



# **BIRD POPULATION AND VEGETATION TRENDS AT THE LAS VEGAS WASH, 2005-2017**



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*Cover photo: Las Vegas Wash #10A, 17 September 2017. Photo by David Henderson.*

## Abstract

In 2017, Great Basin Bird Observatory completed the ninth year of bird surveys and vegetation assessments along an 8.7 km stretch of the Las Vegas Wash (hereafter: Wash). This effort, conducted on the behalf of the Las Vegas Wash Coordination Committee (LVWCC), continues work done in the first four years (2005-2009) by the San Bernardino County Museum. It accompanies the LVWCC's stabilization and enhancement project designed to prevent erosion and reclaim wetland and riparian habitat in the Wash. The project includes in-channel construction and habitat restoration, resulting in 19 weirs and impoundments, a major reduction of tamarisk cover and over 500 acres revegetated with native plants.

In this report, we summarize bird species occurrence, trends in richness and abundance, and changes in vegetation over the 12 years of the project. In each of the nine years of data collection, bird surveys were completed year-round every two weeks using 29 (later amended to 31) permanently established survey points. Once a year, in the fall, vegetation assessments were conducted at each survey point.

A total of 213 bird species were recorded over the nine years, constituting approximately 44% of the total bird species richness recorded in Nevada. Of these, 51 are conservation priority species according to conservation rankings by regional bird initiatives.

Average species richness and total abundance increased significantly over the project period, particularly in the three most recent years of Wash surveys. Species-specific trends were mixed with six species showing significant declines and eight showing significant increases over the study period. Several of the declining birds are riparian shrub-associated, including non-native shrubs, and many of the species with increasing trends are marsh or water-dependent. We expect that with further recovery of native vegetation, even the species currently in decline will recover at the Wash in the long term.

Over the 12 years of the project, tree cover has significantly declined, primarily because of the removal of the non-native tamarisk along the Wash. While cover of mesquite has apparently increased, this trend is not yet statistically significant; however, the proportion of total tree cover consisting of mesquites has experienced a statistically significant increase over time. Where tamarisk has been removed on dry sites, upland shrub cover has significantly increased over the course of the project.

In this report, we note a marked shift in bird recovery along the Wash that started in the past three years (2015-2017) of the project, as species richness and abundance significantly increased relative to the first six years of surveys (2005-2011). These increases are largely the result of increased wetland formation resulting from weir construction along the Wash. Riparian shrub-associated species are expected to recover more slowly than the marsh- and water-associated species. However, as clearing and construction activities decline, and woody riparian and mesquite habitats continue to recover and be actively restored, we will be able to document the responses of the bird community associated with these habitats.

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## Introduction

The Las Vegas Wash (hereafter: Wash) is the primary drainage of the Las Vegas Valley Hydrographic Basin and is located in the southeastern portion of Las Vegas Valley. The lower Wash extends approximately 20 km, flowing through the Clark County Wetlands Park (Figure 1) and terminating in Las Vegas Bay of Lake Mead. While the Wash was historically ephemeral, it has become a perennial riverine and wetland complex due to drainage of treated wastewater and urban runoff, as well as a shallow groundwater table. From the increasing Las Vegas Valley discharge, the Wash began to degrade through channel down-cutting, which led in 1998 to the formation of the Las Vegas Wash Coordination Committee (LVWCC), a stakeholder group that includes local, state, and federal agencies, citizens, businesses, a university and environmental groups. The LVWCC developed the Las Vegas Wash Comprehensive Adaptive Management Plan that recommended measures to halt the channel degradation, restore riparian and wetland habitats, and conduct wildlife monitoring (LVWCC 2000). In 2000, implementation of this plan began and continues to the present. Plan activities include installing weirs and bank protection to halt erosion, and extensive vegetation improvements through tamarisk (*Tamarix ramosissima*) control, revegetation with native woodland species, and other plantings. For more details on the history of these efforts, see Braden et al. (2009). The plan also led to the creation and implementation of the Las Vegas Wash Wildlife Management Plan, which contains 31 recommended actions designed to conserve native species, protect and enhance their habitats and increase community awareness of these resources (Shanahan et al. 2008).

In 2005, the San Bernardino County Museum, in conjunction with the Southern Nevada Water Authority (SNWA; the lead agency of the LVWCC), began point count bird surveys along an 8.7 km reach of the Wash (Braden et al. 2007, 2009). The purpose of these bird surveys was to (1) inventory bird populations and bird habitat parameters to provide a baseline dataset, (2) set up a long-term monitoring program that is designed to document the benefits of project activities, and (3) assist in the adaptive management process by providing valuable insight to which activities are effective and in what time frame. The museum conducted four years of surveys which are summarized in Braden et al. (2009). Our report summarizes nine years of surveys: the four years

conducted by the museum, and the five years conducted by the Great Basin Bird Observatory (GBBO; 2009-2011 and 2014-2017, respectively), for which we analyzed all data to characterize bird community structure, population trends, and habitat conditions. Treatment effects related to construction and restoration through the 11th year of the project were reported in GBBO (2018).

## Methods

### Study Area

The study area encompasses 8.7 km of the Wash between the Upper Diversion and Powerline Crossing weirs (Figure 1). Twenty-nine points were established in 2005, and later additions and a deletion yielded 31 points by the end of 2006. The survey points are arranged along both sides of the Wash (Figure 1) at regular intervals to monitor the bird community and vegetation where channel modification and revegetation has occurred or will occur, as well as in areas where project activities are unlikely to occur (Braden et al. 2007), providing a broad cross-section of the different habitat types found at the Wash. The upland vegetation is dominated by Mojave scrub (dominated by creosote bush, *Larrea tridentata*). Earlier in the project, the riparian area was dominated by the invasive, non-native tamarisk and common reed (*Phragmites australis*); these habitats are no longer the most predominant, however, tamarisk remained the most abundant tree species along the Wash through 2015 (GBBO 2016). Native vegetation present includes Goodding's willow (*Salix gooddingii*), sandbar willow (*S. exigua*), seep willow (*Baccharis salicifolia*), Fremont cottonwood (*Populus fremontii*), honey and screwbean mesquite (*Prosopis glandulosa* and *P. pubescens*), arrowweed (*Pluchea sericea*), cattail (*Typha domingensis*), and bulrush (*Schoenoplectus* spp.). Mesquites are now the most abundant category of tree along the Wash (GBBO 2016).

Active channel stabilization and revegetation activities occurred along the length of the study area throughout the study period. By the end of the first year, nine weirs and 75 acres of revegetation had been installed. Mid-way through the study period (Year 6), 12 weirs and approximately 280 acres of revegetation were in place. By 2017, 19 weirs were constructed and over 500 acres were revegetated.

### Bird Data and Analyses

#### Data Collection Methods

Birds were surveyed using standardized five-minute point counts (Ralph and Scott 1981). Initially, 26 survey points were established and three were added within a few months, reaching a total of 31 by the end of the second year. Subsequently, from Year 3 through Year 12, all 31 points were surveyed or attempted to be surveyed each year, with some survey points having to be skipped in some years due to active construction. Some points had to be replaced due to recent construction activities during the course of the project (Table 1). Replacement points were

established in locations as close as was safely possible to the original location, which resulted in replacement points up to 50 m from their original location.

Each survey point was visited approximately every two weeks, with all survey points visited over a two-day period. The order in which points were sampled was rotated among survey visits. Surveys were conducted from sunrise to approximately five hours post-sunrise to capture the period of greatest bird activity and vocalization. Nesting evidence was collected from 2009 onward using standard breeding bird atlas methods (e.g., Floyd et al. 2007), which consider breeding to be confirmed if active nests, dependent young, food/nest material/fecal sac carrying, or nest building is observed. For more details on the point count protocol, see Braden et al. (2007).

Twenty-six surveys were conducted per year (Table 1), with the survey year typically running from mid-February through January for the first phase of the study. For the three most recent years of surveys, the survey year ran from September through August. The majority of this report covers the first full six years between 12 February 2005 and 31 January 2011, and the final three years between 5 September 2014 and 31 August 2017. The few seventh-year surveys conducted in 2011 (1 February through 24 April) were not included in most of our analyses, but they were used for the comprehensive species list.

## **Data Analysis**

### **Species List**

A comprehensive species list of all birds recorded at the Wash was generated based on all visits between 12 February 2005 and 31 August 2017, including all survey points (the total of which typically varied among years), all detection distances, and all birds detected incidentally outside of formal surveys. The list also includes “fly-over” sightings (e.g., Red-tailed Hawks flying high overhead) of birds that were in the Wash area but may not have been closely tied to the vegetation present at a survey point. This species list was generated to characterize the bird community of the Wash as comprehensively as possible, and because no quantitative comparisons are necessary to do that, all survey results and incidental and fly-over detections were included regardless of survey effort.

### **Species Richness and Abundance**

Unlike our approach for the comprehensive species list, species richness and abundance patterns were analyzed using standardized comparisons that included only bird detections that occurred within a 100 m radius of each survey point. Fly-overs were also excluded even if they occurred directly above a survey point, because these birds were generally not assumed to actively use the surveyed area. Limiting the sample to detections within 100 m of the point allowed us to compare bird abundances among survey points and treatment areas, but it precluded analyses for species with a primarily aerial lifestyle, such as swallows, swifts, and nighthawks. For these species, a separate analysis that includes fly-overs would be necessary, if determining their trends and habitat associations is desired.

We included survey data from all survey points for which data were available, which varied slightly over the first few years of the project. Although species richness (i.e., the number of species detected) can be sensitive to survey effort, we considered the variation to be minor, particularly given that the added and deleted survey points were representative of the rest of the study area in habitat types and species composition present.

To be able to compare the Wash data to other regional and national abundance data, we used the standardized estimate of density of the number of bird detections per 40 ha, converted from the fixed radius of 100 m around each point (3.14 ha). We then plotted the number of bird species and the number of bird detections per 40 ha by survey visit in order to illustrate temporal variation in species richness and abundance. Juvenile birds were excluded from analyses of breeding season data. We also performed simple linear regression analyses on total abundance and total species richness by survey visit. For all statistical analysis results in this report,  $P < 0.05$  was used as the significance level.

Species richness and abundance were also examined for the breeding and non-breeding seasons. In previous analyses (Braden et al. 2009), the breeding season was defined as the period between 15 March through 31 August to encompass the breeding of the majority of both year-round resident and migrant species. In this report, we used the same definitions to retain consistency with previous analyses. This time period overlaps with spring and early fall migration of several mid and long-distance migrants, so at least some non-breeding birds are included in the breeding season estimates. The non-breeding season was defined as 1 October through 31 January to include overwintering birds, but to exclude nesting of most resident species. Average richness and estimated density per survey were calculated for these seasons. Transitional periods covering the dates not included in either the breeding or non-breeding seasons were also included in the results, where appropriate.

## **Species-Specific Abundances**

For each species, estimated bird density (birds per 40 ha) was calculated for each year overall, and for its breeding and non-breeding seasons. Relative abundance (proportion of total bird abundance contributed by a species) was calculated for the same periods, but only for species representing at least one percent of the total abundance in one or more periods. We also report species frequency, which stands for the percentage of the Wash survey points at which the species was detected. This metric provides a measure of how widespread a species is within the study area.

Breeding season abundances from the Wash surveys were also compared to data collected as a part of GBBO's Nevada Bird Count (NBC) in other Clark County lowland riparian areas. This was done to provide a reference point for the estimated densities at the Wash from regional data collected in similar habitat types. The NBC data were collected on 190 survey visits of 46 transects, generating surveys on approximately 1,900 point-visits (since each transect typically consists of ten points) in roughly the same period (2005-2014) as the Wash surveys (7,073 point-visits). Both datasets included only detections from within 100 m of the survey point for the purpose of comparisons. However, NBC data were collected over a ten-minute survey period per point, rather than the five-minute period used at the Wash. Further, the breeding season periods

differed in that the Wash data were for the period between 15 March through 31 August, with surveys evenly distributed throughout that time period, while the NBC data were collected from mid-April through June, with surveys primarily occurring in May and early June. Regardless of these differences in methods, we consider the regional comparisons of estimates of breeding densities reported here informative for most breeding landbird species.

