birds of special local management concern: the Marsh Wren (Figure 1) and the Common Yellowthroat (Figure 2). The Long-billed Curlew is a Species of High Concern by the US Shorebird Conservation Plan. Table 4 summarizes the seasonal distribution of these birds of special status.

We review three species in more detail: Marsh Wren was chosen because of its status as a bird of local management concern. Common Yellowthroat was also selected as a bird of local management concern, and as a focal species in the Riparian Bird Conservation Plan. Song Sparrow was included in our detailed review because of its status as a Focal Species in the Riparian Bird Conservation Plan, and as one of the most abundantly encountered species during the study.

Marsh Wren also shows consistent numbers with 32-38 total detections during the spring and 18-23 total winter detections (Figure 1a). More wrens were counted in spring than winter, but this may be due to the population migrating further south for the winter (Kroodsma and Verner 1997), and the remaining wrens being less vocal. Marsh wrens were mainly found in the Oak Savannah riparian habitat type during both seasons throughout the study period (Figure 1b).

Common Yellowthroat detections fluctuated between 39 and 53 over four breeding seasons (Figure 2a). Common Yellowthroats were recorded in wetland habitats with large concentrations of Cat-tail and/or Tule, or intact riparian habitat with rich understory. They were mainly found in oak-savannah-riparian; riparian-floodplain-oak-savannah; floodplain-oak-savannah, and riparian-grassland habitat types (Figure 2b). In 2009, some singing males were recorded in oak-woodland (station 20), and oak-savannah (station 26) habitat types. They appeared to be using the tall, cultivated grasses under the shade of large oaks. Common Yellowthroats are known to use a variety of habitats (Morimoto and Wasserman1991, Shuford, Gardali and Comsrack 2008).

Total seasonal Song Sparrow point counts range between ~450-500 in spring, and ~280-330 in winter throughout the study period (Figure 3a). The higher detections of sparrows in the spring months than during the winter months, was likely a factor of the tendency of Song Sparrows to be more vocal during the breeding season than during the winter months. Song sparrow counts varied by habitat type and years with most encounters in the riparian-grassland; oak-savannah-riparian; and oak-woodland habitat types (Figure 3b). Song sparrows are least found in vineyard and short-grassland habitats (Figure 3b).

Non-Native or Potential Pest Species

The point counts tracked native and non-native populations of nine potential pest species: Brown-headed Cowbird, (native, nest parasite), Cattle Egret (non-native), Canada Goose (native, increasing as breeder in formerly non-breeding range), Wild Turkey (non-native), Rock Pigeon (non-native), European Starling (non-native), House Sparrow (non-native), Ring-necked Pheasant (non-native) and Eurasian Collared Dove (non-native; Table 5). Two additional non-native species were encountered during point count surveys, but were not considered worth tracking because of the small number and lack of persistence of the species: Bobwhite

heard in the riparian area of Stone Farm in the spring of 2007, and European Goldfinch which was likely an escaped pet bird with a banded leg, encountered along Duer Creek on Kelly Farm in the winter of 2007-08.

Two encountered species with potentially deleterious effects on the capabilities of a variety of native birds to breed are: 1) European Starling (takes over tree hollows potentially available for woodpeckers, swallows, nuthatches, bluebirds; Koenig 2003); and 2) the Brown-headed Cowbird (nest parasite of several species of birds, including neo-tropical migrants (Kosciuch & Sandercock 2008). The breeding season occurrence numbers of both of these species have increased steadily from 2005 to 2009: ~2.5-fold between breeding seasons 2005/07, ~3-fold between 2005/08, and 3.2-fold between 2005/09 (Figure 4a, $p < 0.05$). Increases were 1.2-fold between 2007/08, 1.3-fold between 2007/09, and 1.1-fold between 2008/09 (Figure 4a, all not significant at alpha 0.05). During spring, starlings are primarily found in short-grassland; grassland; riparian-grassland, and oak-woodland habitat types (Figure 4b). In winter, starlings are mainly found in vineyard-oak savannah; oak savannah; short-grassland; and oak savannah-riparian habitats (Figure 4c). In 2009, an unusually large number of starlings were encountered at station 55 (short grassland) during spring, and station 43 (vineyard, oak savannah) during winter.

Brown-headed Cowbirds breeding season numbers increased 1.3-fold between 2005/07, 1.6-fold between 2005/08 and 2005/09, and 1.2-fold between 2007/08 and 2007/09. (Figure 5a, $p < 0.05$). Counts remained steady between 2008 and 2009 (Figure 5a). Cowbirds were only rarely detected during winter months (Figure 5a). Habitat types with most cowbird encounters include riparian-floodplain-oak savannah; oak-woodland; riparian-grassland; oak-savannah-riparian; and oak savannah (Figure 5b).

Wetland/Pond Surveys

Wetland/pond surveys revealed the importance of these open water habitats, providing roosting and feeding habitat for a variety of waterfowl, waterbirds and wetland-associated landbirds. Birds observed at the ponds are summarized in Table 6 through 10. Birds of special status are marked in bold. Averages that include representations of broods of young have an asterisk.

Species List

All birds seen or heard at any time during any visits to the study area, during the study months, were recorded. By the end of the first year of study, PRBO Conservation Science had acquired a cumulative list of 102 species in the study site area. Five additional seasons of surveys (beyond PRBO CONSERVATION SCIENCE's 2004/05 study) added another 41 species to the study area species list (Appendix B).

Breeding Evidence

Several nests were found during the springs of 2007, 2008 and 2009. These nests were not actively searched for, but found while on-site before or after conducting the surveys. Table 11 shows bird species with confirmed nests and nests locations.

Species Richness

We quantified the average number of species detected per point count station in each vegetation type (Table 2). Species richness per habitat type varied in both seasons (Figure 6, Table 12). Habitat types with ~15 - 30 observed species per station included riparian floodplain oak savannah, floodplain oak savannah, vineyard/oak savannah, short grassland, and oak savannah/riparian. Riparian/grassland, oak savannah, oak woodland, grassland and vineyard are habitat types with ~3-14 observed species per station during the study period. Species richness by habitat types also varied between years and seasons, with a distinctly lower species richness documented in spring 2005 versus both springs 2007 to 2009, while the difference during winters 2004/05, 2007/08, and 2008/09 is significant yet the a yearly trend is less clear (Figure 6, Table 12, $p < 0.001$).

Relative Abundance

Relative abundance is the number of detections per unit area (in this case ~986 square meters surrounding each point count station). The number of individuals detected at a given point count station is a function of the probability of detecting an individual (that is present) and the absolute abundance (USFWS 1999). Here we surveyed each point count station three times throughout a season and used the sum of the three detections per point station in our analysis. We used analysis of variance (ANOVA) to compare relative abundance per station per season across years. On average, relative abundance fluctuated only slightly by point count station (as a likely function of different vegetation/ habitat types) in both seasons (Figure 7, Table 13, $p =$ n.s. (winter), $p < 0.05$ (spring)). Across years, average relative abundance was notably reduced in winter 08/09 (Figure 7, Table 13, $p = 0.0001$) and spring 2009 (Figure 7, Table 13, $p < 0.0001$) compared to all earlier surveys.

Species Diversity

Species diversity is a measure of both species richness and relative abundance. For example, species diversity is high in an area that has a large number of species and many representative individuals from each. There are a variety of recognized species diversity indices; the most widely used being the Shannon-Weaver index (USFWS 1999). This index reflects both species richness and evenness of distribution among species present and was used here. Shannon's H can range from zero to about 4.6 with higher values representing increasing diversity. We used analysis of variance (ANOVA) to compare species diversity per station per season across years. Species diversity varied across sampling stations and across years in spring (Figure 8, Table 14, $p < 0.001$) and in winter (Figure 8, Table 14, $p = 0.05$). The variation across stations is likely a function of the variation in station vegetation/habitat types (Table 2). Average species diversity across years increased significantly between spring 2005 and the sampled springs up to 2009, and diversity is highest in 2009 (Figure 9, Table 14, $p < 0.001$). Diversity also increased from winters 2004/05 to 2007/08 and is highest in 2008/09 (Figure 9, Table 14, $p < 0.005$).

Discussion

Species of Special Concern

Seven species of Special Concern (American White Pelican, Grasshopper Sparrow, Northern Harrier, Loggerhead Shrike, Short-eared Owl, Vaux's Swift, and Yellow Warbler) were located during actual point counts and one more was encountered en route between points on Alpha Farm in May, 2008. Of these eight species, three were found during the first year of study (2004-05), the remaining five were found in three seasons of follow-up study in 2007-08. The addition of special status species over time illustrates one significant benefit of long-term surveys.

American White Pelican, Northern Harrier, and Loggerhead Shrike are species of special concern encountered during the initial study conducted by PRBO Conservation Science, and again in our follow-up study. American White Pelican was encountered at Brown Farm and also as fly-over during point counts in the follow-up seasons of 2007 through 2009. There was no evidence of breeding. Northern Harriers were encountered during the winter months in 2004-05, 2007-08 and 2008-09 with no evidence of breeding. The species was seen consistently around Point 25 on the Brown Farm during the spring months of 2008 and the observer highly suspects that there could have been a nest either in the grasslands of Brown Farm, or more likely on the adjacent property to Brown Farm. The Harriers probably used the Brown Farm grasslands as feeding grounds. Loggerhead Shrikes were encountered in February of 2005 and again in February of 2008 on Alpha Farm, in approximately the same area. There was no evidence of breeding, but the habitat is appropriate as a breeding territory.

Additionally, in 2007-08 five more species of Special Concern were encountered. Vaux's Swifts were observed flying over Duer Creek on Kelly Farm in May and June of 2008, and spring 2009. They were also observed flying over the Laguna Wetlands Preserve in June 2008. The May records could represent migrants. The presence of the swifts in June strongly suggests that the birds were breeding in the area. They could have utilized nearby chimneys in the town of Sebastopol, or hollows in large trees in the Laguna (Sterling and Paton, 1995).

Short-eared Owls were observed on Kelly Farm and Brown Farm in January 2008. The winter of 2007/08 was very dry, possibly making the grassland areas of the Laguna more suitable for raptors. One of the Short-eared Owls was observed near point 25 on Brown Farm, in the same area that the Northern Harrier was suspected to have nested in the spring of 2008. Grasshopper Sparrows were found singing on territories in the grassland habitat on Brown Farm in both June of 2007 and 2009. They were likely to have nested or have attempted to nest in the hayfield. Yellow Warbler was heard singing in the Laguna Wetlands Park in June 2007, June 2008 (not during point counts), and June 2009. This species is very likely breeding in this area.

Sixteen White-faced Ibis were observed flying over Alpha Farm in May 2008. These birds may have just been passing over, or they may have been surveying the landscape for possible foraging areas during migration. White-faced Ibis in California went through a serious population decline in the early and middle twentieth century. However, breeding populations in the California Central Valley have increased in recent decades (South Sacramento Habitat Conservation Plan – draft). In addition, the Long-billed Curlew (listed as a species of High Concern by the US Shorebird Conservation Plan) was observed flying over Brown Farm in the winter of 2007-08 and again over Alpha Farm in the spring of 2008. As in the case of the White-faced Ibis, these birds may have just been passing over, or they may have been surveying the landscape for possible foraging areas during migration.

Of these nine species of special conservation status, five species utilize grasslands: Northern Harrier, Short-eared Owl, Long-billed Curlew, White-faced Ibis, and Grasshopper Sparrow. Grassland habitat may not host a wide variety of species, but it can be important for some important species. This information emphasizes the caution in evaluating the quality and importance of a habitat by species diversity alone.

Non-native and Pest Species

European Starlings and Brown-headed Cowbirds are species which may negatively impact the overall abundance and diversity of native birds. Cavity-nesting species such as woodpeckers, swallows, bluebirds and nuthatches may be negatively impacted by the competition for nest holes by the European Starling (Koenig 2003). Small songbirds, using cup nests, particularly neo-tropical migrant species, frequently become victims of nest parasitism by Brown-headed Cowbirds (Kosciuch and Sandercock 2008). Due to the steady population increase throughout the study period, populations of these birds should be continually monitored over time, and if populations do not level off or decrease, control measures should be considered in the near future.

Conspicuously Absent Species

Three bird species were conspicuously absent from the Laguna point count surveys: Acorn Woodpecker, Bewick's Wren, and Yellow-breasted Chat. Acorn Woodpeckers were only encountered three times during the winter of 2004-05 and once in the spring of 2007. They were not encountered at all during 2008. Acorn Woodpeckers are the most widely distributed breeding woodpecker in Sonoma County. It was present as a likely breeder in 138 of 183 blocks (one block equal to 5 square kilometers) in the Sonoma County Breeding Bird Atlas (Burridge, 1995). The two factors that are known to affect the status of Acorn Woodpeckers are the presence of mature oak trees and the ability of Acorn Woodpeckers to compete with invasive European Starlings for nest sites (Burridge, 1995). The presence of large numbers of large oak trees in the Laguna, with many suitable nesting cavities for potential woodpecker nesting suggests that the habitat should support Acorn Woodpeckers. The abundance of nesting Starlings in the Laguna may be having a significant impact on the ability of Acorn Woodpeckers to set up nesting colonies. A more detailed look at this dynamic is recommended.

Work by Troetschler (1976) concludes that Acorn Woodpecker breeding success is not significantly affected by Starling competition for nest-holes because the Acorn Woodpeckers generally have a later and longer breeding season than Starlings. However, the Woodpeckers were using energy to defend nest-holes and were losing night-time roosting holes to Starlings which may reduce adult survivorship. This dynamic might need to be observed in the Laguna population. Acorn Woodpeckers were also forced to spend energy defending nest-hole sites during the fall months, reducing their available energy for drilling acorn-storage holes and harvesting acorns, which may have an impact on adult survivorship over time.

Roberts (1979) found that Acorn Woodpeckers nesting in habitats with a more diverse presence Oak species were likely to be more successful than habitats with only one or a few species of Oaks. This oak diversity increases the probability on any one year producing a sufficient acorn crop for the woodpeckers. Acorn Woodpecker territories are characterized by a central granary (usually large snag or tree with soft bark for acorn storage) and radiates outward from that point. There are no records of Bewick's Wren in the study site. Bewick's Wrens are recorded as likely breeders in 125 of 185 blocks (Burridge, 1995). Bewick's Wrens are also recorded regularly in the current (2007 to present) Area Search surveys conducted by the Laguna Foundation in the areas of Middle Reach (Kelly Farm) and Railroad Forest (Brown Farm). Both of

these Area Search sites include more complex Oak Forest with a more sophisticated structure of tree sizes, species diversity, and a wider variety of shrubs and forbs than at any of the points surveyed here – with the possible exception of points 13 and 46 in the wildlife preserve area of Alpha Farm.

It is unclear whether the lack of Bewick's Wrens in the study area is due to habitat restrictions, or possible interspecific competition from other birds in the area. In the eastern United States, Bewick's Wrens have suffered severe population declines and apart of that decline has been attributed to competition for nesting sites by the more aggressive House Wren. Human land-use changes have enabled the House Wren to be more successful in the eastern region than the Bewick's Wren (Kennedy and White, 1997). However, one study of House Wren and Bewick's Wren competition where the two species co-exist in the California Sierran foothills, found no evidence of the House Wrens outcompeting the Bewick's Wren for nest sites (Verner and Purcell, 1991). House Wrens were encountered in this survey in spring 2005 (Appendix B). A study by Gorton (1977) suggests that there is some interspecific territorial competition between Song Sparrows and Bewick's Wrens. In this study, the Song Sparrow was found to be more aggressive toward the Bewick's Wren than vice versa. Song Sparrow numbers are very high in the Laguna, and this could be a possible influence on the apparent absence of Bewick's Wrens. In areas where the two species co-exist, the Bewick's Wren is more able to utilize taller trees than the Song Sparrows and the Bewick's Wrens' territory may actually shift over the top of the Song Sparrow's habitat. The implication for land management is to plant more trees for Bewick's Wrens to use.

The Yellow-breasted Chat not encountered in the Laguna during point counts or any other time. This species was confirmed as a breeder along Channel Drive in Annadel State Park during the Sonoma County Breeding Bird Atlas survey period (Burridge 1995). Historically, there are ten records of singing birds from the banks of Laguna de Santa Rosa, just north of Guerneville, between the years of 1961 and 1965 (Mike Parmeter, pers. com). These populations may still be extant, but lack of site access restricts confirmation. There are further records inside the Laguna de Santa Rosa watershed from the Santa Rosa Creek area, just west of Willowside Road, in the springs of 2005, 2007 and 2008, and from Ragle Ranch Regional Park in Sebastopol in the springs of 2002 and 2007 (Lisa Hug, personal records). These relatively nearby recordings highly suggest that Yellow-breasted Chats should be present in the survey area during the breeding season. The areas in which Yellow-breasted Chats were observed in the watershed contained the presence of Red Willow, or *Salix laevigata*, in addition to the more common Arroyo Willow, or *Salix lasiolepis.* Planting Red Willow in the riparian areas of the study site may increase the structural complexity of the riparian habitat and encourage Yellow-breasted Chats to take up residence in the area. Improved structural complexity in the riparian areas may also decrease the ability of Brown-headed Cowbirds to penetrate areas of where small songbirds nest.

Wetland/Pond Surveys

Wetlands and ponds are an important part of the ecosystem of the Laguna. The birdlife on the ponds surveyed showed a large range of variability in species present, between years and season. This was probably due to the variable water levels in the ponds, the annual variation in breeding success of wintering waterfowl in their spring breeding areas, and factors that may not be easily observable. More data need to be collected to better understand the baseline patterns of seasonal occurrence and breeding status of bird species using the ponds in the study area. In February 2009, data on the water levels of Brown and Alpha Pond were collected from the water gauges in the ponds (Table 12).

Breeding Evidence

Confirmation of a species breeding status in a study area affirms the importance of that area for the future survival of that species. Of the twenty species of bird nests found, none were of Species of Special Concern, two species were of potential pest species (Canada Goose and European Starling), three species of Local Management Concern (Double-crested Cormorant, Great Blue Heron, and White-tailed Kite) and three habitat focal species (Nuttall's Woodpecker, Tree Swallow, and Western Bluebird). Begging Song Sparrow fledglings were encountered on many occasions throughout the study area.

Species Richness, Relative Abundance and Diversity

We have established a current baseline of the natural range of variation of bird species richness, relative abundance and diversity across habitat types and years. Our data show that in general yearly richness, abundance and diversity fluctuated less during the winter season, and that during spring the most recent survey years 2007, 2008 and 2009 were more similar than the first survey in 2005. A portion of this variation might at first glance be attributed to the difference in observer, as K. Fehring conducted the first year of surveys and subsequent surveys were carried out by L. Hug (Table 1). However, the variation in these parameters is less distinct between the two winter seasons, and so there are likely other factors adding to the observed variation such as fluctuations in climate, migration related dynamics or resource availability. More detailed analysis of these parameters with available climate data, for example, could help to clarify the source of the observed variation. This will become important as data are gathered during and after trail construction and are compared to the baseline dataset. Multivariate statistical methods, such as multiple regression will be useful tools in order to determine the source of distinct trends in these important parameters as this long-term study continues.

Conclusion

Seven seasons of monitoring the abundance, richness and diversity of bird species in the Laguna study area has produced an important baseline illuminating the current status of bird populations. We have established the initial range of fluctuations in bird abundance, species richness and diversity over five seasons prior to implementation of a planned trail system throughout the area. Continuation of pre-trail surveys in winter 09/10 and spring 2010 will help to add additional insight to this current baseline and will make it more robust to compare against survey data collected during and after trail construction to assess the potential impacts on bird life in the area.

Our current database and insights can be used in planning the future management of trails throughout the area, and in planning habitat restoration and conservation strategies. For example, we suggest an increase in structural complexity of riparian corridors by planting *Salix laevigata* or other appropriate species in riparian areas. This is already under way in some areas as riparian restoration conducted by the Laguna de Santa Rosa Foundation throughout the middle reach section in the Laguna, between Highway 12 and Occidental Road. We further recommend that some grassland areas are kept intact for their importance to Grasshopper Sparrows, Short-eared Owls, Northern Harriers, Long-billed Curlews, and possibly even White-face Ibis, all species of special conservation status.

Our current survey data can further be utilized to identify species that are struggling in the Laguna. This is illustrated by the conspicuous absence of Acorn Woodpeckers and Bewick's Wrens in Laguna areas where the habitat should theoretically support healthy populations of these species. At present, neither of these

species is listed as Species of Special Concern or of local management concern. Without this study, the absence of these species would have gone completely unnoticed. Our data also help to identify the importance of different areas of the Laguna by habitat type and to highlight potential problem species in the Laguna, such as Brown-headed Cowbirds and European Starlings. Monitoring potential pest species in an area is as important as monitoring beneficial species.

Birds are a relatively easy group of animals to observe, and monitoring the health of Laguna bird populations over the long term will very likely have positive ramifications for other types of wildlife. By assessing bird community diversity, species abundance and distribution over time we can guide the design and use of appropriate management actions along the future Laguna trail system. It will therefore be imperative to continue these surveys in future years to monitor the impacts of the implementation and use of the trail system in the area and to continue to monitor special concern and pest species. Especially as we face climate change, regular surveys provide a means to evaluate potential causes of detected changes and will help in decreasing uncertainty in predictive modeling. Long-term standardized datasets such as this are thus valuable not only in assessing the potential effects of immediate land use changes such as trail development, but also in understanding the changing conditions arising due to climate change.

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References

Burridge, B. 1995. Sonoma County Breeding Bird Atlas. Madrone Audubon Society. Santa Rosa, CA.

Fancy, S. G., and J. R. Sauer. 2000. Recommended methods for inventorying and monitoring land birds in National Parks. National Park Service Inventory and Monitoring Program, 1201 Oak Ridge Dr., Suite 200, Fort Collins, CO 80525.

Fehring, K. and T. Gardali. 2005. Bird Inventory and Monitoring at Laguna de Santa Rosa. Final Report to Sonoma County Agricultural Preservation and Open Space District. PRBO Contribution Number 1332.

George, T. L., and S. Zack. 2001. Spatial and temporal considerations in restoring habitat for wildlife. Restoration Ecology 9: 272-279.

Gorton, Robert E. Jr.1977. Territorial Interactions in Sympatirc Song Sparrow and Bewick's Wren Populations. Auk: Vol. 94, No. 4, October-December,

Honton, J. and A. Warwick Sears. 1996. Enhancing and Caring for the Laguna: Restoring and Managing the Laguna de Santa Rosa. Laguna de Santa Rosa Foundation.

Kennedy, E. Dale and Douglas W. White. 1997. Bewick's Wren (*Thryomanes bewickii*), The Birds of North America Online (A. Poole Ed.) Ithaca Cornell Lab of Ornithology; Retieved from the Birds of North America Online: http://bna.birds.cornell.edu//bna/species/315.

Koenig, W. D. 2003. European Starlings and their effect on native cavity-nesting birds. Conservation Biology, 17, pp. 1134-40.

Kosciuch K. L., Sandercock B. K. 2008. Cowbird removals unexpectedly increase productivity of a brood parasite and the songbird host. Ecological Applications, 18(2):537-548.

Kroodsma, Donald E. and Jared Verner. 1997. Marsh Wren (Cistothorus palustris), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/308.

Morimot, David C. and Fred E. Wasserman. 1991. Dispersion patterns and habitat associations of rufous-sided towhees, common yellowthroats, and prairie warblers in the southeastern Massachusetts pine barrens. Auk: Vol. 108, No. 2, April-June.

Parmeter, Benjamin D. personal communication.

Ralph, C. J., G. R. Geupel, P. Pyle, T. E. Martin, and D. F. DeSante. 1993. Field methods for monitoring landbirds. General Technical Report PSW-GTR 144. USDA Forest Service 41pp.

Roberts, Robert C. 1979. Habitat and Resource Relationships in Acorn Woodpeckers. Condor, 81:1-8. The Cooper Ornithological Society.