Finally, to determine whether population trends over time were significant, we performed negative-binomial regression analyses for count, using year as a predictor and number of points per visit as an exposure variable. The 20 species reported here were those analyzed in the 2016 report, and were selected based on number of detections, indicator and conservation priority status, and seasonal use of the Wash (for more information, see GBBO 2018).

## ***Vegetation Measurements***

### **Data Collection**

Vegetation data were collected at each bird survey point along the Wash during each fall in 2005-2010 and in 2014-2016, using a vegetation protocol developed by Braden et al. (2009). Three 100 m vegetation transects were laid out radially, at 120° angles from the point. Data were collected every two m along each transect at the distances of 20-40 m and 50-70 m from the survey point. Along each of these six 20 m segments, plant species occurrence, height, and vertical structure were recorded at 2 m intervals, yielding 60 sampling stations per point. Using an 11-15 m survey rod, perennial plant height was measured to within 0.1 m; any vegetation exceeding the height of the survey rod was estimated to within 0.5 m. Perennial plant structure was measured as the number of vegetation contacts at 1 m vertical intervals along the survey rod.

### **Data Analysis**

Percent cover type composition was calculated for each survey point, using averages from the point's vegetation transects, and also across the Wash, using averages from the 28 points surveyed consistently over the study period. Cover types included in the analyses were categorized as trees, shrubs, grasses, forbs, and cattails. Because some vegetation transects ended in the channel, emergent vegetation may be underestimated overall due to its naturally-clustered distribution along the channel shores. Analysis of Variance (Anova) was used to investigate vegetation cover type differences.

Percent cover of live trees by species was also calculated for each survey point and across the Wash. The species included in this analysis were catclaw (*Acacia greggii*), Fremont cottonwood, honey mesquite, screwbean mesquite, Goodding's willow, sandbar willow, and tamarisk.

Perennial vegetation height for each point was calculated as the average perennial height of the 60 sampling stations, and was analyzed for differences among years using the point as the sample unit. Vertical structural diversity was assessed by plotting the mean number of contacts vegetation made with the survey rod against the height categories 0-2 m, 2-4 m, 4-6 m, 6-8 m, and 8-10 m. These data were also analyzed for between-year differences.



Horizontal perennial heterogeneity was evaluated using the Hill (1973) proportional diversity measure  $[1/\sum p_i^2]$ , where  $p_i$  is the proportion of vegetation-rod hits at each of the six vegetation-transect segments at a survey point. The horizontal diversity measure was calculated for each point over the nine years of data collected, with values increasing as vegetation becomes more evenly distributed.

## Results and Discussion

### *Species List*

Between 12 February 2005 and 31 August 2017, 213 bird species were observed during visits to the Wash (Table 2). In the 12th year since the start of the project, four new species were detected for the first time in the Wash, including Tundra Swan, White Ibis, Stilt Sandpiper, and Black-and-white Warbler (all scientific names in Table 2). Sixty-eight species that had been detected at least once (including as incidentals) during the first eight years of surveys were not found in 2016-2017, including for example, Bushtit, Spotted Towhee, Brewer's Blackbird, and Western Sandpiper.

Of the 213 species observed during the nine years of surveys, 184 were recorded during the breeding season (15 March - 31 August), and 160 were recorded during the non-breeding season (1 October - 31 January). Only a small number of species (8) were detected exclusively during the transitional seasons between the designated breeding and non-breeding seasons, suggesting that most migrants actually passed through during the "breeding" or "non-breeding" seasons. Fifty-one species recorded in the Wash are conservation priorities according to the Nevada Comprehensive Bird Conservation Plan (GBBO 2010), the Clark County Multiple Species Habitat Conservation Plan (Clark County 2000), the Lower Colorado River Multi-Species Conservation Program (Bureau of Reclamation 2006), and/or the Partners in Flight Landbird Conservation Plan (Rosenberg et al. 2016; Table 2). Thirty-five of the priority species were recorded during the non-breeding season, and 43 were recorded during the breeding season. Thirty-nine priority species were detected during the transitional periods, but only three of these were detected exclusively in the transitional seasons.

Two new species were confirmed as breeders in 2016-2017 (Least Bittern and Western Kingbird), resulting in a total of 42 species confirmed to be nesting in the Wash based primarily on breeding evidence gathered in 2009-2017. Ten conservation priority species were confirmed to nest within the Wash, including Gambel's Quail, Least Bittern, Costa's Hummingbird, Loggerhead Shrike, Bell's Vireo, Long-eared Owl, Lucy's Warbler, Yellow Warbler, Abert's Towhee, and Blue Grosbeak. The full list of birds confirmed as breeders along the Wash is as follows:

Abert's Towhee	Indigo Bunting
American Kestrel	Killdeer
Bell's Vireo	Least Bittern
Bewick's Wren	Loggerhead Shrike
Black Phoebe	Long-eared Owl
Black-chinned Hummingbird	Lucy's Warbler
Black-crowned Night-Heron	Mallard
Black-tailed Gnatcatcher	Mourning Dove
Blue Grosbeak	Northern Harrier
Brown-headed Cowbird	Northern Mockingbird
Canada Goose	Northern Rough-winged Swallow
Common Gallinule	Red-shouldered Hawk
Common Yellowthroat	Red-tailed Hawk
Cooper's Hawk	Red-winged Blackbird
Costa's Hummingbird	Say's Phoebe
Crissal Thrasher	Song Sparrow
Double-crested Cormorant	Verdin
Gambel's Quail	Western Kingbird
Greater Roadrunner	Yellow Warbler
Great-tailed Grackle	Yellow-breasted Chat
House Finch	Yellow-headed Blackbird

### ***Species Richness and Total Abundance***

Species richness varied seasonally across the study period and was lowest in January and peaked during September due to migration and juvenile dispersal (Figure 2a). However, richness patterns changed after the first six years of the project, with richness typically being lowest during the non-breeding season and the winter transition and highest during the fall transition in the early years, and the pattern becoming less clear in the three most recent years (Figure 2b; Table 3). In Year 10, the lowest richness was in the fall transition, and the highest was in the breeding season; in Year 11, the lowest was in the breeding season, and the highest during the winter transition; and in Year 12, the lowest richness was in the breeding season, and the highest during the fall transition.

Some of this change in pattern is likely due to increased migrating and wintering waterfowl, as well as reduced seasonal variability in richness. In the first six years, the average yearly difference between the maximum and minimum seasonal richness values was ten species (range: 6.3-14.8; Table 3). Over the past three years, the average yearly difference between the maximum and minimum seasonal richness values was only 4.6 species (range: 4.1-5.1; Table 3). Overall species richness remained similar throughout the first six years, showing only a slight increase, but it was significantly higher in Years 10 through 12 (Adjusted  $R^2 = 0.50$ ;  $P < 0.001$ ; Figure 3; Table 3).

Total bird abundance (bird detections per 40 ha) also varied seasonally (Figure 4a), and the pattern changed over time (Figure 4b). Over the first six years, the pattern shows a peak in the breeding season (in May-July) and a larger increase during the late fall migration period (October-November; Figure 4b). However, from year to year within this period, the season with the highest abundance varied, while the lowest abundances were found in either February/March or August/September, generally corresponding with the winter and fall transitional periods (Table 4). Seasonal averages were fairly similar during the first six years, but the difference between maximum and minimum seasonal abundance was 56.2 birds per 40 ha (range: 17.5-79.6; Table 4). For the most recent three years of surveys, the pattern became much more consistent, with the lowest abundances found in the fall transition and breeding season (May, August, and September) and the highest abundances found in the non-breeding and winter transition seasons (January and February; Figure 4b; Table 4). The differences between these seasonal averages increased from the first six years to a difference between the maximum and minimum seasonal estimates in this period of 224.5 birds per 40 ha (range: 170.9-285.5; Table 4).

Total bird abundance increased almost every year (Figure 5; Table 4) and showed an overall significant increasing trend (Adjusted  $R^2 = 0.34$ ;  $P < 0.001$ ). The largest increase in abundance occurred in the winter transition period, which averaged fewer than 100 birds per 40 ha in Year 1 and increased almost 350% by Year 12 (down from a peak in Year 11).

## ***Species-Specific Abundances***

### **Overall Abundance Patterns**

For the entire study period, the ten species with the greatest absolute abundances were American Coot, Red-winged Blackbird, Abert's Towhee, Yellow-rumped Warbler, Mallard, Song Sparrow, Gadwall, Marsh Wren, White-crowned Sparrow, and American Wigeon (Table 5). In the three most recent survey years, waterbird numbers increased dramatically from the first six years, particularly American Coot, American Wigeon, Eared Grebe, Gadwall, and Mallard (Tables 5 and 6). Several species of riparian shrub/tree habitats declined over this period (e.g., Abert's Towhee, Bewick's Wren, Lucy's Warbler, Song Sparrow, and Yellow-breasted Chat), however, these species are also generally less numerous than waterbird species under any habitat conditions.

The species with the highest absolute abundances also had the highest relative abundances (percentage of total bird abundance by each species; Tables 7 and 8), including American Coot, Red-winged Blackbird, Abert's Towhee, and Yellow-rumped Warbler. The relative frequency of each species (i.e., the percentage of total survey points at which the species was detected at least once) showed that the species that are most widespread within the study area included typical riparian songbirds, such as Yellow-rumped Warbler, Abert's Towhee, Black Phoebe, White-crowned Sparrow, Song Sparrow, Verdin, Bewick's Wren and Black-tailed Gnatcatcher (Table 9).

## **Breeding Season Species Abundances in Relation to Regional Abundances**

During the breeding season, the ten most abundant species at the Wash included Red-winged Blackbird, Abert's Towhee, Song Sparrow, Common Yellowthroat, Great-tailed Grackle, American Coot, Brown-headed Cowbird, Bewick's Wren, Verdin, and Gambel's Quail (Table 10). In comparison, the ten most abundant species recorded during ten years of NBC surveys within Clark County included Gambel's Quail, Abert's Towhee, Lucy's Warbler, Mourning Dove, Brown-headed Cowbird, Yellow Warbler, Verdin, House Finch, Red-winged Blackbird, and Song Sparrow (Table 10). Six of the ten most abundant species in the NBC were also among the ten most abundant for the Wash, and of the 50 most abundant species at the Wash, 33 (66%) were also in the 50 most abundant species in the NBC surveys (Table 10). Thus, there is a large degree of similarity between the Wash and other lowland riparian areas of the region.

The largest differences between the Wash and regional riparian areas are with regard to wetland, disturbed, and upland associated species. The Wash tended to support greater numbers of wetland species, such as Red-winged Blackbirds, Song Sparrows, Bewick's Wrens, Common Yellowthroats, Mallards, and American Coots than are found in regional riparian areas. Disturbance-associated birds, such as Brown-headed Cowbird and Great-tailed Grackle, were also more abundant along the Wash than regionally. However, while Abert's Towhees and Blue Grosbeaks were more abundant at the Wash, Gambel's Quail, Phainopepla, Bell's Vireo, and Black-throated Sparrows were all more abundant in the regional comparison sites (Table 10). This may be in part a result of construction and other barren areas adjacent to riparian areas at the Wash, thus reducing habitat for Black-throated Sparrows and Gambel's Quail near the survey points. Also, while mesquites and catclaws are present on the Wash, they may not yet be old enough to support sufficient mistletoe, and/or possibly not yet widespread enough, to support Phainopepla. Bell's Vireos tend to prefer dense riparian shrub habitats, and are often associated with mesquites. While the Wash does contain areas with dense riparian shrubs, this habitat type has been in decline for several years due to weir construction activities. Additionally, while mesquite has been planted extensively as a part of project efforts, it may be that it is not yet suitable for the vireo.

## **Non-Breeding Season Species Abundances**

During the non-breeding season, the ten most abundant species of the Wash included American Coot, Yellow-rumped Warbler, Mallard, White-crowned Sparrow, Gadwall, Abert's Towhee, Marsh Wren, American Wigeon, American Pipit, and Red-winged Blackbird (Tables 5 and 6). No similar datasets were available from elsewhere, preventing us from making regional comparisons. The most abundant birds of the non-breeding season were a mix of year-round residents (e.g., Abert's Towhee, Red-winged Blackbird), migrants and wintering species of the Mojave Desert (e.g., Yellow-rumped Warbler, White-crowned Sparrow, American Pipit), and wetland/aquatic species (e.g., American Coot, Gadwall, Mallard, Marsh Wren, American Wigeon).

The change in composition of this list through 2017 relative to that through 2010 is striking, as waterfowl become more and more abundant. In 2010, the most abundant species were Yellow-rumped Warbler, White-crowned Sparrow, Abert's Towhee, Marsh Wren, American Coot, Song

Sparrow, American Pipit, Red-winged Blackbird, Mallard, and Ruby-crowned Kinglet. Now, Gadwall and American Wigeon are among the ten most abundant species, and American Coots and Mallards are among the three most abundant species, while Song Sparrow and Ruby-crowned Kinglet are no longer among the ten most abundant. In total, the ten most abundant species in the past three years included American Coot, Gadwall, Mallard, American Wigeon, Yellow-rumped Warbler, White-crowned Sparrow, American Pipit, Marsh Wren, Abert's Towhee, and Red-winged Blackbird.

## **Trends in Species Abundances**

We examined trends in abundance for 20 focal species of the Wash over the 12-year survey period (Figures 6a-e; Table 11). Eight species showed significant increases over the study period, including Red-winged Blackbird, Mallard, Gadwall, Verdin, Black-tailed Gnatcatcher, American Pipit, Gambel's Quail, and Orange-crowned Warbler. These species tend to be found in wetland marsh (e.g., Red-winged Blackbird), open water (Mallard, Gadwall), and drier or more open habitat types than cottonwood/willow riparian shrublands and woodlands (e.g., Black-tailed Gnatcatcher, Verdin, American Pipit, Gambel's Quail). Orange-crowned Warbler migratory habitats are more variable, with differences documented according to subspecies, season, and age. Western individuals appear to use riparian corridors (e.g., cottonwood, willow, and tamarisk) and brushy habitats (Gilbert et al. 2010).

Six of the species showed significant declines including Abert's Towhee, Song Sparrow, Bewick's Wren, Ruby-crowned Kinglet, Lucy's Warbler, and Yellow-breasted Chat. These species tend to be found in dense riparian shrub habitats (e.g., Song Sparrow, Bewick's Wren, Yellow-breasted Chat), and where stems are large enough to provide nest cavities (Lucy's Warbler). These species likely responded to the temporary reduction of such vegetation due to tamarisk removal.

## ***Vegetation Measurements***

### **Tree Cover**

Based on our measurements, tree cover differed significantly among years over the 12-year period (Figure 7; Table 12), declining from 41% average cover in 2005 to 16% cover in 2016. Native riparian tree cover (including Fremont cottonwood, Goodding's willow, and sandbar willow, but not including mesquites) increased through 2008, dropped off in 2009, and has stayed fairly stable since; none of the changes were statistically significant (Figure 8; Table 12).

Tamarisk cover differed significantly among years between 2005 and 2016 (Figure 9; Table 12). Tamarisk originally formed the majority of the tree cover of the Wash, averaging 36% of total vegetative cover in 2005 compared with 4% in 2016. Cover estimates for cottonwood and Goodding's willow were statistically similar over the 12-year period (Figures 10-11; Table 12), however, sandbar willow cover differed significantly among years, from a high in 2008 to a low in 2015. Average cover values had increased from 1.0% in 2005 to 2.7% in 2008, then dropped to below 0.5% for 2009 through 2016 (Figure 12; Table 12).

Mesquite cover showed an apparent increase from 1 to 7% over the 12 years, but there were no significant differences across years (Figure 13; Table 12). The proportion of tree cover provided by native riparian species (not including mesquite) was statistically similar throughout this period (Figure 14; Table 12); however, the proportion of tree cover provided by mesquites significantly differed, increasing from 4% in 2005 to 29% in 2016 (Figure 15; Table 12).

## **Perennial Plant Height**

Mean perennial plant height slightly decreased across the 12-year period, from 2.9 m in 2005 to 2.0 m in 2016, but there were no significant differences among years (Figure 16; Table 12).

## **Cover Types**

Beyond tree cover, four other cover types were also evaluated for changes at the Wash over the 12-year study period, including shrubs, forbs, grasses, and cattails (Figures 17-20; Table 12). Overall shrub cover (including *Phragmites*) increased over the study period from 23% in 2005 to 31% in 2016 (Figure 17); however, there were no significant differences among years. This apparent increase in overall shrub cover was driven primarily by significant changes in upland shrubs ( $P = 0.022$ ; Table 12). Riparian shrub cover did not significantly change over this period.

Forb cover significantly differed among years, declining over the study period from 9% to 1% (Figure 18). Grass cover also significantly differed over the 12 years, ranging from 0 to 4% cover (Figure 19); however there was no apparent trend. Cattail cover was statistically similar throughout the study (Figure 20).

## **Vertical Perennial Plant Structure**

Vertical perennial plant structure changed slightly over the study period, though this change was not statistically significant (Figure 21; Table 12). Significant differences among years were observed in the 0-2 m, 2-4 m, and 4-6 m height intervals (Figures 22-24; Table 12), with the mean number of rod hits increasing through 2010, then decreasing again, in the 0-2 m height interval. In the 2-4 m height interval, mean rod hits have varied, but have decreased overall from 131 in 2005 to 40 in 2016. Similarly, in the 4-6 m height interval, mean rod hits have decreased overall from 63 in 2005 to 8 in 2016. These results reflect the large number of points that were cleared and under construction beginning in 2010. There were no significant changes in the 6-8 m height interval (Figure 25), nor the 8-10 m height interval (Figure 26) over the time period of the study.

## **Horizontal Perennial Plant Structure**

Horizontal structure of perennials was evaluated using a proportional plant diversity measure based on rod hits along the vegetation transect line. The horizontal heterogeneity index differed significantly over the 12-year survey period, declining from a mean of 3.6 in 2005 to 2.8 in 2016 (Figure 27; Table 12).

## Discussion

As discussed in previous reports (GBBO 2011a and b, 2018), the bird community of the Wash is rich, featuring approximately 44% of the total bird species richness recorded in Nevada, and providing important habitat for 51 conservation priority species, ten of which were confirmed to be nesting on the site.

Our regional comparisons show that the Wash functions much like other riparian areas of the Mojave Desert, although it features higher abundances of several riparian and wetland-associated species than encountered regionally. Bird species richness was highest during the breeding and post-breeding season, as is typical for temperate riparian areas that support a diverse bird community during the seasons of insect productivity. However, this pattern did change over the course of the project – while richness increased overall, during the early part of the project, the lowest richness was primarily during the period from December through March, while in the most recent three years, these months included some of the greatest numbers of species recorded during the year.

Total bird abundance also changed dramatically over the course of the project. During the early years, abundances were high during the breeding season and at their highest in October and November, which was mostly attributable to regularly-recorded winter birds that flock, such as American Pipits. More recently, abundances peaked December through February, as wintering and migrating waterbirds increasingly used the created wetlands.

Over the life of the Wash stabilization and enhancement project, 19 weirs were constructed, non-native tamarisk was removed, and over 500 acres were revegetated with native plants. Recent construction resulted in multiple survey areas lacking significant vegetation, which explains overall decreases in several plant height intervals, in horizontal heterogeneity, and ultimately in riparian shrub-associated birds, such as Abert's Towhee, Song Sparrow, Bewick's Wren, and Yellow-breasted Chat (Figures 6a-e; Table 11). Cover of non-native tamarisk decreased while upland shrub cover and the proportion of mesquite cover increased as a result of revegetation efforts, and many of these habitat changes need additional recovery time to provide suitable habitat for birds that specialize in native woodlands.

Wetlands created by the weirs and revegetation resulted in overall increased species richness and abundance of birds, particularly in bird groups that are associated with aquatic and wetland habitat types. The replacement of dry tamarisk sites by upland shrubs and mesquites has also impacted the bird community. Several species that rely on these habitats increased significantly in abundance, including Red-winged Blackbird, Mallard, Gadwall, Verdin, and Black-tailed Gnatcatcher.

Among the most dramatic changes in the bird community over the course of the project was a large increase in species richness over the most recent three years of the project. Much of that increase can be attributed to the weir impoundments and the consequent increase in shorebirds and waterfowl. Similarly, the increase in total bird abundance recorded during this same period can be attributed in large measure to these impoundments.

The Wash supported larger estimated densities of many riparian shrub and wetland bird species compared with similar areas in the Mojave Desert, including Red-winged Blackbird, Abert's Towhee, Song Sparrow, Common Yellowthroat, Yellow-breasted Chat, and Marsh Wren. Species found to be more common at other sites than the Wash included Gambel's Quail, House Finch, Black-throated Sparrow, Phainopepla, and Ash-throated Flycatcher. For further details on the natural history and habitat use of these species, see GBBO (2010, 2011a and b).

## **Recommendations**

### ***Monitoring***

We recommend that landbird monitoring along the Wash be continued on an annual basis until the site is fully recovered from construction and restoration activities. Specifically, our findings indicate that the bird community is still very much in flux, both showing immediate responses to recent construction activities and intermediate responses in areas where the vegetation has begun to recover from construction. Some species may not be added to the community until the site has reached a new equilibrium, and continued monitoring will allow a full assessment of the benefits of the restoration project to wildlife. For continuity of the long-term monitoring database, we recommend annual implementation of the full survey schedule as was done in 2005-2017, but if funding availability demands a cut, we can provide recommendations for reducing survey frequency while minimizing the loss of information or compatibility with previously-collected survey data. Reduction in survey frequency leads to larger variability in data and increases the probability of missing rare and rarely-detected birds, but monitoring at a reduced frequency would still be valuable for detecting basic patterns of abundance and community turnover. We also note that some of the strongest responses to the recovery of native riparian vegetation were found in the non-breeding seasons, so we recommend against complete elimination of surveys during fall, winter, and spring, and instead recommend, if cuts need to be made, reducing overall frequency of surveys during these seasons.

Current analyses compare breeding season results along the Wash to those found within Mojave Desert lowland riparian habitats through the NBC. Depending on the availability of funds, we may forgo these regional comparisons or else expand them to include other sites that continue to be monitored, such as the Warm Springs Natural Area, and/or the lower Colorado River.

### ***Conservation and Management***

The past three years of surveys began to show a large positive response of migrating and wintering birds to the restoration activities along the Wash, particularly in the wetlands created through weir construction, but several bird species also showed initial declines after vegetation had to be cleared for construction. Abert's Towhees, Bewick's Wrens, Lucy's Warblers, and Yellow-breasted Chats are among the species that declined initially, but these are also expected to recover with maturing revegetation sites, as they were detected in older revegetation and in



relic riparian stands. As mesquite stands are being restored across the Wash, we also expect increases in mesquite-associated species that are currently rare, such as Phainopepla, and those that require large trees, such as Lucy's Warblers.