Shorebird Conservation Plan. 2000. Division of Migratory Bird Management, U.S. Fish and Wildlife Service, PO Box 25486 DFC-Parfet, Denver, CO, 80225-0486, USA.

Shuford, D. W., T. Gardali, L. Comrack. 2008. California Bird Species of Special Concern. Studies of Western Birds, no.1. Western Field Ornithologists and California Department of Fish and Game Camarillo and Sacramento, CA.

South Sacramento Conservation Plan draft appendix A. Species Analysis White-faced Ibis. http://www.planning.saccounty.net/habitat-conservation/docs/species/White-faced-Ibis.pdf

Sterling, J. and P. W. C. Paton. 1995. Breeding Distribution of Vaux's Swift in California. http://www.fs.fed.us/psw/publications/4251/sterling1.PDF

Tewksbury J. J., A. E. Black, N. Nur, V. A. Saab, B. D. Logan, D. S. Dobkin. 2002. Effects of anthropogenic fragmentation and livestock grazing on western riparian bird communities. Studies in Avian Biology (25):158-202.

Troetschler, Ruth G. 1976. Acorn Woodpecker Breeding Strategy as Affected by Starling Nest-hole Competition. Condor: Vol. 78, No. 2, March-April.

USFWS. 1999. Statistical Guide to Data Analysis of Avian Monitoring Programs *Biological Technical Publication BTP-R6001-1999* http://www.fws.gov/mountain-prairie/migbirds/avian_monitoring.pdf

Verner, Jared and Purcell Kathryn L. 1999. Fluctuating Populations of House Wrens and Bewick's wrens in Foothills of the Western Sierra Nevada of California. Condor Vol. 101, No.2, March-April.

Tables and Figures

Table 1. Point Count Survey Dates

Year	Season	Month	Dates	Obesrver
2004/05	Winter	December	14, 16, 24	K. Fehring
	Winter	January	12, 25, 27	K. Fehring
	Winter	February	10, 24, 25, 28	K. Fehring
2005	Spring	April	9, 13, 14, 18	K. Fehring
	Spring	May	10, 13, 16, 17	K. Fehring
	Spring	June	28, 29, 30	K. Fehring
2007	Spring	April	25 ,26, 27, 30	L. Hug
	Spring	May	17, 18, 20, 21	L. Hug
	Spring	June	12, 13, 14, 15	L. Hug
2007/08	Winter	December	8, 9, 10, 11, 12	L. Hug
	Winter	January	16, 17, 18, 19, 20	L. Hug
	Winter	February	10, 11, 14, 15, 16	L. Hug
2008	Spring	April	18, 20, 21, 23, 24	L. Hug
	Spring	May	11, 12, 13, 14	L. Hug
	Spring	June	6, 7, 8, 9,10	L. Hug
2008/09	Winter	December	2, 4, 5, 7, 9	L. Hug
	Winter	January	18, 19, 20, 21, 22	L. Hug
	Winter	February	18, 19, 20, 23, 25	L. Hug
2009	Spring	April	13, 15, 16, 17, 18, 24	L. Hug
	Spring	May	10, 11, 13, 14, 26	L. Hug
	Spring	June	13, 15, 19, 20	L. Hug

Table 2. Habitat Assessment for Individual Points

Vegetation Type	Description	Point Station	Property
Grassland	Cultivated hayfield with one oak tree or fewer within a 50m radius of point	1, 5, 7, 9, 24, 25, 39, 42, 48, 49,	Alpha, Brown, Kelly
Short Grassland	Heavily grazed grassland with grass less than 1 inch tall year-round	55	CDFG
Oak Savannah	Cultivated hayfield or grazed land with one to about 5 widely spaced oak trees present	11, 12, 17, 21, 23, 26, 27, 35, 38, 40, 44, 45	Alpha, Brown, Kelly
Oak Woodland	Several oak trees present, of varying heights, densely packed together	3, 13, 15, 20, 28, 33, 36,	Alpha, Brown, Kelly
Riparian	Streamside or wetland vegetation composed of a diversity of plants - typically willows, cat-tails and blackberries	none	none
Riparian, Grassland	Part of the area surrounding the point is riparian and part is grassland	8, 16, 32, 47, 50, 51, 52	Alpha, Brown, Kelly, Meadowlark Field
Oak Savannah, Riparian	Part of the area surrounding the point is riparian and part is oak savannah	29, 46	Alpha
Vineyard	Cultivated grape vineyard	19, 31	Balletto
Vineyard, Oak Savannah	Part of the area surrounding point is vineyard and part is oak savannah	43	Balletto
Floodplain Oak Savannah	Oak savannah that is frequently under water during the winter months	53	Stone
Floodplain Oak Savannah, Riparian	Part of the area is floodplain oak savannah and part is riparian	54	Stone

Table 3. Wetland Pond Survey Dates

Month Year	Kelly Pond North	Kelly Pond South	Brown Pond	Alpha Pond	Balletto Pond
December 2004	12/23/2004	12/23/2004	12/23/2004	-	-
January 2005	1/12 & 1/25/2005	1/12 & 1/25/2005	1/12,1/25 & 1/27/2005	-	-
February 2005	2/10 & 2/24/2005	2/10 & 2/24/2005	2/10 & 2/24/2005	-	-
April 2005	4/13/2005	4/13/2005	4/13/2005	-	-
May 2005	5/16/2005	5/16/2005	5/16/2005	-	-
June 2005	6/28/2005	6/28/2005	6/28/2005	-	-
April 2007	4/30/2007	4/30/2007	4/30/2007	4/26/2007	-
May 2007	5/20/2007	5/20/2007	5/17/2007	5/21/2007	-
June 2007	6/17/2007	6/17/2007	6/13/2007	6/14/2007	-
December 2007	12/12/2007	12/12/2007	12/12/2007	12/10/2007	-
January 2008	1/17/2008	1/17/2008	1/21/2008	1/18/2008	1/17/2008
February 2008	2/10/2008	2/10/2008	2/11/2008	2/15/2008	2/14/2008
April 2008	4/20/2008	4/21/2008	4/24/2008	4/18/2008	4/21/2008
May 2008	5/11/2008	5/11/2008	5/13/2008	5/14/2008	5/12/2008
June 2008	6/7/2008	6/7/2008	6/10/2008	6/10/2008	6/10/2008
December 2008	12/9/2008	12/9/2008	12/9/2008	12/5/2008	12/4/2008
January 2009	1/19/2009	1/19/2009	1/21/2009	1/20/2009	1/19/2009
February 2009	2/18/2009	2/18/2009	2/20/2009	2/20/2009	2/19/2009
April 2009	4/18/2009	4/18/2009	4/17/2009	4/16/2009	4/13/2009
May 2009	5/14/2009	5/14/2009	5/26/2009	5/13/2009	5/11/2009
June 2009	6/13/2009	6/13/2009	6/19/2009	6/15/2009	6/15/2009

Table 4. Number of Encounters of Birds with Special Conservation Status on Point Counts (CP = Conservation Plan)

Species	Status*	Winter 2004/05	Winter 2007/08	Winter 2008/09	Spring 2005	Spring 2007	Spring 2008	Spring 2009
American White Pelican	Species of Special Concern	0	11	1	0	0	11	9
California Quail	Focal Species in Oak Woodland CP	7	18	1	45	14	16	19
California Towhee	Focal Species in Oak Woodland CP	25	26	26	40	54	58	76
Common Yellowthroat	Local Management Concern and Focal Species in Riparian Bird CP	0	0	0	51	43	39	53
Double-crested Cormorant	Local Management Concern	0	9	15	3	47	31	82
Grasshopper Sparrow	Species of Special Concern	0	0	0	0	4	0	1
Great Blue Heron	Local Management Concern	0	1	4	3	4	3	17
Great Egret	Local Management Concern	5	15	8	16	26	13	20
Loggerhead Shrike	Species of Special Concern and Local Management Concern	1	1	0	0	0	0	0
Long-billed Curlew	Species of High Concern, US Shorebird CP	0	3	0	0	0	1	0
Marsh Wren	Local Management Concern	19	20	23	35	32	36	38
Norhthern Harrier	Species of Special Concern and Local Management Concern	1	10	4	0	0	2	0
Nuttall's Woodpecker	Focal Species - Woodland Bird CP	24	33	38	20	24	20	34
Oak Titmouse	Focal Species - Oak Woodland Bird CP	24	26	23	21	21	23	23
Savannah Sparrow	Focal Species - Grassland Bird CP	127	116	43	34	4	11	19
Short-eared Owl	Species of Special Concern	0	2	0	0	0	0	3
Song Sparrow	Focal Species - Riparian Bird CP	333	280	293	466	502	461	448
Swainson's Thrush	Local Management Concern	0	0	0	1	1	2	3
Tree Swallow	Focal Species - Riparian Bird CP	21	20	41	142	98	91	97
Vaux's Swift	Species of Special Concern	0	0	0	0	0	6	4
Virginia Rail	Local Management Concern	1	0	0	0	0	0	2
Western Bluebird	Focal Species - Oak Woodland Bird CP	81	20	57	13	10	11	20
Western Meadowlark	Focal Species - Grassland Bird CP	98	45	225	6	11	7	17
Western Scrub-Jay	Focal Species - Oak Woodland Bird CP	18	23	24	15	11	17	24
White-breasted Nuthatch	Focal Species - Oak Woodland Bird CP	0	5	18	8	8	13	19
White-tailed Kite	Local Management Concern	6	26	8	4	7	26	10
Yellow Warbler	Species of Special Concern*	0	0	0	0	2	0	5

*Species of Special Concern are species, subspecies, and distinct populations on the list of Bird Species of Special Concern in California (Shuford and Gardali, 2008.). Species of local management concern are species that do not have official status but were deemed of local concern by the Wildlife Committee of the Laguna de Santa Rosa Restoration and Management Plan. CP = Conservation Plan.

Table 5. Number of Encounters of Potential Pest Bird Species

Species	Winter 2004-05	Winter 2007-08	Winter 2008-09	Spring 2005	Spring 2007	Spring 2008	Spring 2009
Canada Goose	120	160	374	10	92	84	93
Cattle Egret	0	34	14	0	10	12	41
Ring-necked Pheasant	7	0	0	8	29	22	12
Wild Turkey	0	81	24	3	3	13	21
Rock Pigeon	0	7	4	0	24	11	33
Eurasian Collared Dove	0	0	1	0	1	0	10
European Starling	298	304	392	129	305	367	397
Brown-headed Cowbird	4	0	3	77	99	122	124
House Sparrow	0	4	9	0	2	23	22

Table 6. Seasonal Distribution of Birds at and Around Alpha Pond - Average Number of Birds per Visit

Species	Winter 2004-05	Winter 2007-08	Winter 2008-09	Spring 2005	Spring 2007	Spring 2008	Spring 2009
Canada Goose	not surveyed (ns)	76	45	not surveyed (ns)	37	16	13
Cackling Goose	ns	1	1	ns	0	0	0
Mallard	ns	171	70	ns	43	23	26
Gadwall	ns	1	0	ns	0	0	0
Northern Shoveler	ns	20	0	ns	0	0	0
American Wigeon	ns	10	26	ns	0	0	1
Cinnamon Teal	ns	0	1	ns	1	0	0
Common Merganser	ns	1	1	ns	0	1	1
Bufflehead	ns	3	13	ns	0	1	1
Ruddy Duck	ns	31	20	ns	1	2	0
Lesser Scaup	ns	1	1	ns	0	0	0
Greater Scaup	ns	0	0	ns	0	1	0
Ring-necked Duck	ns	0	0	ns	0	0	0
Canvasback	ns	0	1	ns	0	1	0
Eared Grebe	ns	2	0	ns	0	0	0
Pied-billed Grebe	ns	0	0	ns	1	0	0
Clark's Grebe	ns	0	0	ns	1	0	0
Western Grebe	ns	2	0	ns	0	1	0
Double-crested Cormorant	**ns**	**1**	**0**	**ns**	**0**	**2**	**1**
Snowy Egret	ns	1	1	ns	0	0	1
Great Egret	**ns**	**1**	**0**	**ns**	**0**	**0**	**1**
Cattle Egret	ns	0	0	ns	0	0	1
Black-crowned Night-Heron	ns	0	0	ns	0	0	1
Great Blue Heron	**ns**	**1**	**0**	**ns**	**1**	**1**	**1**
American Coot	ns	1	0	ns	0	0	1
Killdeer	ns	6	2	ns	1	3	2
Least Sandpiper	ns	9	1	ns	0	0	0
Spotted Sandpiper	ns	2	1	ns	0	1	0
Greater Yellowlegs	ns	1	1	ns	0	0	0
Black-necked Stilt	ns	0	1	ns	0	1	0
Caspian Tern	ns	0	0	ns	0	1	0