As recent revegetation sites are maturing and construction and restoration activities are winding down, we recommend focusing on enhancements and improvements at a finer scale than is possible during construction of entire reaches. With this goal in mind, we highlight the following activities and landscape/habitat features that attract a variety of bird species:

- Monitor degree of horizontal and vertical plant diversity using very simple techniques (e.g., repeated photo points, drone flights); using off-site reference sites, determine whether diversity is sufficiently maintained through natural processes or should be artificially enhanced
- Maintain or increase tree and shrub diversity with plantings of vegetation that is normally recruited through natural processes (e.g., early and mid-successional riparian stands) or by mimicking those processes; particularly willow stands with saturated soils tend to disappear over time in the course of succession, and these may need to be artificially disturbed or otherwise maintained
- Maintain or increase emergent wetlands by sustaining or mimicking natural processes; this habitat type tends to transition at the Wash due to sediment aggradation in weir impoundments
- Protect snags, woody debris and old trees and shrubs unless they are hazardous to the public; these provide important nest, roost, and thermal cover sites for a variety of bird species
- If feasible, plant additional species that provide unique resources to birds:
  - Wolfberries form an important food source, and were associated with peak abundance of at least one sensitive riparian bird species at the Warm Springs Natural Area
  - Thorny and otherwise impenetrable shrubs (e.g., wolfberry, quailbush) provide important barriers to nest predators and parasites, including feral cats, corvids, raccoons, rats, and cowbirds
  - Any native shrubs that bloom in the summer may provide a hummingbird resource for nesting
  - Any native shrub that features berries that may benefit fall migrant and wintering birds

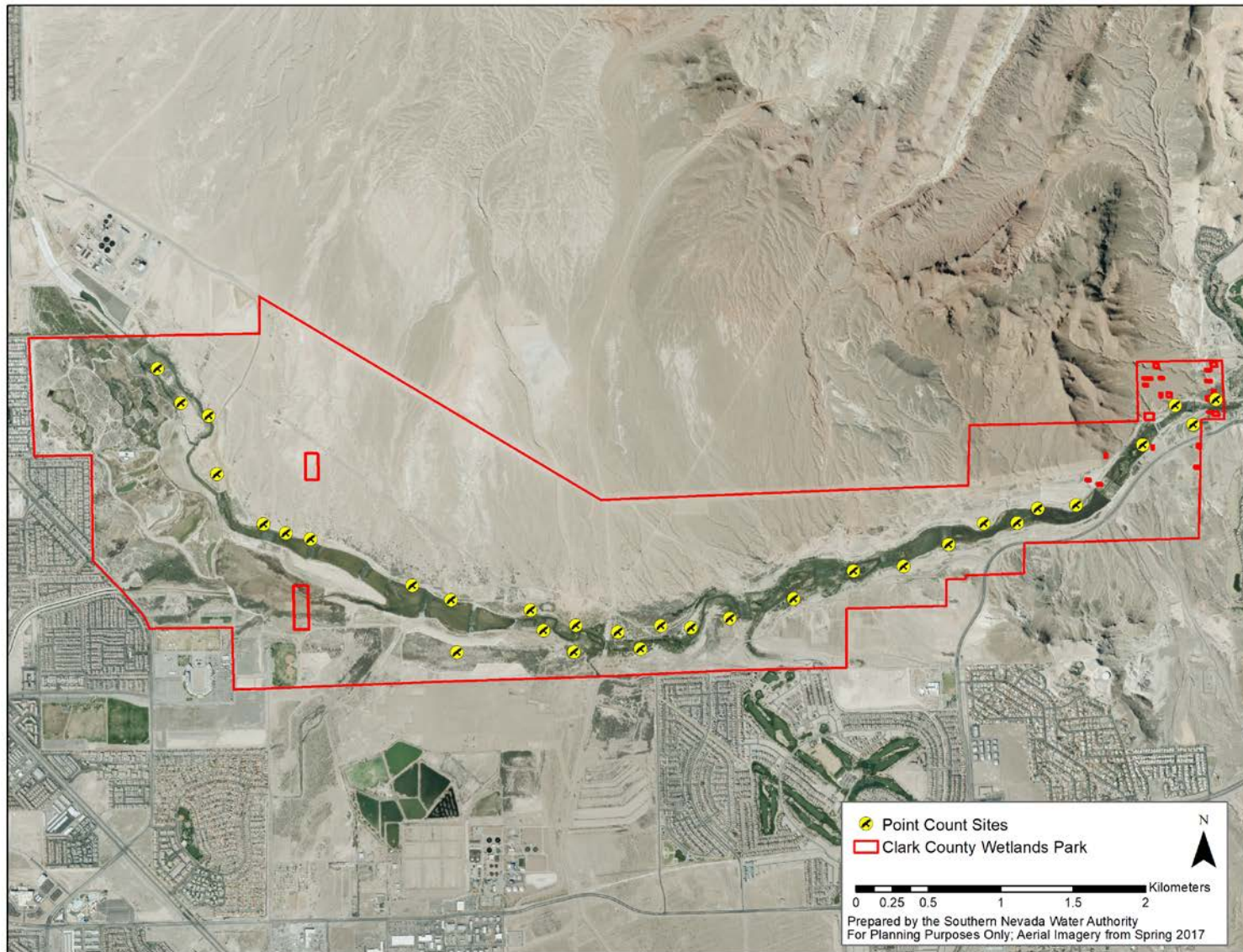
## Literature Cited

Braden, G.T., L. Crew, and A. Miller. 2007. Avian diversity, vegetation composition, and vegetation structure of the Las Vegas Wash: Year One – Final Report. Unpubl. Report, Prepared by San Bernardino County Museum for the Las Vegas Wash Coordination Committee, August 2007.

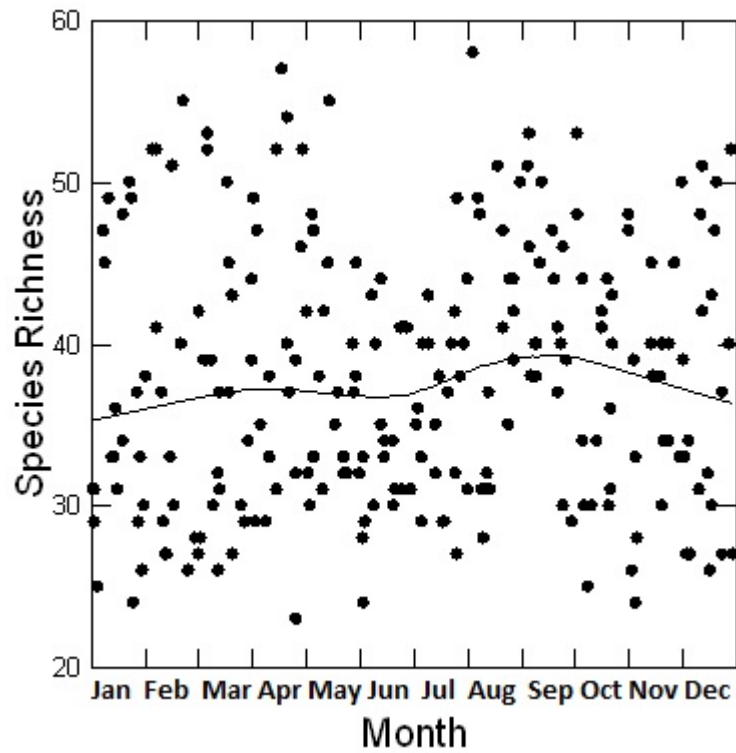
- Braden, G.T., L. Crew, and A. Miller. 2009. Avian diversity, vegetation composition, and vegetation structure of the Las Vegas Wash: 2005 to 2009. Unpubl. Report, Prepared by San Bernardino County Museum for the Las Vegas Wash Coordination Committee, November 2009.
- Bureau of Reclamation. 2006. Lower Colorado River Multi-Species Conservation Program. <http://www.lcrmscp.gov>
- Clark County. 2000. Clark County Multi-Species Habitat Conservation Plan: Final Environmental Impact Statement. [http://www.co.clark.nv.us/comprehensive\\_planning/Environmental/MultipleSpecies/MultipleSpeciesHabitatConservationPlan.htm](http://www.co.clark.nv.us/comprehensive_planning/Environmental/MultipleSpecies/MultipleSpeciesHabitatConservationPlan.htm)
- Floyd, T., C.S. Elphick, G. Chisholm, K. Mack, R.G. Elston, E.M. Ammon, and J.D. Boone. 2007. Atlas of the Breeding Birds of Nevada. University of Nevada Press, Reno. 581 pp.
- (GBBO) Great Basin Bird Observatory. 2010. Nevada Comprehensive Bird Conservation Plan, Version 1.0. [http://www.gbbo.org/bird\\_conservation\\_plan.html](http://www.gbbo.org/bird_conservation_plan.html)
- (GBBO) Great Basin Bird Observatory. 2011a. Bird community and vegetation of the Las Vegas Wash, 2005-2010. Unpubl. Report Submitted to the Southern Nevada Water Authority, Las Vegas, Nevada.
- (GBBO) Great Basin Bird Observatory. 2011b. Bird population trends and habitat treatment effects at the Las Vegas Wash, 2005-2011. Unpubl. Report Submitted to the Southern Nevada Water Authority, Las Vegas, Nevada.
- (GBBO) Great Basin Bird Observatory. 2016. Bird population and vegetation trends at the Las Vegas Wash, 2005-2015. Unpubl. Report Submitted to the Southern Nevada Water Authority, Las Vegas, Nevada.
- (GBBO) Great Basin Bird Observatory. 2018. Bird population trends and habitat treatment effects at the Las Vegas Wash, 2005-2016. Unpubl. Report Submitted to the Southern Nevada Water Authority, Las Vegas, Nevada.
- Gilbert, W.M., M.K. Sogge, and C. van Riper, III. 2010. Orange-crowned Warbler (*Oreothlypis celata*), version 2.0. In The Birds of North America (A.F. Poole, ed). Cornell Lab of Ornithology, Ithaca, NY. <https://doi.org/10.2173/bna.101>
- (LVWCC) Las Vegas Wash Coordination Committee. 2000. Las Vegas Wash Comprehensive Adaptive Management Plan. Las Vegas Wash Project Coordination Team, Southern Nevada Water Authority, Las Vegas, Nevada.
- Ralph, C.J., and J.M. Scott. 1981. Estimating the numbers of terrestrial birds. C.J. Ralph and J.M. Scott (eds). Studies in Avian Biology No. 6.

- Rosenberg, K.V., J.A. Kennedy, R. Dettmers, R.P. Ford, D. Reynolds, J.D. Alexander, C.J. Beardmore, P.J. Blancher, R.E. Bogart, G.S. Butcher, A.F. Camfield, A. Couturier, D.W. Demarest, W.E. Easton, J.J. Giocomo, R.H. Keller, A.E. Mini, A.O. Panjabi, D.N. Pashley, T.D. Rich, J.M. Ruth, H. Stabins, J. Stanton, and T. Will. 2016. Partners in Flight Landbird Conservation Plan: 2016 Revision for Canada and Continental United States. Partners in Flight Science Committee.
- Shanahan, S.A., D.M. Van Dooremolen, T. Sharp, S. Martin, and B. Brown. 2008. Las Vegas Wash Wildlife Management Plan. Prepared by the Southern Nevada Water Authority, Las Vegas, NV, and SWCA Environmental Consultants, Salt Lake City, UT. Prepared for the Las Vegas Wash Coordination Committee.  
[http://www.lvwash.org/assets/pdf/resources\\_ecoresearch\\_wildlife.pdf](http://www.lvwash.org/assets/pdf/resources_ecoresearch_wildlife.pdf)

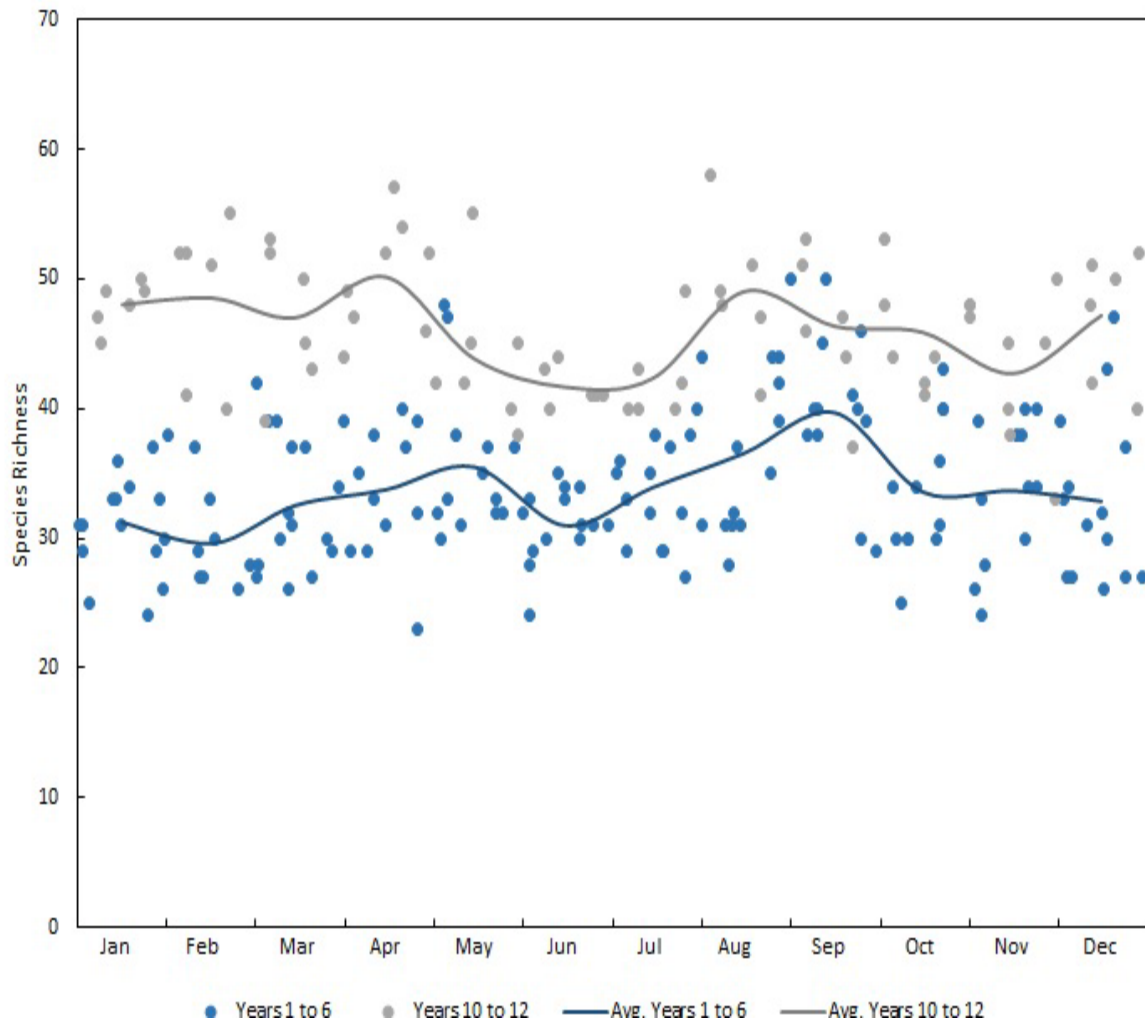
## Figures



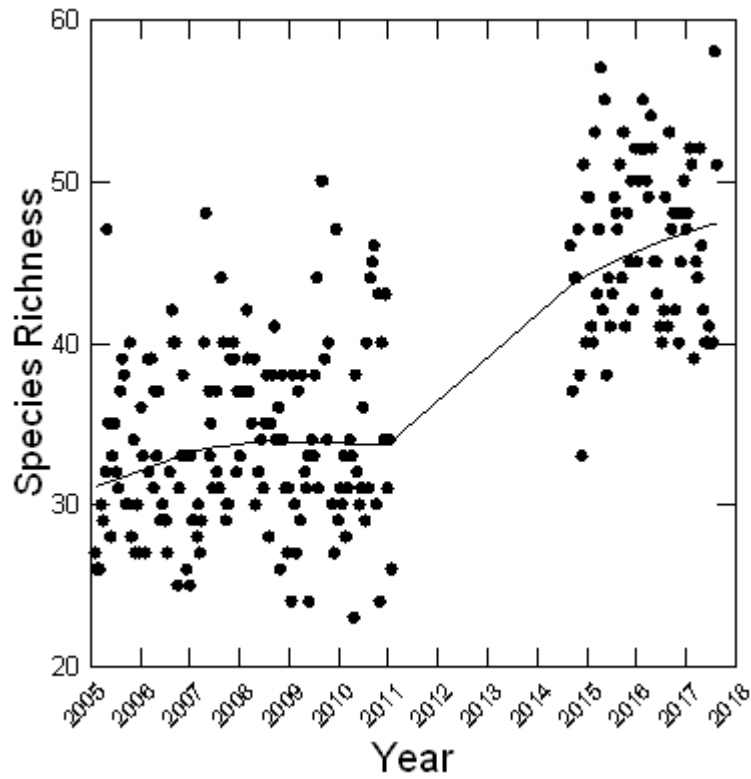
**Figure 1.** Distribution of points across Las Vegas Wash. Map courtesy of Southern Nevada Water Authority.



**Figure 2a.** Seasonal species richness per survey visit from 234 surveys of the Las Vegas Wash (2005 – 2017). Curve represents a LOWESS smoothed fit for variation in richness among survey visits.

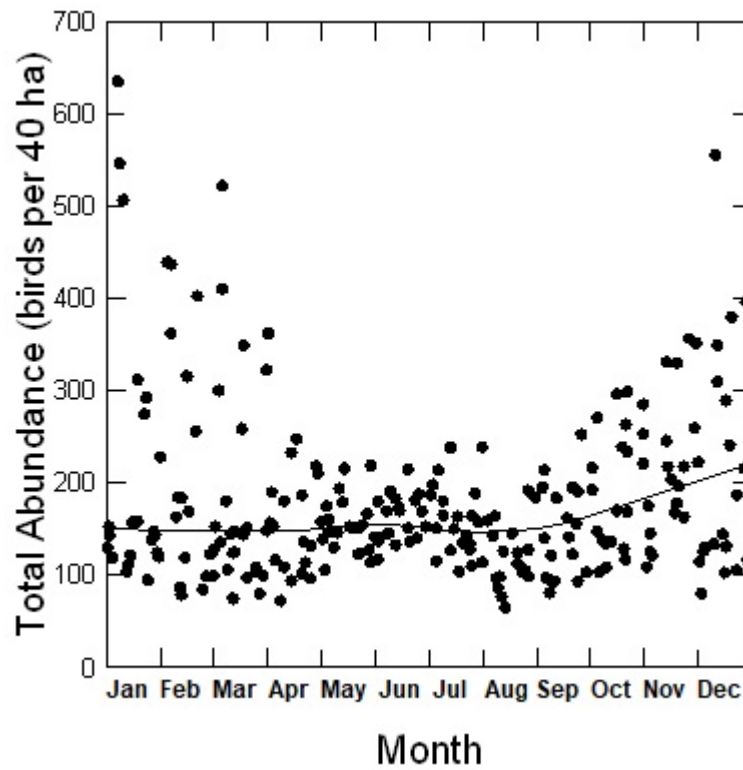


**Figure 2b.** Seasonal bird richness per survey visit from 234 surveys of the Las Vegas Wash (2005-2017), showing smoothed fit of average richness per month by period (Years 1 to 6 and Years 10 to 12).

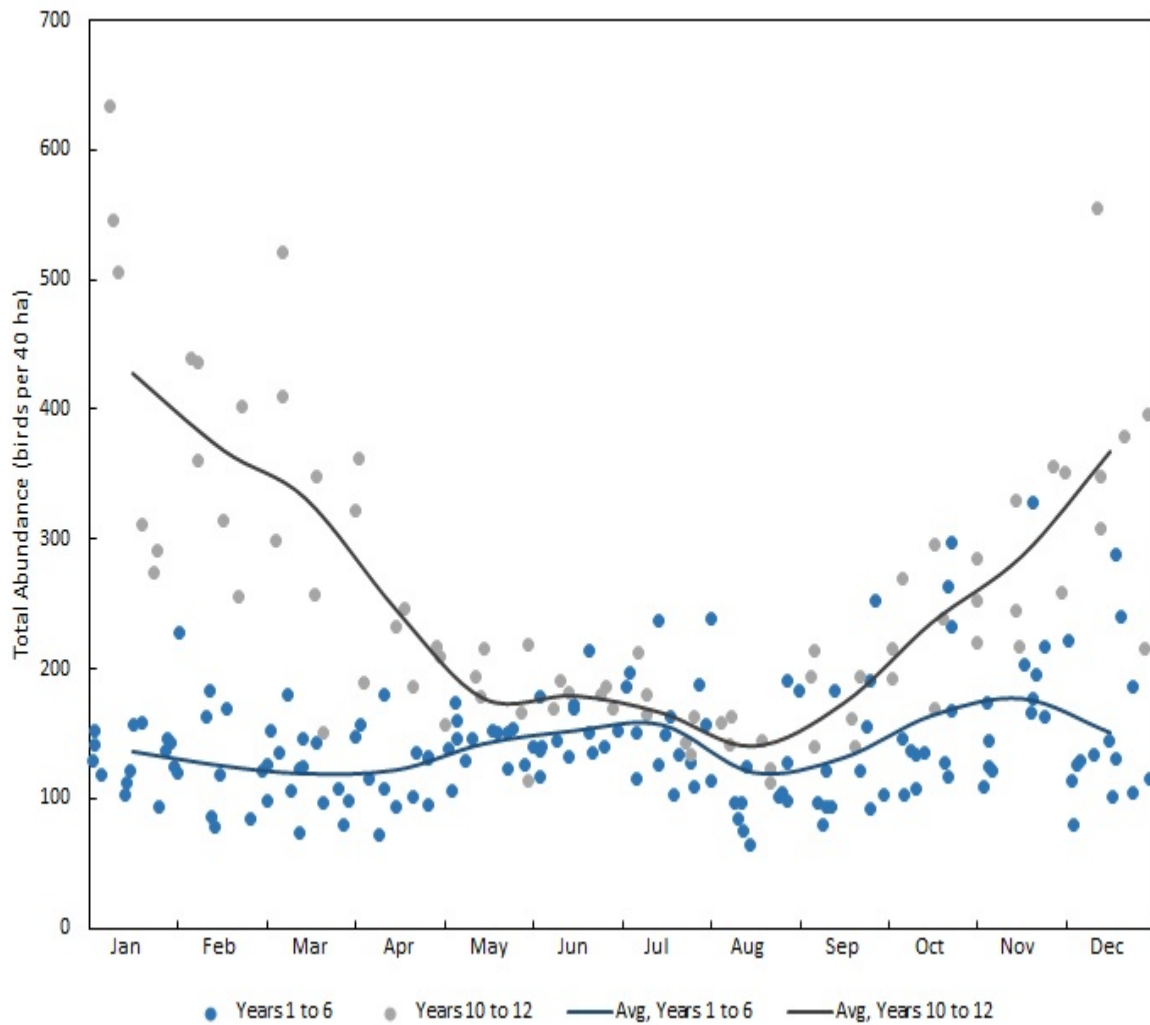


**Figure 3.** Trend in species richness from 234 surveys of the Las Vegas Wash (2005 – 2017). Curve represents a LOWESS smoothed fit for variation in richness among survey visits.