Table 7. Seasonal Distribution of Birds at and around **Balletto Pond** - Average Number of Birds per Visit

Species	Winter 2004-05	Winter 2007-08	Winter 2008-09	Spring 2005	Spring 2007	Spring 2008	Spring 2009
Mallard	not surveyed (ns)	3	0	not surveyed (ns)	not surveyed (ns)	1	1
Common Merganser	ns	1	1	ns	ns	0	1
Bufflehead	ns	2	0	ns	ns	0	0
Ruddy Duck	ns	7	0	ns	ns	0	0
Greater Scaup	ns	25	1	ns	ns	0	0
Pied-bied Grebe	ns	1	0	ns	ns	0	0
Great Blue Heron	**ns**	**1**	**0**	**ns**	**ns**	**0**	**0**
American Coot	ns	11	0	ns	ns	1	1

Table 8. Seasonal Distribution of Birds at and around **Brown Pond** - Average Number of Birds per Visit

Species	Winter 2004-05	Winter 2007-08	Winter 2008-09	Spring 2005	Spring 2007	Spring 2008	Spring 2009
Canada Goose	30	17	42	30	*p*	16*	72
Cackling Goose	0	2	2	0	0	0	1
Mallard	271	71	84	19	*p*	11	12
Northern Shoveler	2	5	0	0	0	0	0
American Wigeon	14	5	3	0	0	0	0
Northern Pintail	1	0	0	0	0	0	0
Cinnamon Teal	0	1	0	0	0	0	0
Canvasback	1	0	1	0	0	0	0
Common Merganser	1	4	0	0	0	0	0
Bufflehead	1	2	3	0	0	0	0
Eared Grebe	2	1	2	1	0	0	0
Pied-bied Grebe	2	0	3	1	0	0	0
Clark's Grebe	0	1	0	0	*p*	2	0
Western Grebe	0	1	0	0	*p*	1	0
American White Pelican	**0**	**1**	1	**0**	**0**	**3**	2
Double-crested Cormorant	**2**	**1**	2	**2**	**0**	**1**	1
Snowy Egret	1	1	0	1	*p*	0	3
Great Egret	**1**	**1**	2	**1**	***p***	**0**	1
Great Blue Heron	**1**	**1**	1	**1**	***p***	**0**	1
American Coot	12	25	1	1	*p*	3	0
Killdeer	0	3	1	0	*p*	1	1
Spotted Sandpiper	0	1	12	0	0	0	1
Osprey	0	0	0	0	0	0	1

p=present, no count

Table 9. Seasonal Distribution of Birds at and around **Kelly Pond North** - Average Number of Birds per Visit

Species	Winter 2004-05	Winter 2007-08	Winter 2008-09	Spring 2005	Spring 2007	Spring 2008	Spring 2009
Canada Goose	0	0	1	0	0	1	1
Mallard	1	1	16	1	p	1	1
Gadwall	14	0	8	0	0	0	1
American Wigeon	13	0	7	0	0	0	0
Bufflehead	0	4	5	0	0	0	0
Ruddy Duck	0	5	2	0	0	0	0
Lesser Scaup	0	1	0	0	0	0	0
Greater Scaup	0	1	0	0	0	0	0
Common Goldeneye	0	3	1	0	0	0	0
Pied-bied Grebe	2	3	0	0	p	0	0
Double-crested Cormorant	**0**	**1**	**1**	**0**	**0**	**0**	0
Black-crowned Night-Heron	1	0	0	1	p	1	1
Great Egret	**0**	**1**	0	**0**	**0**	**0**	1
Great Blue Heron	**0**	**1**	0	**0**	**0**	**0**	1
American Coot	5	4	0	1	0	0	0
Common Moorhen	2	0	2	1	0	0	1
Virginia Rail	**1**	**1**	**0**	**0**	**0**	**0**	0
Killdeer	0	0	1	0	0	0	0
Greater Yellowlegs	0	0	0	1	0	0	0
American Pipet	0	0	1	0	0	0	0

p = presence, no count

Table 10. Seasonal Distribution of Birds at and around **Kelly Pond South** - Average Number of Birds per Visit

Species	Winter 2004-05	Winter 2007-08	Winter 2008-09	Spring 2005	Spring 2007	Spring 2008	Spring 2009
Canada Goose	0	0	1	1	0	2	1
Mallard	5	3	1	3	p	1	0
Gadwall	1	0	22	0	0	0	1
American Wigeon	2	1	0	0	0	0	1
Bufflehead	1	0	0	0	0	0	0
Ruddy Duck	0	4	5	0	0	0	0
Common Merganser	4	0	1	0	0	0	0
Pied-bied Grebe	2	1	0	1	0	0	0
Double-crested Cormorant	**1**	**1**	1	**1**	**p**	**0**	0
Great Egret	**1**	**0**	0	**0**	**p**	**0**	0
Snowy Egret	1	0	0	1	0	0	0
Great Blue Heron	**0**	**1**	0	**0**	**p**	**0**	0
Black-crowned Night-Heron	0	0	0	0	0	0	0
Killdeer	0	0	0	0	0	0	1

p = presence, no count

Table 11. Birds Confirmed Nesting by Locating Physical Nest Structure (LWP = Laguna Wetlands Preserve)

Species	Season	Property
Canada Goose	Spring 2008	Brown
Double-crested Cormorant	Spring 2007, Spring 2008 & Spring 2009	Alpha
Great Blue Heron	Spring 2007 & Spring 2009, Winter 2008 & Spring 2008	Alpha
White-tailed Kite	Spring 2008	Kelly, Brown
Cooper's Hawk	Spring 2007 & Spring 2008	Brown (Railroad Forest)
Red-shouldered Hawk	Spring 2008	Alpha
Red-tailed Hawk	Spring 2007, Spring 2008 & Spring 2009	Kelly, Brown
Mourning Dove	Spring 2007	Kelly
Great Horned Owl	Spring 2008	Kelly
Nuttall's Woodpecker	Spring 2007	Kelly
Black Phoebe	Winter 2009	Kelly
Western Kingbird	Spring 2007	Balletto
Bushtit	Spring 2009	Brown
Tree Swallow	Spring 2007, Spring 2008 & Spring 2009	Alpha, Kelly, Brown, LWP
Violet-green Swallow	Spring 2007 & Spring 2008	Kelly, Brown, LWP
Western Bluebird	Spring 2008	LWP
European Starling	Spring 2008 & Spring 2009	Alpha, Brown
Brewer's Blackbird	Spring 2007 & Spring 2008	Alpha, Brown
Bullock's Oriole	Spring 2007 & Spring 2008	LWP
House Finch	Spring 2007 & Spring 2009	Kelly, Brown, Balletto
Lesser Goldfinch	Spring 2007	Kelly
American Goldfinch	Spring 2007	LWP
House Sparrow	Spring 2009	Alpha

Table 12: Water depth at Alpha and Brown Farm ponds.

Alpha		Brown	
Date	**Depth**	**Date**	**Depth**
2/20/2009	5.5 feet	2/20/2009	81 feet
4/16/2009	9 feet	4/17/2009	85.5 feet
5/13/2009	9.5 feet	5/26/2009	85 feet
6/15/2009	3 feet	6/19/2009	82 feet

Table 12a: ANOVA of species richness by habitat types across years - Spring.

ANOVA

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
short grassland	4	73	18.25	24.91666667
vineyard	4	34	8.5	4.166666667
vineyard, Oak Savannah	4	72	18	46
floodplain Oak Savannah	4	84	21	30
Riparian, floodplain Oak Savannah	4	90	22.5	15
Oak Savannah, riparian	4	54.5	13.625	9.729166667
grassland	4	14.54545	3.636364	0.600550964
Oak Woodland	4	24.14286	6.035714	0.181972789
Oak Savannah	4	16.5	4.125	0.150462963
Riparian, grassland	4	33.5	8.375	1.081018519
spring 05	10	84.70022	8.470022	20.70715922
spring 07	10	130.9805	13.09805	65.90277965
spring 08	10	140.3344	14.03344	70.51206521
spring 09	10	140.1732	14.01732	67.80025674

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Habitat type	1840.9784	9	204.5532	30.12697815	8.06915E-12	2.250131477
Year	212.1576	3	70.7192	10.41565829	9.97261E-05	2.960351321
Error	183.32191	27	6.789701			
Total	2236.4579	39				

Table 12b: ANOVA of species richness by habitat types across years - Winter

ANOVA

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
short grassland	3	29	9.666667	10.33333
vineyard	3	23	7.666667	2.333333
vineyard, Oak Savannah	3	46	15.33333	14.33333
floodplain Oak Savannah	3	59	19.66667	6.333333
Riparian, floodplain Oak Savannah	3	59	19.66667	14.33333
Oak Savannah, riparian	3	32.5	10.83333	3.583333
grassland	3	9.363636	3.121212	0.250689
Oak Woodland	3	16.85714	5.619048	0.496599
Oak Savannah	3	12.33333	4.111111	0.210648
Riparian, grassland	3	24.33333	8.111111	0.731481
winter 04/05	10	86.52922	8.652922	28.31891
winter 07/08	10	114.2316	11.42316	37.49659
winter 08/09	10	110.6266	11.06266	49.20766

ANOVA *Source of Variation*	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Habitat type	974.6997	9	108.3	32.21682	2.67E-09	2.456281
Year	45.37009	2	22.68504	6.748293	0.006503	3.554557
Error	60.50875	18	3.361597			
Total	1080.579	29				

Table 13: ANOVA of relative abundance across years per season.

a) Spring

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Point Ct Stations	40150.74	43	933.7382	1.57523	0.027116	1.474961
Year	23014.29	3	7671.43	12.94181	1.92E-07	2.674832
Error	76466.46	129	592.7633			
Total	139631.5	175				

b) Winter

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Point Ct Stations	36900.55	43	858.1522	0.899856	0.642836	1.521821
Year	28307.64	2	14153.82	14.84165	2.9E-06	3.102552
Error	82014.36	86	953.6554			
Total	147222.5	131				

Table 14: ANOVA of species diversity across stations and years per season

a) Spring

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Point Count Stations	13.77905	43	0.320443	4.221611	1.31E-10	1.474961
Year	9.766523	3	3.255508	42.88903	2.7E-19	2.674832
Error	9.791792	129	0.075905			
Total	33.33736	175				

b) Winter

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Point Count Stations	8.479698	43	0.197202	2.337276	0.00042	1.521821
Year	7.865844	2	3.932922	46.61367	1.94E-14	3.102552
Error	7.256053	86	0.084373			
Total	23.60159	131				

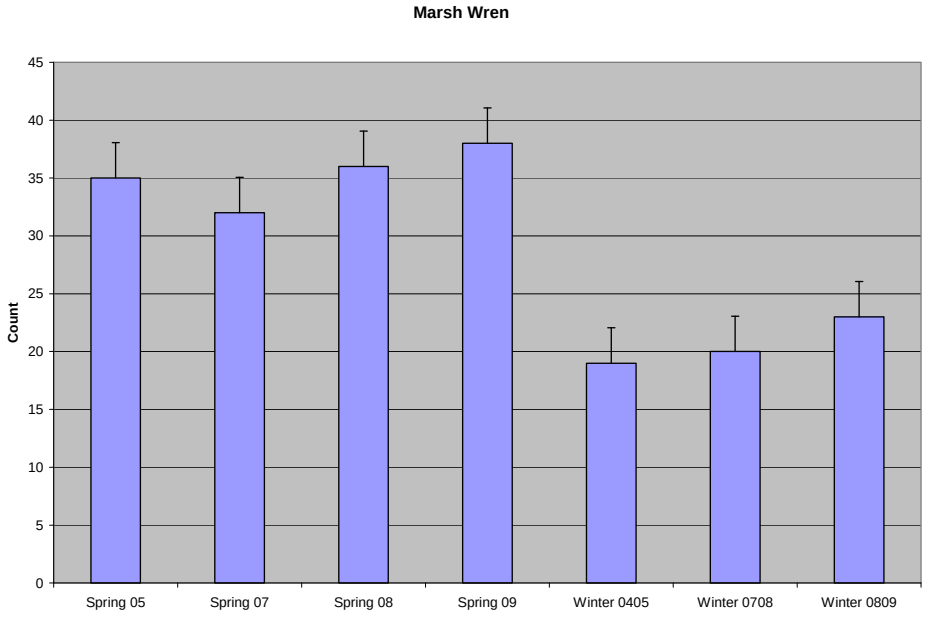


Figure 1a: Marsh Wren abundance throughout the study period [bars = standard error].

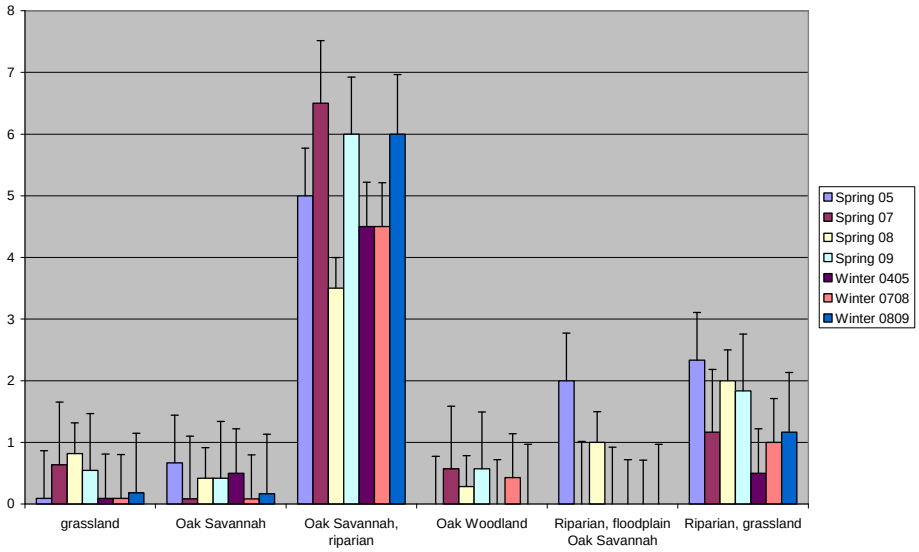


Figure 1b: Average abundance of Marsh Wren per habitat type station across seasons and years [bars = standard error].

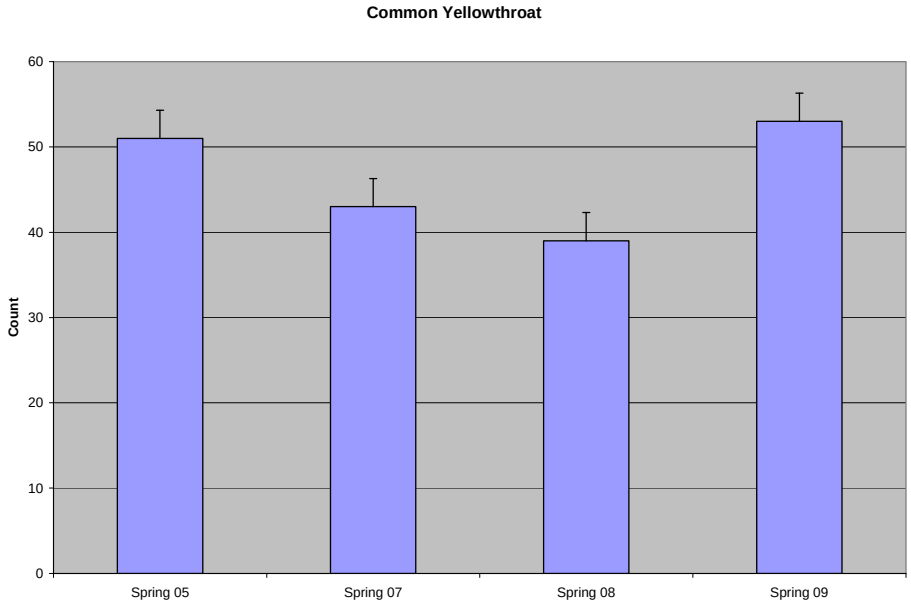


Figure 2a: Common Yellowthroat abundance throughout the study period [bars = standard error].

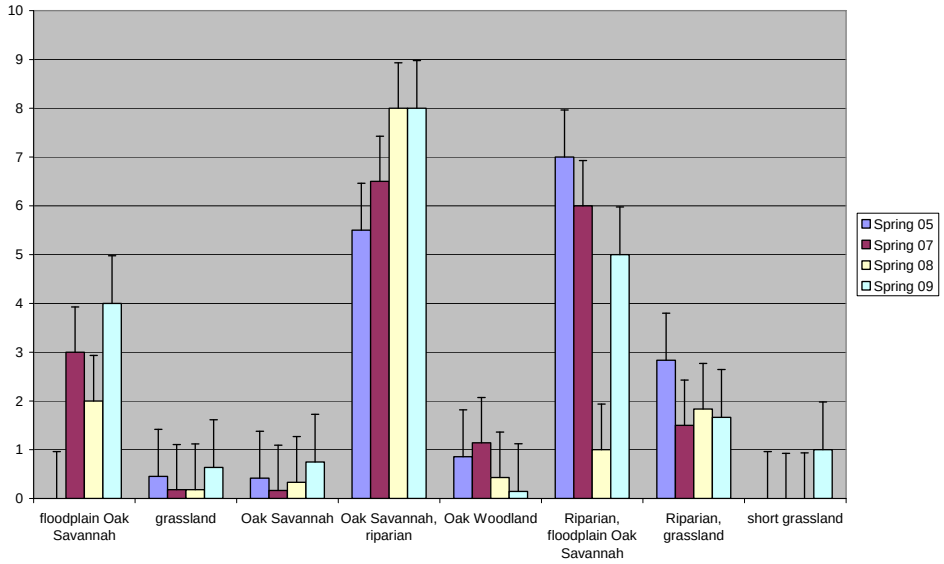


Figure 2b: Average abundance of Common Yellowthroat per habitat type station across breeding seasons and years [bars = standard error].

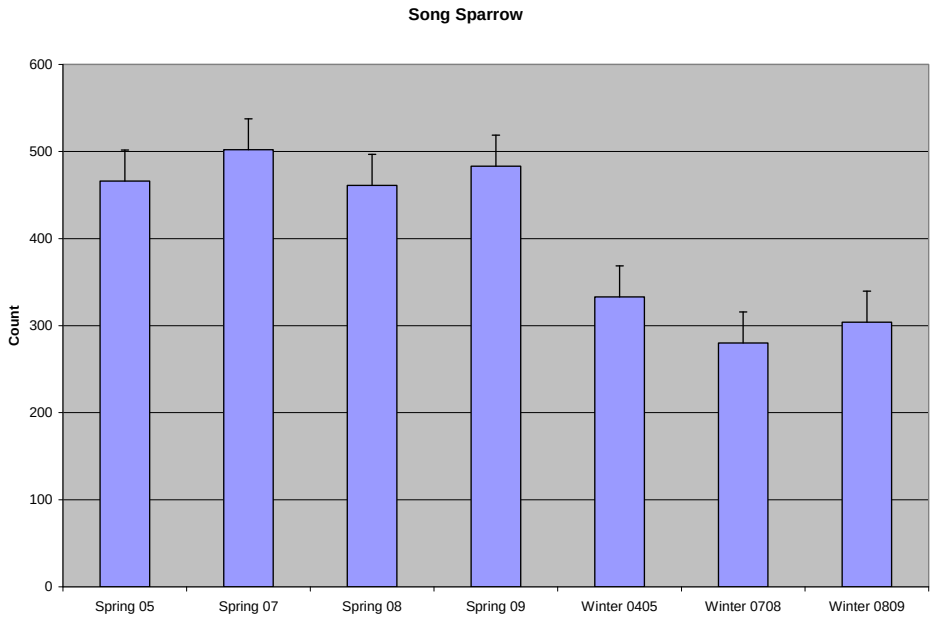


Figure 3a: Song Sparrow abundance throughout the study period [bars = standard error].

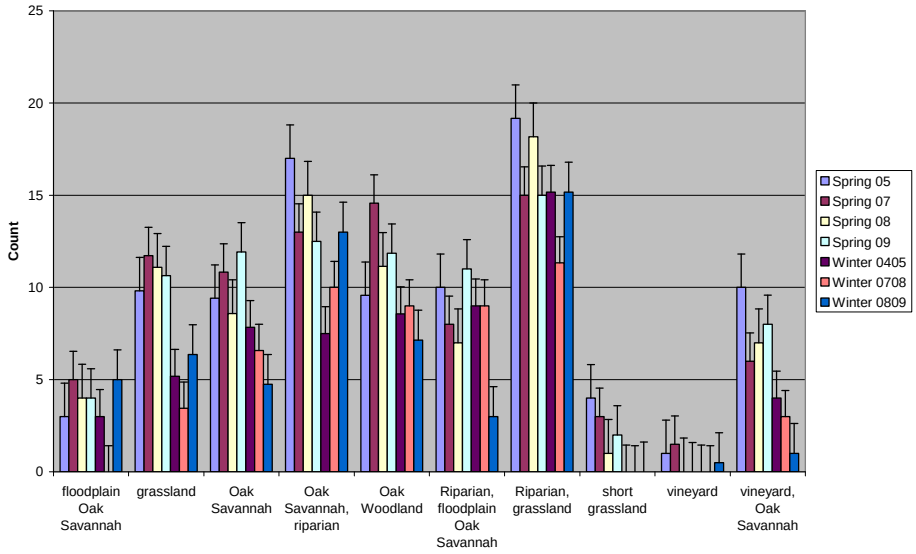


Figure 3b: Average abundance of Song Sparrow per habitat type station across seasons and years [bars = standard error].

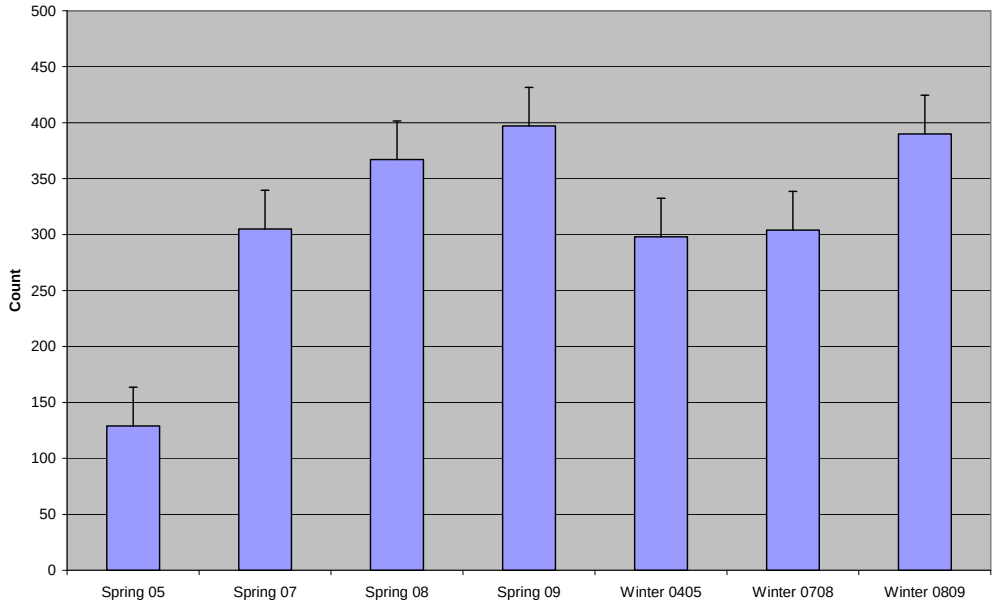


Figure 4a: European Starling abundance at point count stations across four spring breeding seasons ($p < 0.05$ for comparisons between years 05/07, 05/08, 05/09). Winter starling abundance is not different among years ($p = 0.6$) [bars = standard error].