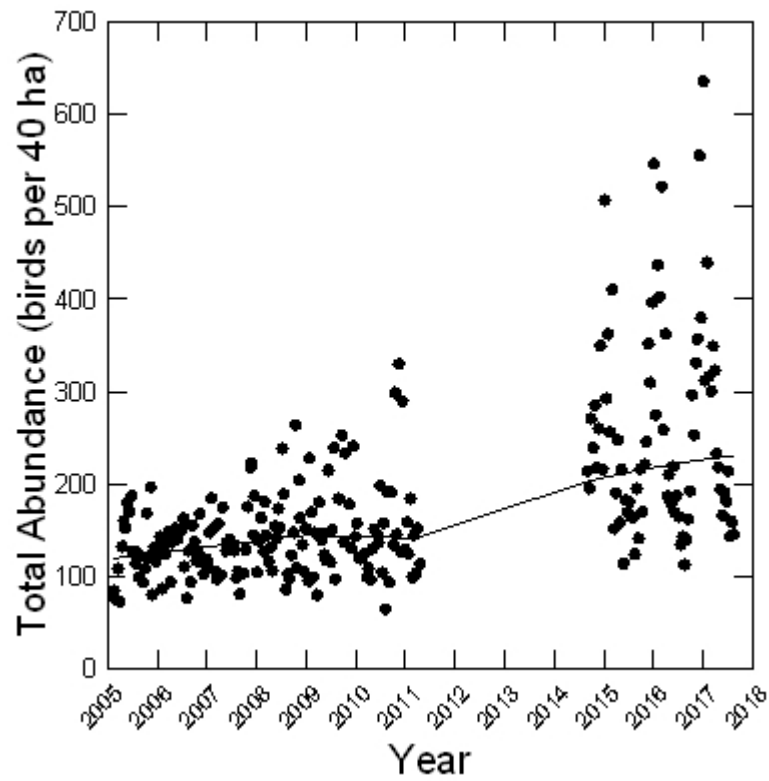




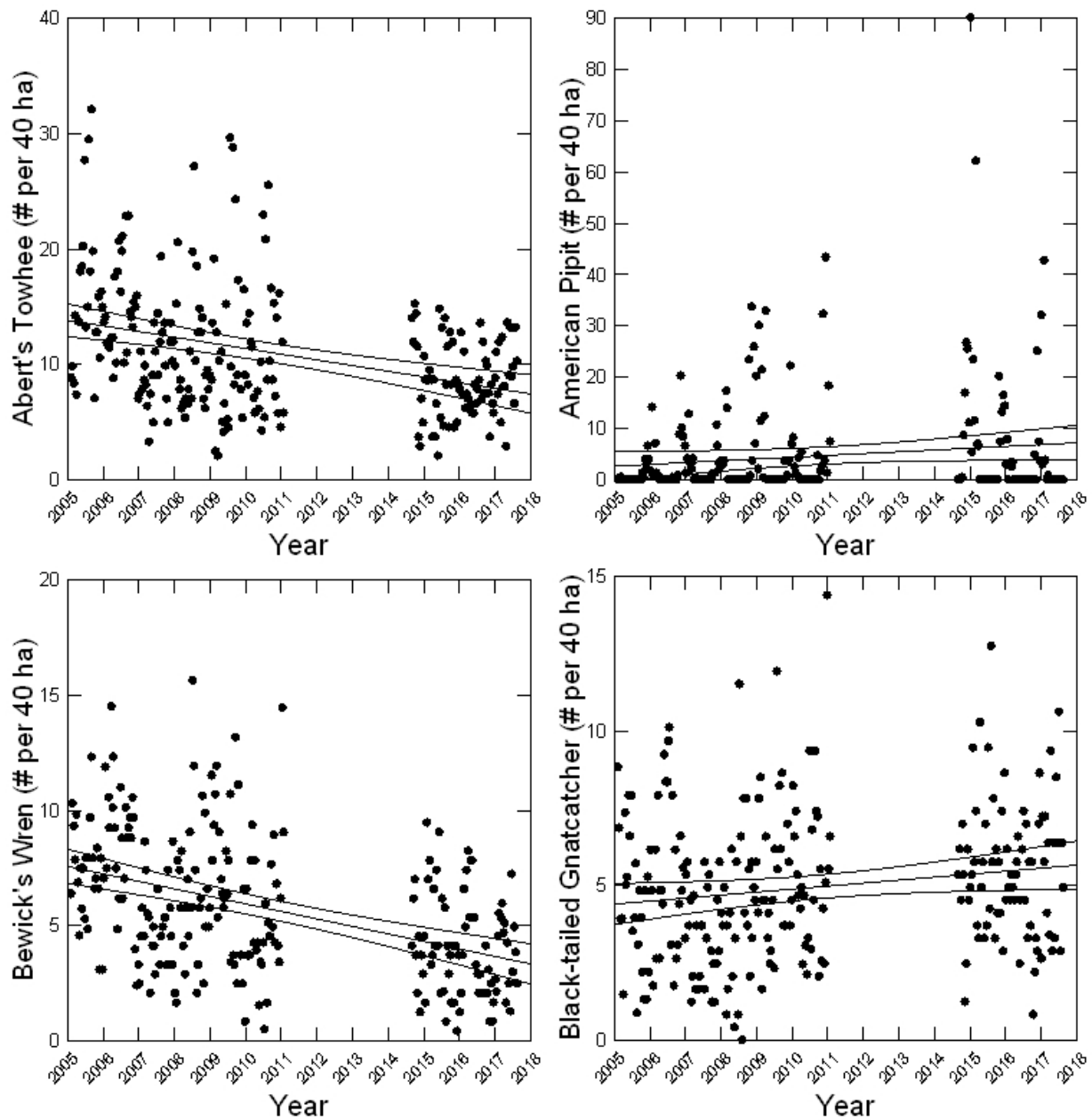
**Figure 4a.** Seasonal total bird abundance per survey visit from 234 surveys of the Las Vegas Wash (2005-2017). Curve represents a LOWESS smoothed fit for variation in abundance among survey events.



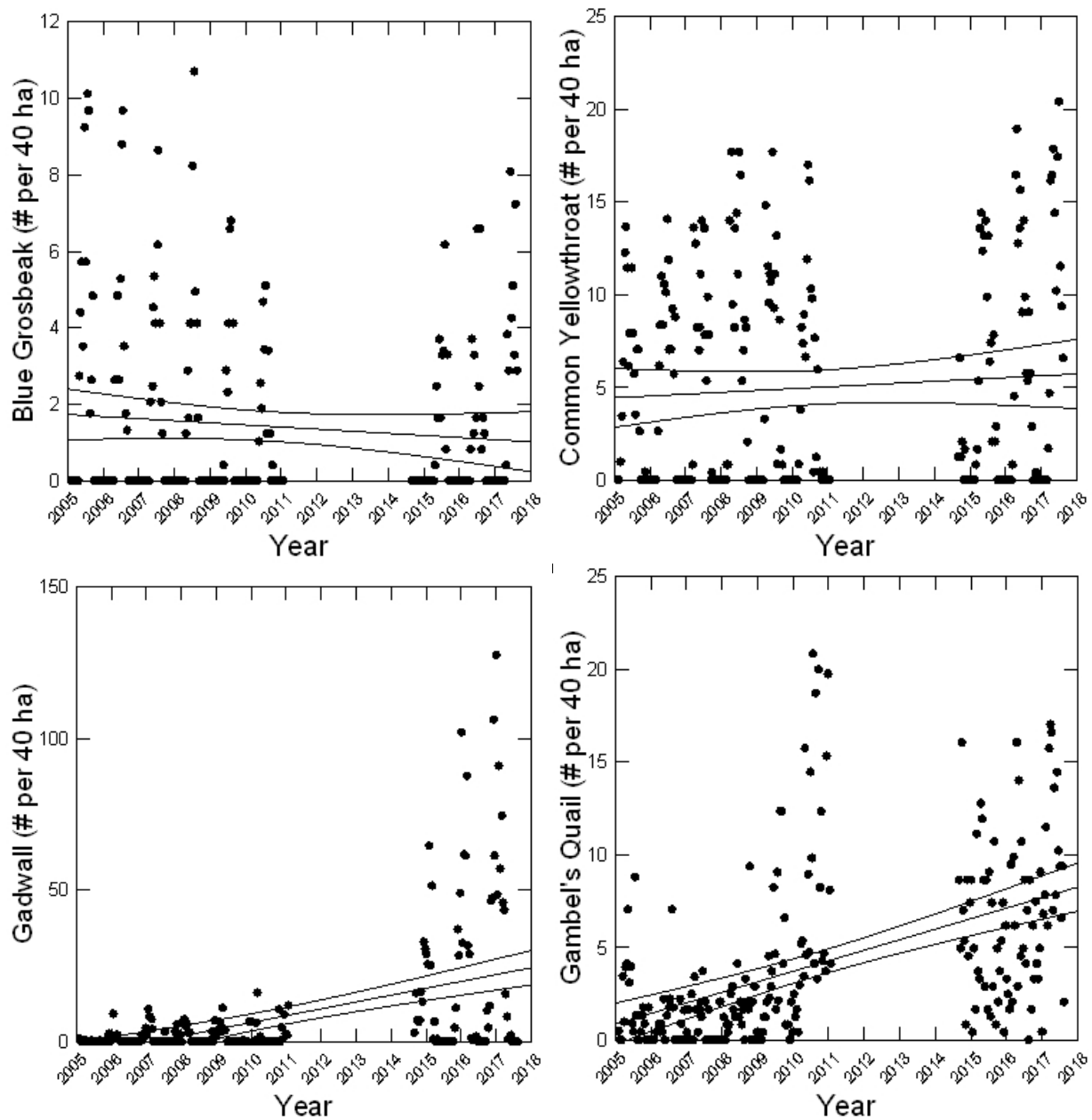
**Figure 4b.** Seasonal total bird abundance per survey visit from 234 surveys of the Las Vegas Wash (2005-2017), showing smoothed fit of average abundance per month by period (Years 1 to 6 and Years 10 to 12).



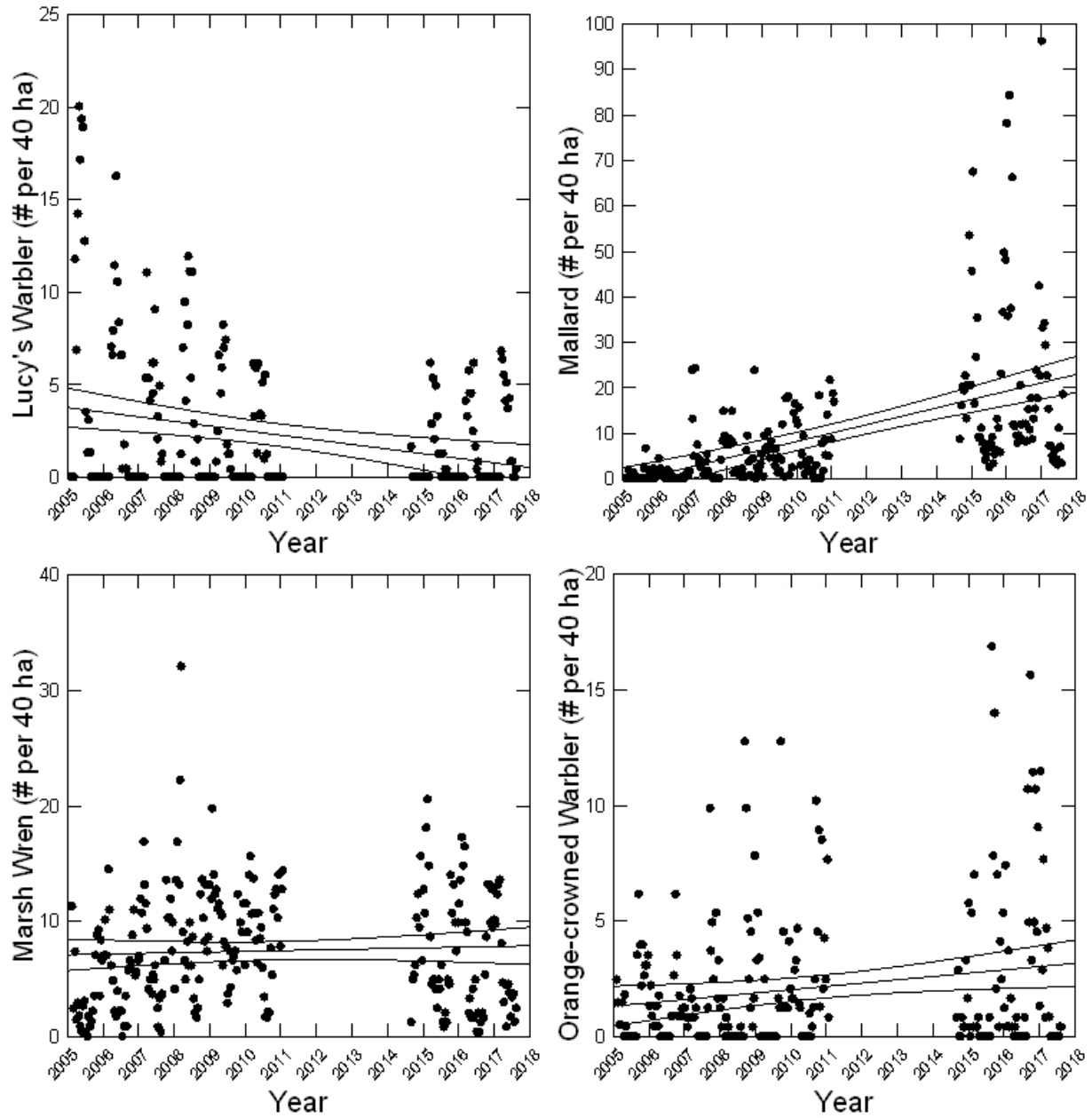
**Figure 5.** Trend in estimated total bird abundance from 234 surveys of the Las Vegas Wash (2005-2017). Curve represents a LOWESS smoothed fit for variation in abundance among survey visits.