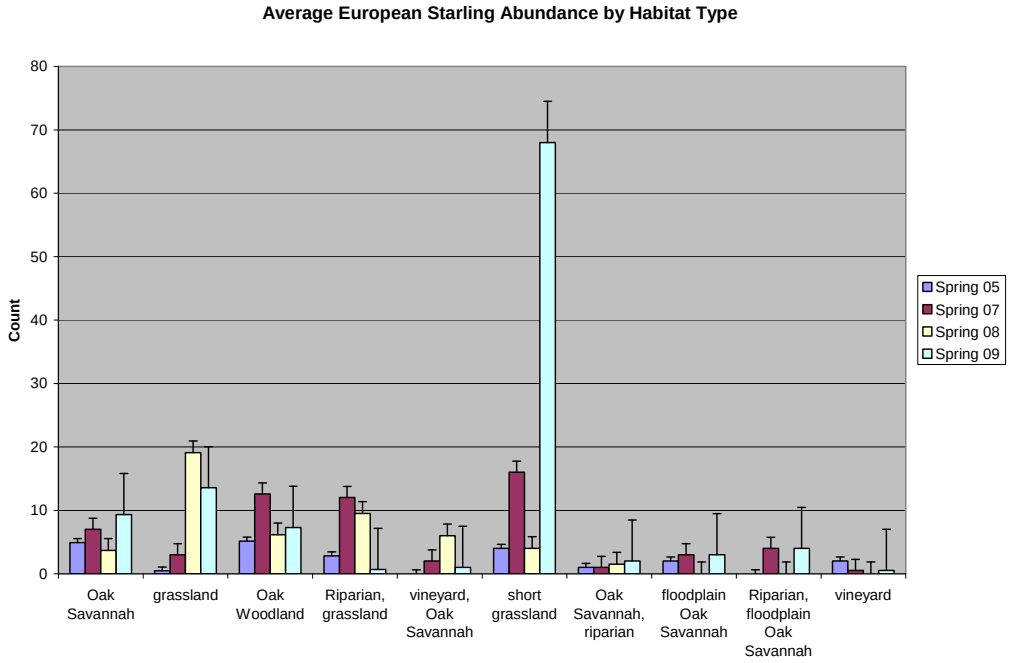


Figure 4b: European Starlings by Habitat Type Station – Spring 2005, 2007 – 2009

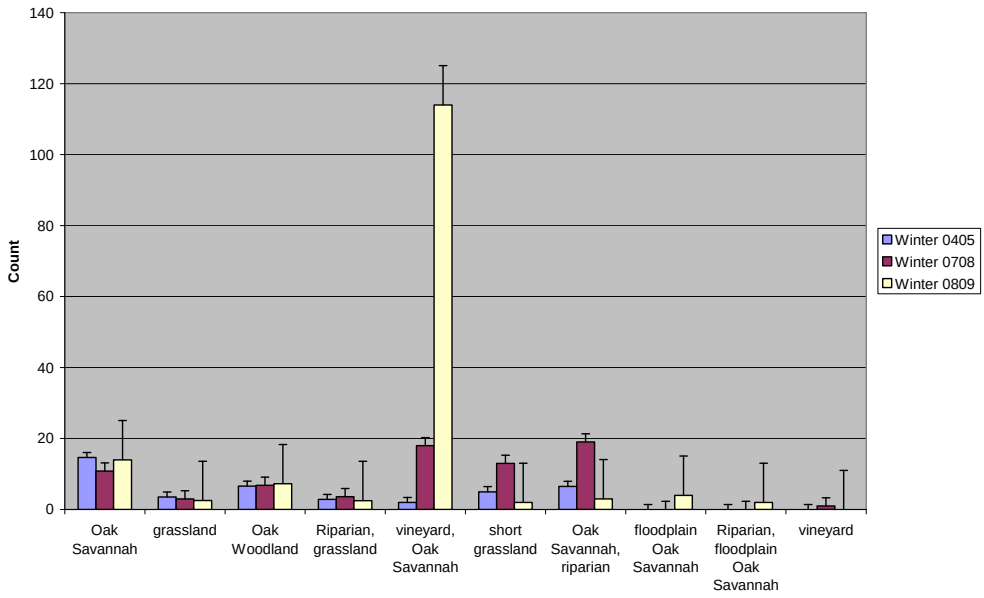


Figure 4c: European Starlings by Habitat Type Station– Winter 2004/05, 2007/08, 2008/09

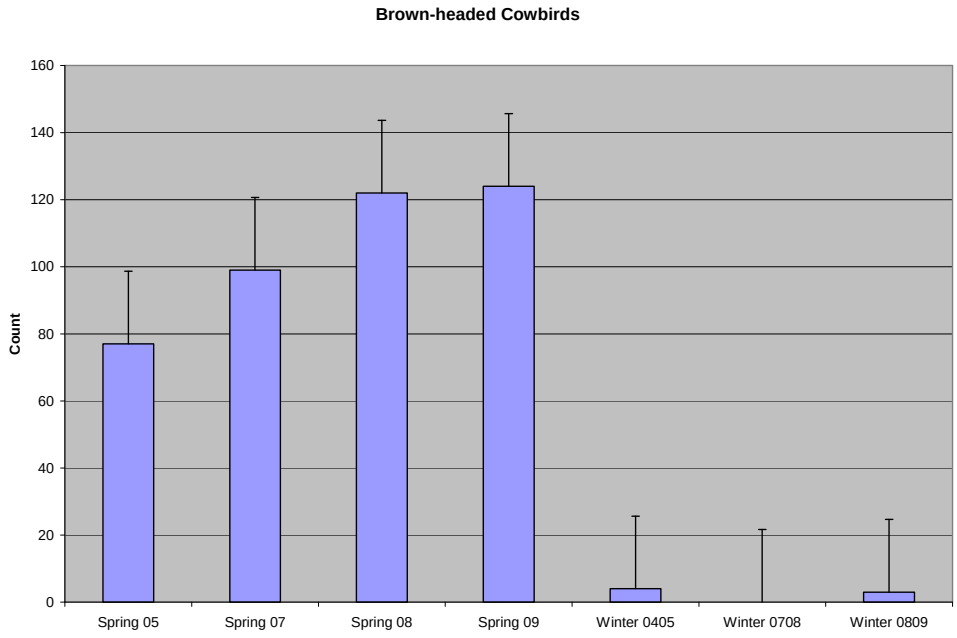


Figure 5a: Brown-headed Cowbird abundance across point count stations across four spring breeding seasons ($p < 0.05$). Winter cowbird abundance is not different among years ($p = 0.4$) [bars = standard error].

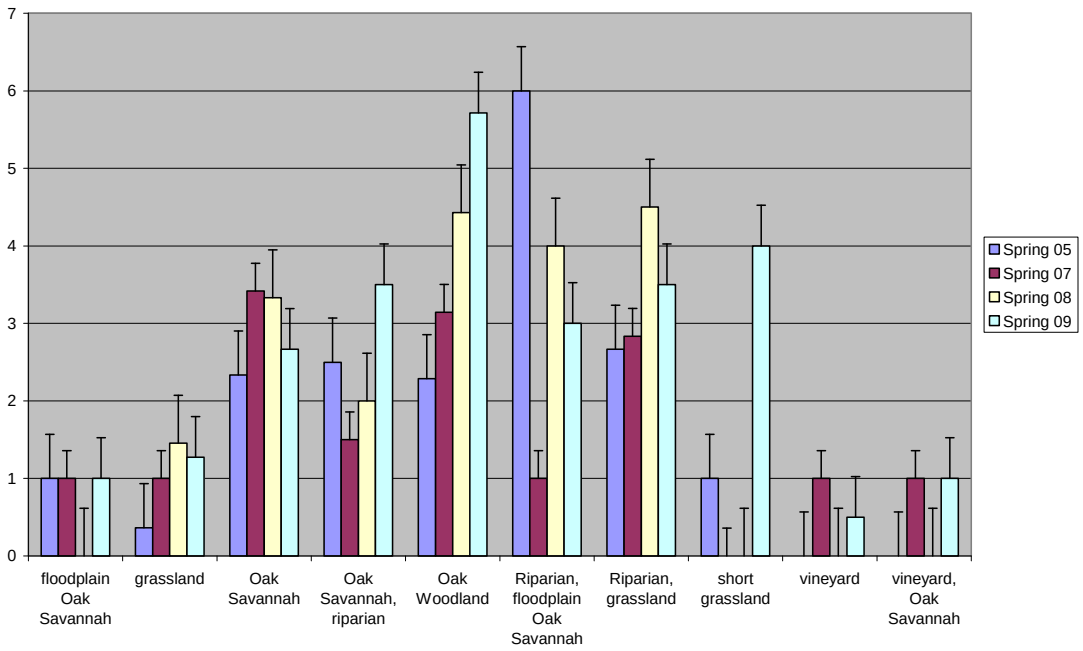


Figure 5b: Average Brown-headed Cowbird abundance by habitat type station across seasons and years

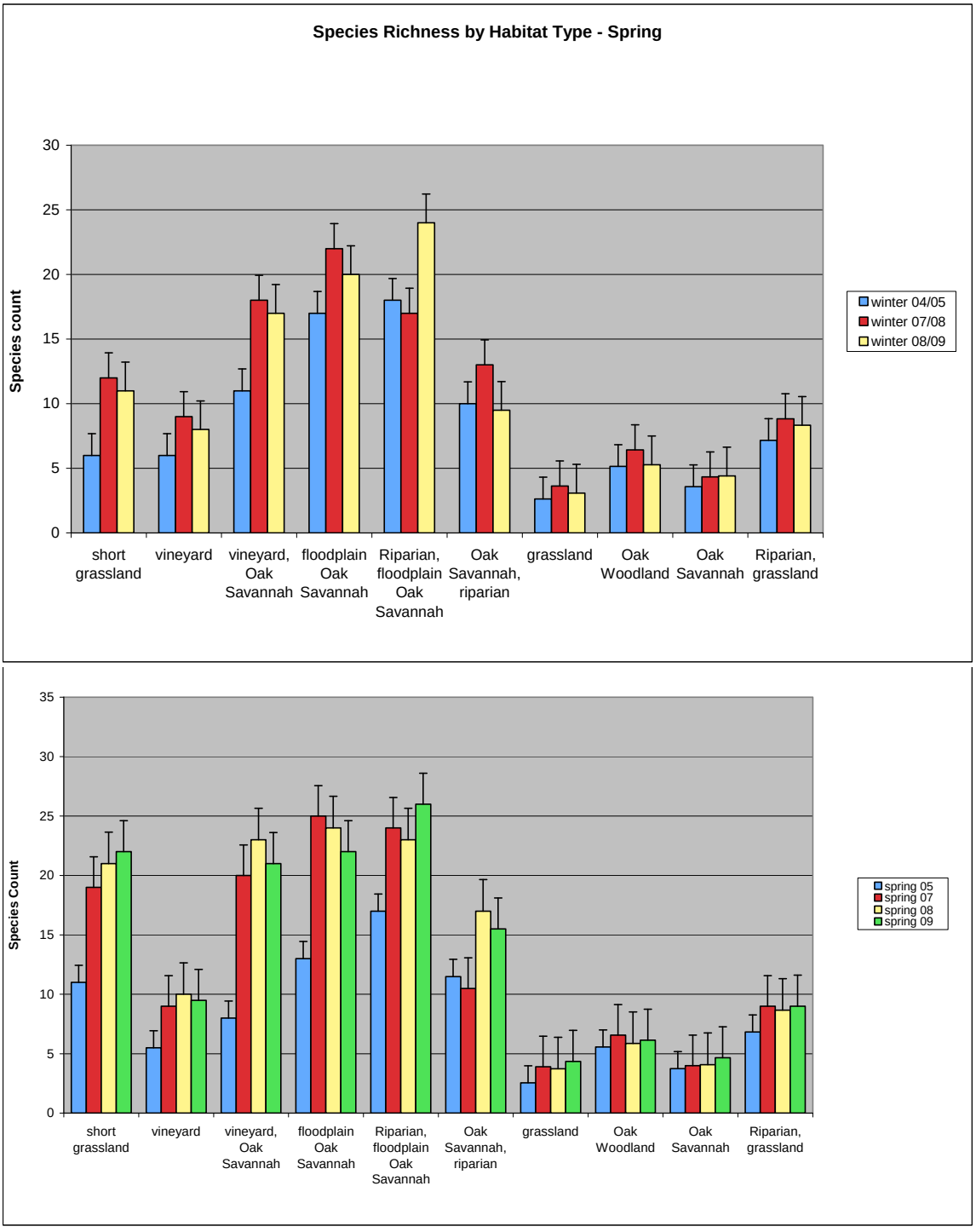


Figure 6: Average species richness by habitat type station during winter (top) and spring (bottom) seasons across years [bars = standard error].

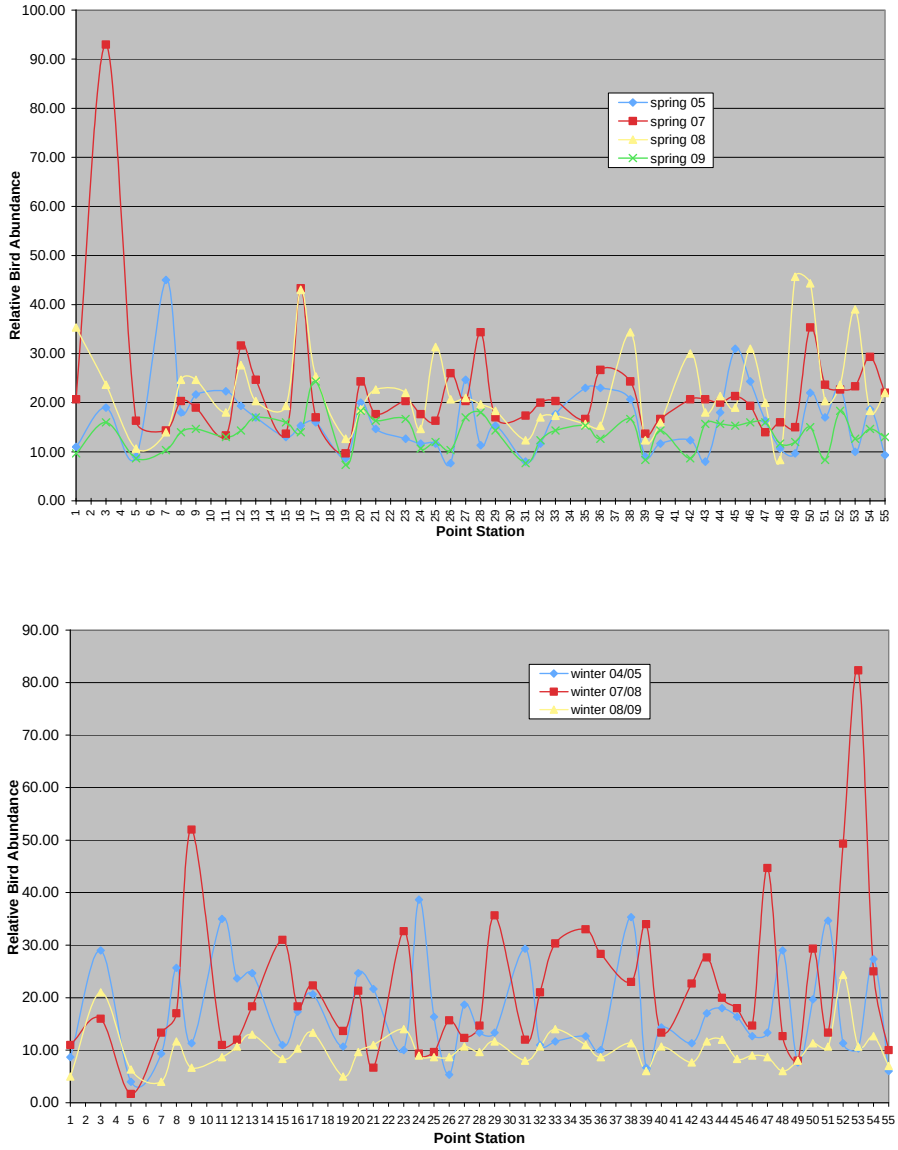
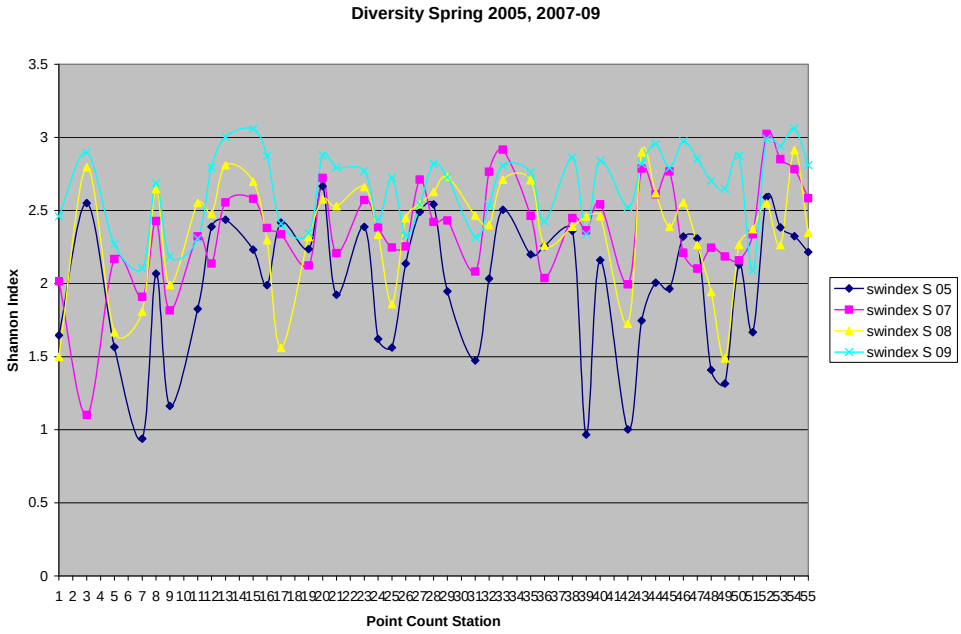


Figure 7: Relative bird abundance per point count station across years during spring (top) and winter (bottom).



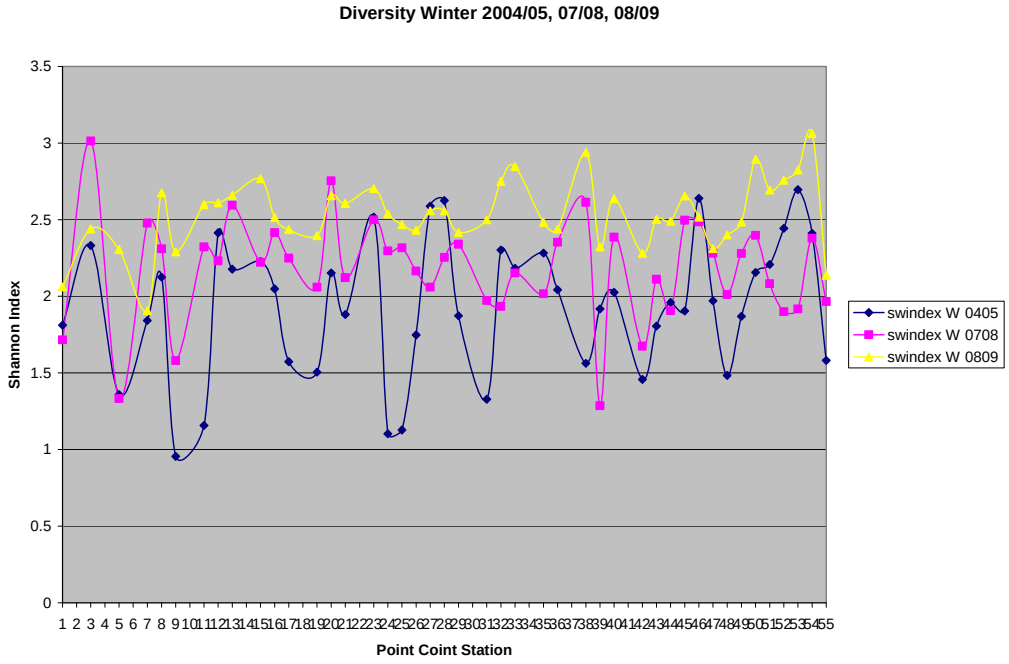


Figure 8: Species diversity (Shannon-Weaver Index *H*) per point station across years during spring (top) and winter (bottom).

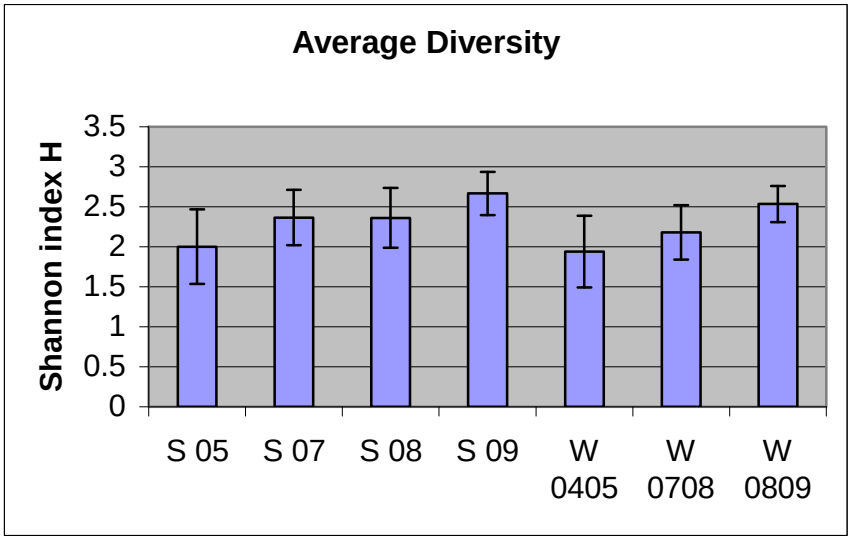
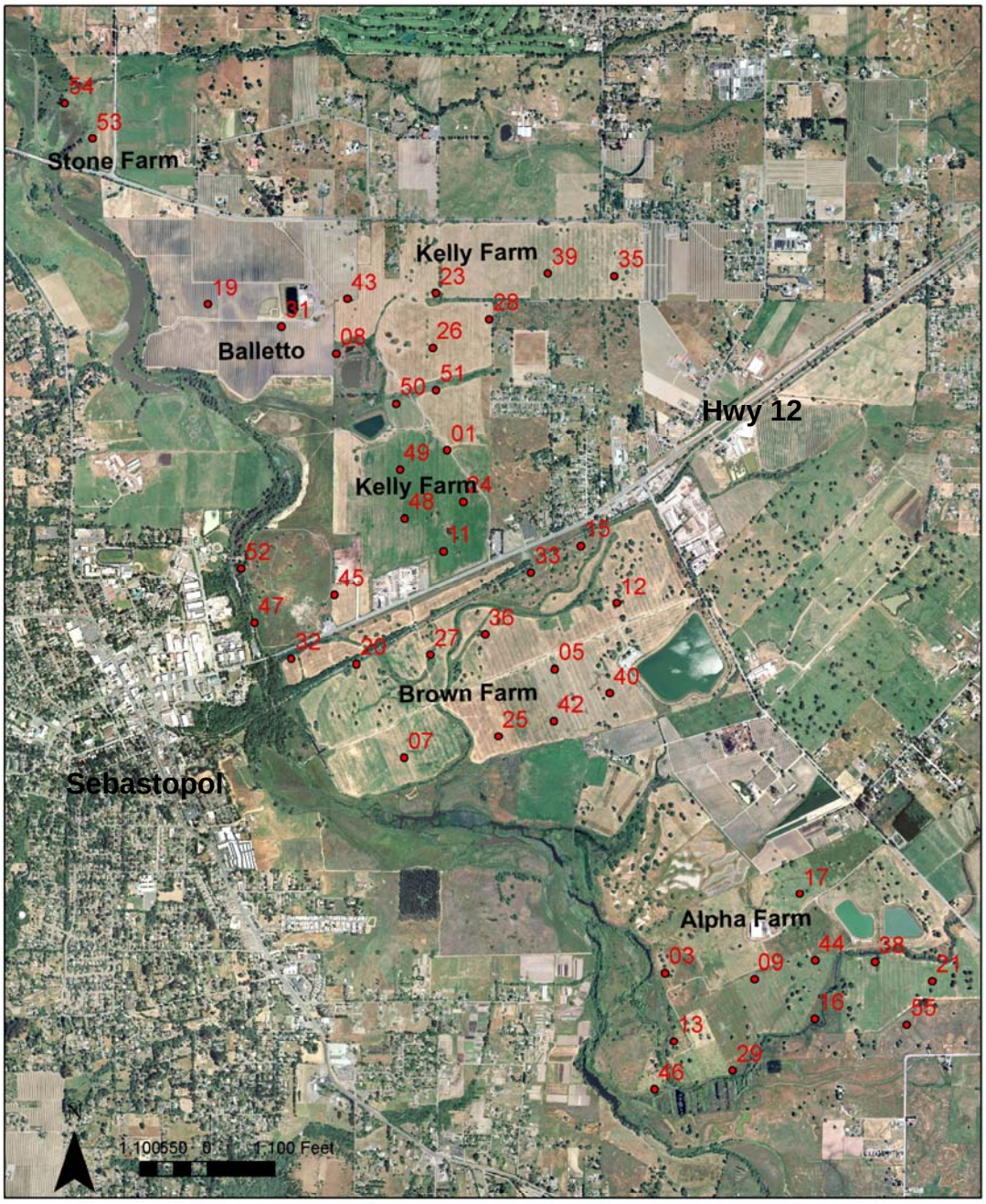