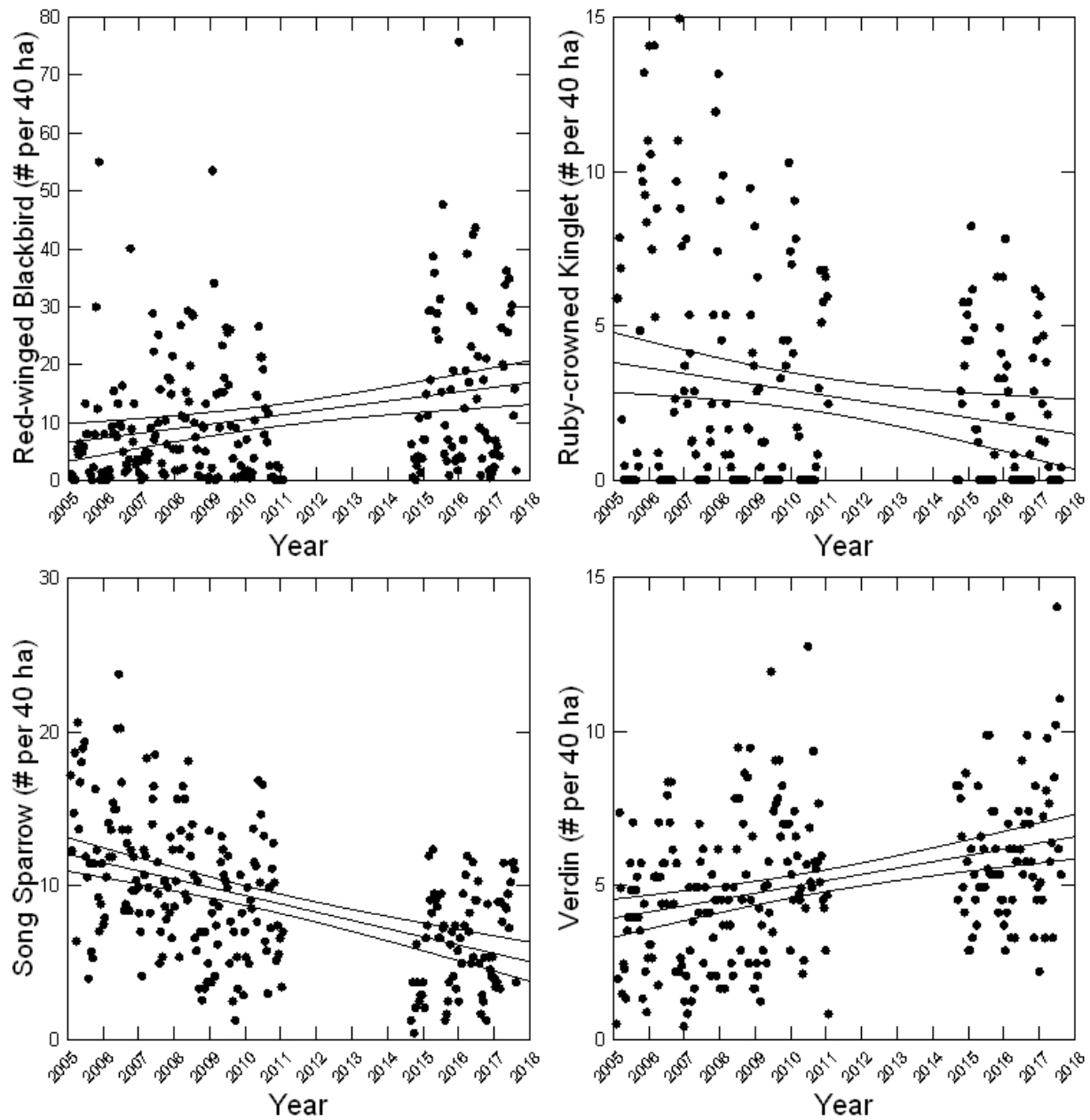
**Figure 6a.** Population trends of four common species along the Las Vegas Wash, by year (2005 – 2017). See Table 11 for statistical analysis results.



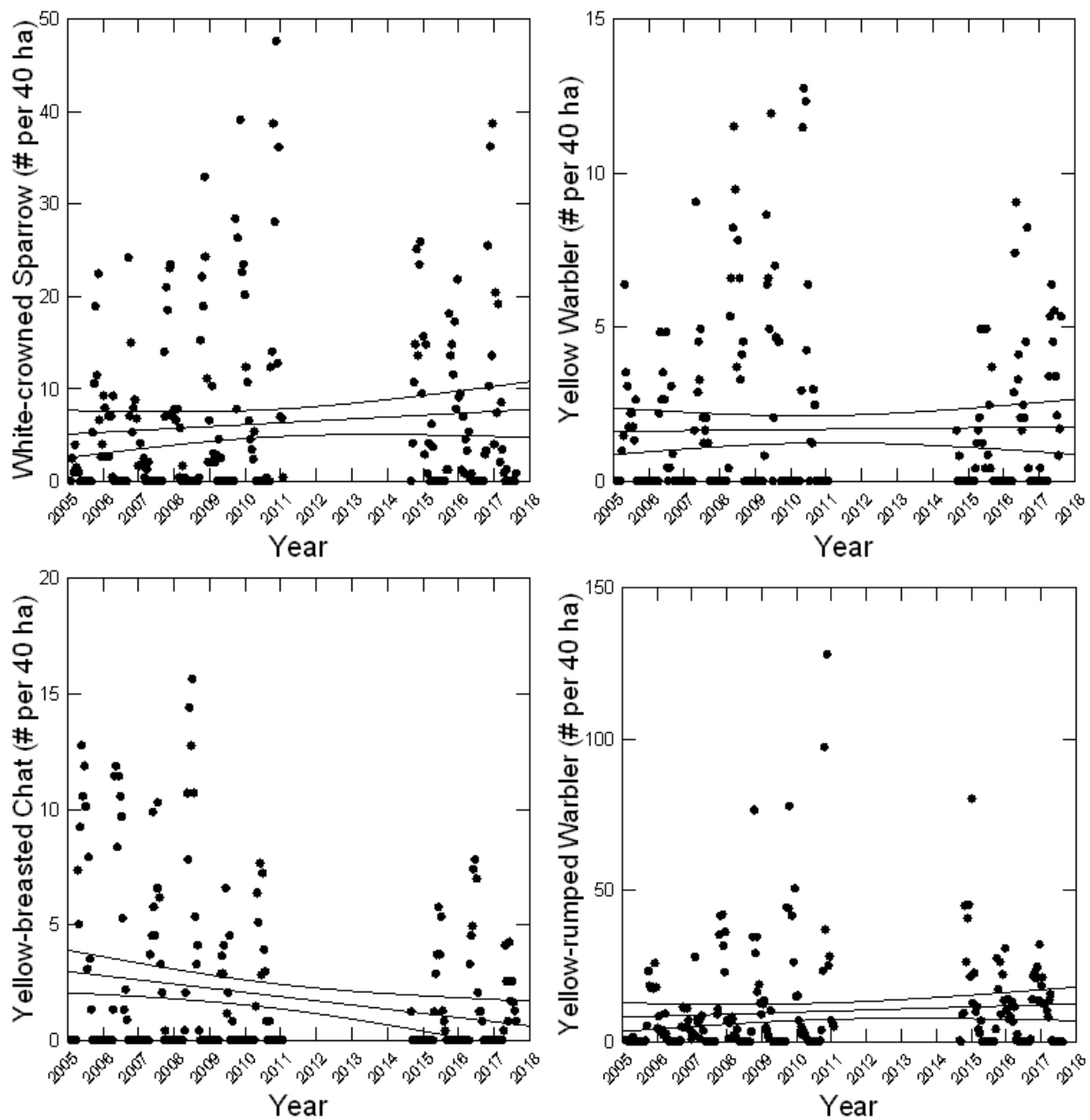
**Figure 6b.** Population trends of four common species along the Las Vegas Wash, by year (2005 – 2017). See Table 11 for statistical analysis results.



**Figure 6c.** Population trends of four common species along the Las Vegas Wash, by year (2005 – 2017). See Table 11 for statistical analysis results.

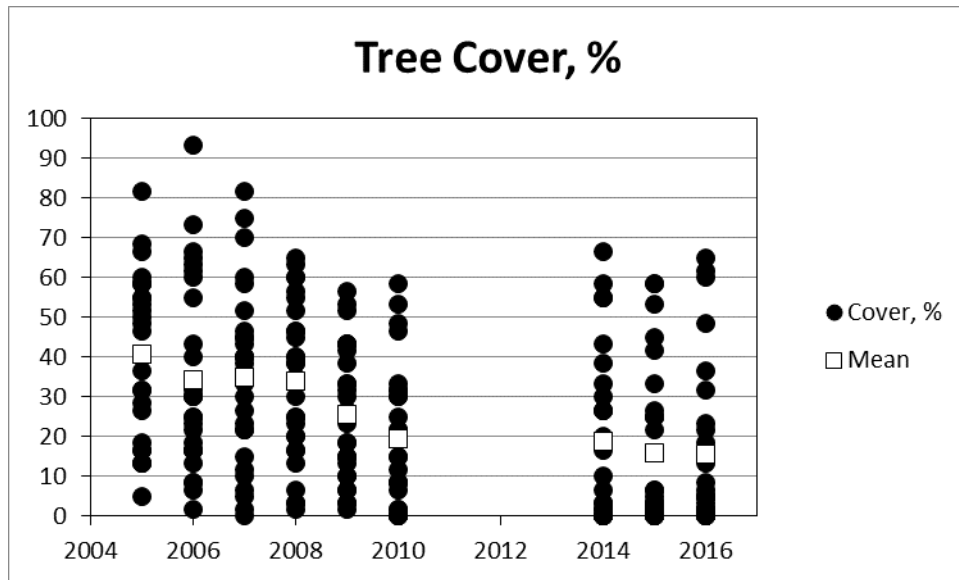


**Figure 6d.** Population trends of four common species along the Las Vegas Wash, by year (2005 – 2017). See Table 11 for statistical analysis results.

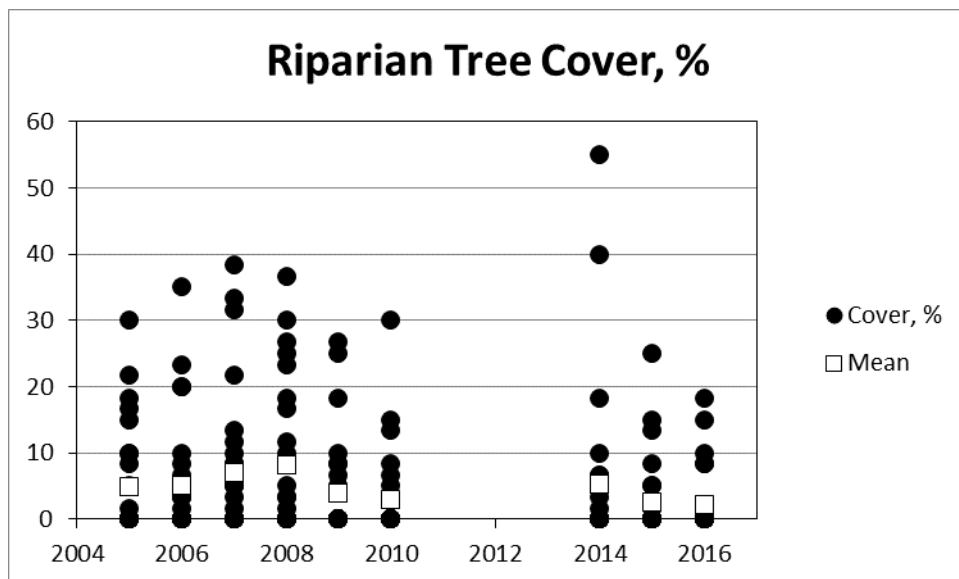


**Figure 6e.** Population trends of four common species along the Las Vegas Wash, by year (2005 – 2017). See Table 11 for statistical analysis results.