Figure 9: Average diversity per point count station across sampling years and seasons (S = spring, W = winter; bars = standard deviation)

Appendix A

Map of Sampling Points



Appendix B

Laguna de Santa Rosa Inclusive Bird List

Includes all species seen or heard in winter or Spring season in 2004-05 and 2007-08.

		Winter			Spring			
Common Name	Scientific Name	2004-05	2007-08	2008-09	2005	2007	2008	2009
Greater White-fronted Goose	*Anser albifrons*	y						
Canada Goose	*Branta canadensis*	y	y		y	Y	y	
Cackling Goose	*Branta hutchinsii*		y					
Wood Duck	*Aix sponsa*		y		y	y	y	
Northern Shoveler	*Anas clipeata*	y	y					
Northern Pintail	*Anas acuta*	y						
Gadwall	*Anas strepera*		y					
American Wigeon	*Anas americana*		y					
Mallard	*Anas platyrhynchos*	y	y		y	y	y	
Green-winged Teal	*Anas crecca*		y					
Cinnamon Teal	*Anas cyanoptera*		y			y		
Bufflehead	*Bucephala albeola*	y	y				y	
Common Goldeneye	*Bucephala clangula*		y					
Lesser Scaup	*Aythya affinis*		y					
Greater Scaup	*Aythya marila*		y				y	
Ring-necked Duck	*Aythya collaris*	y	y					
Canvasback	*Aythya valisineria*	y					y	
Common Merganser	*Mergus merganser*	y	y			y	y	
Ruddy Duck	*Oxyura jamaicensis*	y	y			y	y	
Ring-necked Pheasant	*Phasianus colchicus*	y	y		y	y	y	
Northern Bobwhite	*Colinus virginianus*					y		
Wild Turkey	*Meleagris gallopavo*	y	y		y	y	y	
California Quail	*Callipepla californica*	y	y		y	y	y	

Clark's Grebe	*Aechmophorus clarkii*		y			y	y	
Western Grebe	*Aechmophorus occidentalis*		y			y	y	
Eared Grebe	*Podiceps nigricollis*	y	y			y		
Pied-billed Grebe	*Podilymbus podiceps*	y	y		y		y	
American White Pelican	*Pelacanus erythrorhynchos*		y		y		y	
Double-crested Cormorant	*Phalacrocorax auritus*	y	y		y	y	y	
Great Blue Heron	*Ardea herodias*	y	y		y	y	y	
Great Egret	*Ardea alba*	y	y		y	y	y	
Snowy Egret	*Egretta thula*	y	y		y	y	y	
Cattle Egret	*Bubulcus ibis*	y	y			y	y	
Black-crowned Night-Heron	*Nycticorax Nycticorax*	y	y		y	y	y	
American Bittern	*Botaurus lentigenosis*						y	
White-faced Ibis	*Plegidis chihi*						y	
American Coot	*Fulica americana*	y	y		y	y	y	
Common Moorhen	*Gallinula chloropus*	y			y			
Virginia Rail	*Rallus limicola*	y	y					
Turkey Vulture	*Cathartes aura*	y	y		y	y	y	
Osprey	*Pandion haliaetus*				y	y	y	
White-tailed Kite	*Elanus leucurus*	y	y		y	y	y	
Cooper's Hawk	*Accipiter cooperii*	y	y			y	y	
Sharp-shinned Hawk	*Accipiter striatus*	y	y		y	y		
Red-shouldered Hawk	*Buteo lineatus*	y	y		y	y	y	
Red-tailed Hawk	*Buteo jamaicensis*	y	y		y	y	y	
Northern Harrier	*Circus cyaneus*	y	y				y	
Prairie Falcon	*Falco mexicanus*	y	y					
Peregrine Falcon	*Falco peregrinus*		y					
Merlin	*Falco columbarius*		y					
American Kestrel	*Falco sparvarius*	y	y		y	y		
Killdeer	*Charadrius vociferous*	y	y		y	y	y	
Black-necked Stilt	*Himantopus mexicanus*		y			y	y	
Long-billed Dowitcher	*Limnodromus scolopaceus*		y					
Long-billed Curlew	*Numenius americanus*		y				y	

Least Sandpiper	*Calidris minutilla*		y					
Greater Yellowlegs	*Tringa melanoleuca*	y	y		y	y	y	
Spotted Sandpiper	*Actitis macularia*		y			y	y	
Wilson's Snipe	*Gallinago delicata*	y	y		y	y	y	
California Gull	*Larus californicus*	y	y				y	
Ring-billed Gull	*Larus delawarensis*		y				y	
Mew Gull	*larus brachyrhychos*		y					
Western Gull	*Larus occidentalis*		y					
Glaucous-winged Gull	*Larus glaucescens*		y					
Caspian Tern	*Sterna caspia*						y	
Rock Pigeon	*Columba livia*		y		y	y	y	
Mourning Dove	*Zenaida macroura*	y	y		y	y	y	
Eurasian Collared Dove	*Streptopelia decaoto*					y		
Barn Owl	*Tyto alba*		y					
Great Horned Owl	*Bubo virginianus*						y	
Short-eared Owl	*Asio flammeus*		y					
Vaux' Swift	*Chaetura vauxi*						y	
Anna's Hummingbird	*Calypte anna*	y	y		y	y	y	
Allen's Hummingbird	*Selasphorus sasin*					y		
Belted Kingfisher	*Ceryle alcyon*				y	y		
Northern Flicker	*Colapte auratus*	y	y		y			
Acorn Woodpecker	*Melanerpes formicivorus*	y			y	y		
Nuttall's Woodpecker	*Picoides nuttallii*	y	y		y	y	y	
Downy Woodpecker	*Picoides pubescens*	y	y		y	y	y	
Hairy Woodpecker	*Picoides villosus*				y			
Western Wood-pewee	*Contopus sordidulus*				y	y	y	
Pacific-slope Flycatcher	*Empidinax difficilis*				y	y	y	
Say's Phoebe	*Sayornis saya*	y	y		y			
Black Phoebe	*Sayornis nigricans*	y	y		y	y	y	
Western Kingbird	*Tyrannus verticalis*				y	y	y	
Ash-throated Flycatcher	*Myiarchus ccinerascens*					y		
Loggerhead Shrike	*Lanius vicianus*	y	y					

Warbling Vireo	*Vireo gilvus*	y				y	y	
Western Scrub-jay	*Aphelocoma californica*	y	y		y	y	y	
American Crow	*Corvus brachyrhynchos*	y	y		y	y	y	
Common Raven	*Corvuscorax*	y	y		y	y	y	
Tree Swallow	*Tachycineta bicolor*	y	y		y	y	y	
Violet-green Swallow	*Tachycineta thalassina*	y	y		y	y	y	
Cliff Swallow	*Hirundo pyrrhonota*				y	y	y	
Barn Swallow	*Hirundo rustica*				y	y	y	
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*				y	y	y	
Chestnut-backed Chickadee	*Parus rufescens*		y		y	y	y	
Oak Titmouse	*Parus inornatus*	y	y		y	y	y	
Bushtit	*Psaltriparus minimus*	y	y		y	y	y	
Red-breasted Nuthatch	*Sitta canadensis*	y			y			
White-breasted Nuthatch	*Sitta carolinensis*	y	y		y	y	y	
House Wren	*Troglodytes aedon*				y			
Marsh Wren	*Cistothorus palustris*	y	y		y	y	y	
Ruby-crowned Kinglet	*Regulus calendula*	y	y					
Western Bluebird	*Sialia mexicana*	y	y		y	y	y	
American Robin	*Turdus migratorius*	y	y		y		y	
Swainson's Thrush	*Catharus ustulatus*				y	y	y	
Hermit Thrush	*Catharus guttatus*		y					
Northern Mockingbird	*Mimus polyglottis*	y	y		y	y	y	
American Pipet	*Anthus rubescens*	y	y					
Cedar Waxwing	*Bombycylla cedrorum*						y	
European Starling	*Sturnus valgaris*		y			y	y	
Yellow Warbler	*Dendroica petechia*					y	y	
Yellow-rumped Warbler	*Dendroica coronata*	y	y		y			
Wilson's Warbler	*Wilsonia pusilla*				y	y	y	
Common Yellowthroat	*Geothlypis trichas*				y	y	y	
Black-headed Grosbeak	*Pheucticus melanocephalus*					y	y	
Spotted Towhee	*Papilo maculatus*	y			y	y	y	
California Towhee	*Papilio crissalis*	y	y		y	y	y	

Oregon Junco	*Junco hyemalis*	y	y		y			
Fox Sparrow	*Passerella iliaca*		y					
Chipping Sparrow	*Spizella passerina*				y	y	y	
Grasshopper Sparrow	*Ammodramus savannarum*					y		
Savannah Sparrow	*Passerculus sandwichensis*	y	y		y	y	y	
Lincoln's Sparrow	*Melospiza lincolnii*		y					
Song Sparrow	*Melospiza melodia*	y	y		y	y	y	
White-throated Sparrow	*Zonotrichia albicolis*		y					
White-crowned Sparrow	*Zonotrichia leucophrys*	y	y		y		y	
Golden-crowned Sparrow	*Zonotrichia atricapilla*	y	y		y	y	y	
Red-winged Blackbird	*Agelaius phoenicus*	y	y		y	y	y	
Western Meadowlark	*Sturnella neglecta*	y	y		y	y	y	
Brewer's Blackbird	*Euphagus cyanocephalus*	y	y		y	y	y	
Brown-headed Cowbird	*Molothrus ater*	y			y	y	y	
Bullock's Oriole	*Ecterus bullockii*				y	y	y	
House Finch	*Carpodacus mexicanus*	y	y		y	y	y	
Lesser Goldfinch	*Carduelis psaltria*	y	y			y	y	
American Goldfinch	*Carduelis tristis*	y	y		y	y	y	
European Goldfinch	*Carduelis Carduelis*		y					
House Sparrow	*Passer domesticus*	y	y			y	y	