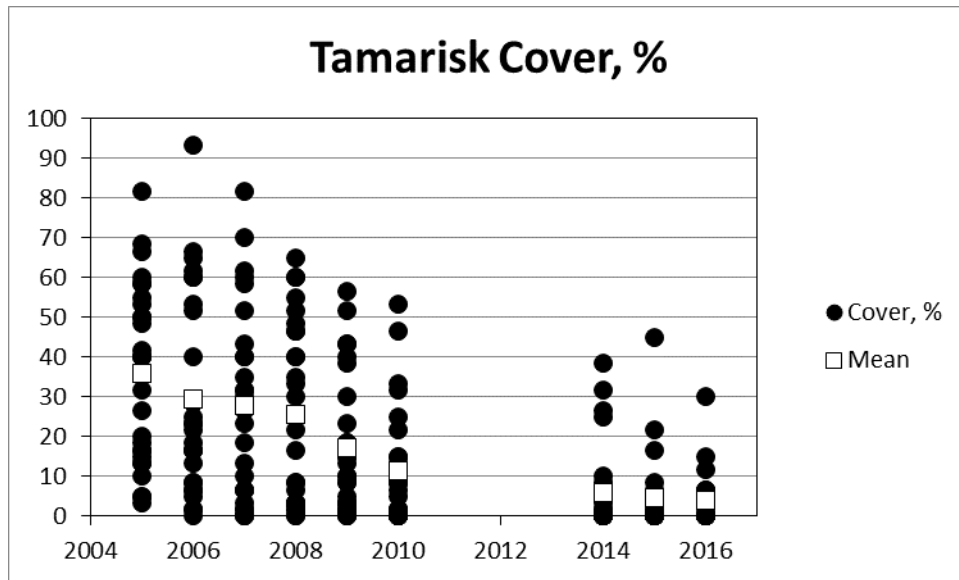




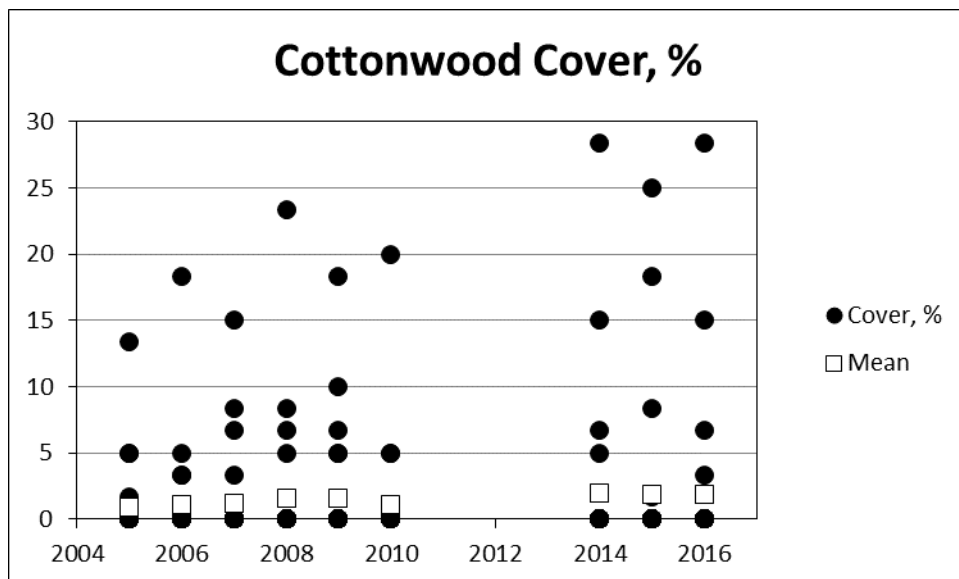
**Figure 7.** Tree cover (% cover of all trees) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.142$ ;  $P < 0.001$ .



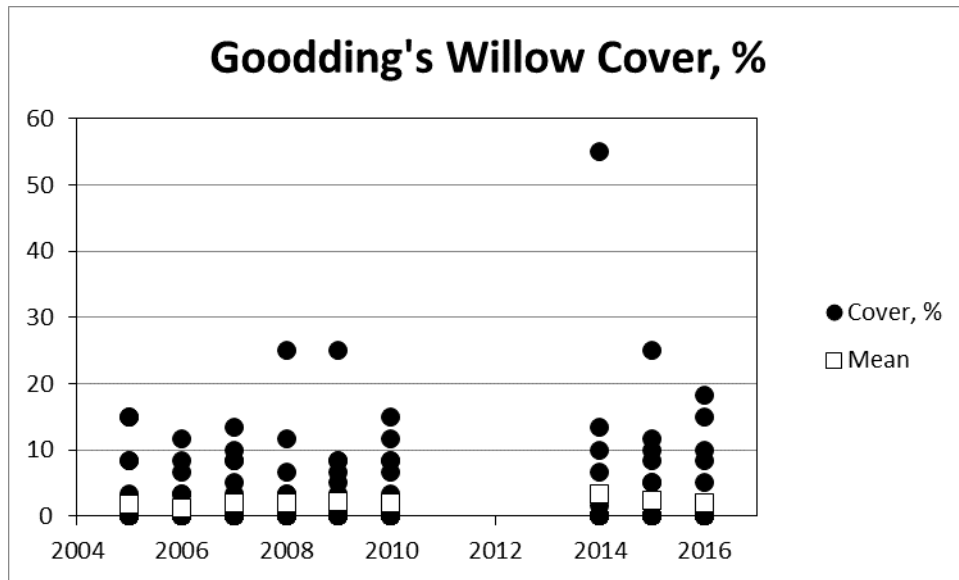
**Figure 8.** Native riparian tree cover (%) in the Las Vegas Wash by year, 2005-2016. (This does not include mesquites). Adjusted  $R^2 = 0.012$ ;  $P = 0.210$ .



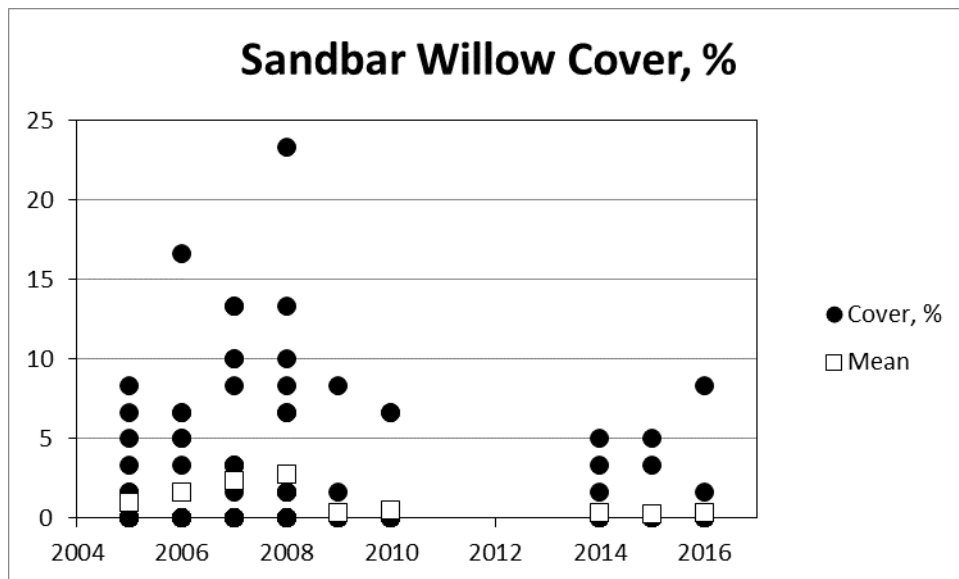
**Figure 9.** Tamarisk tree cover (%) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.270$ ;  $P < 0.001$ .



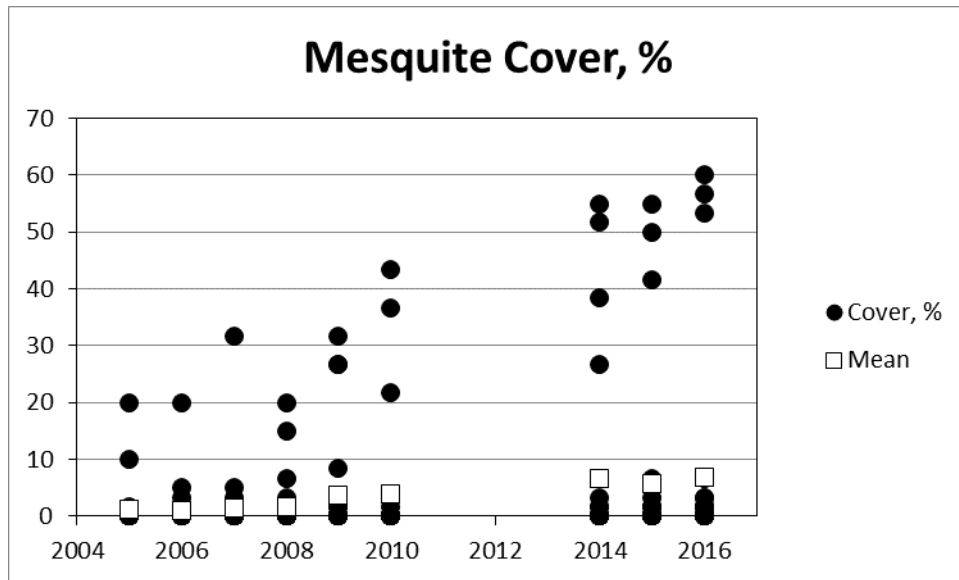
**Figure 10.** Cottonwood tree cover (%) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = -0.026$ ;  $P = 0.988$ .



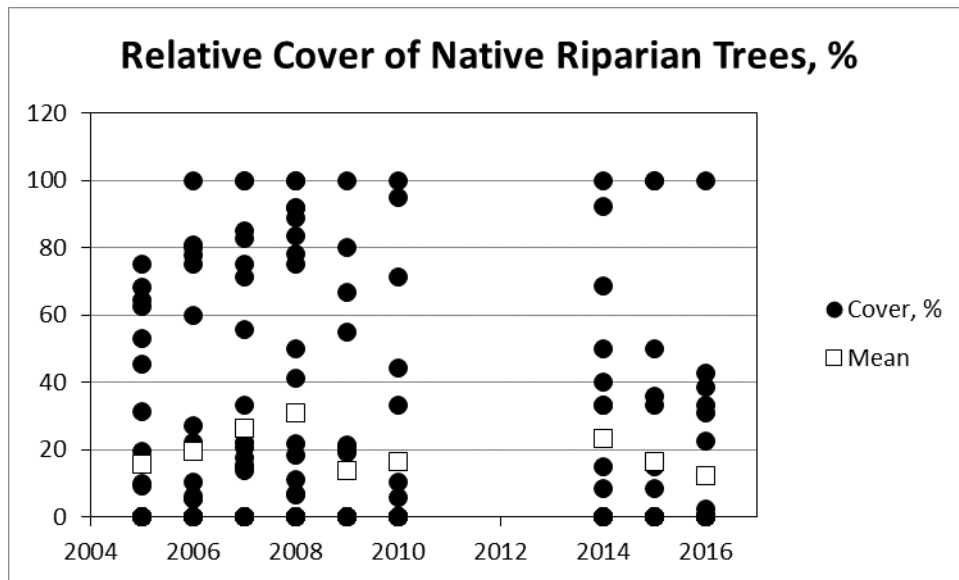
**Figure 11.** Goodding's willow tree cover (%) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.024$ ;  $P = 0.973$ .



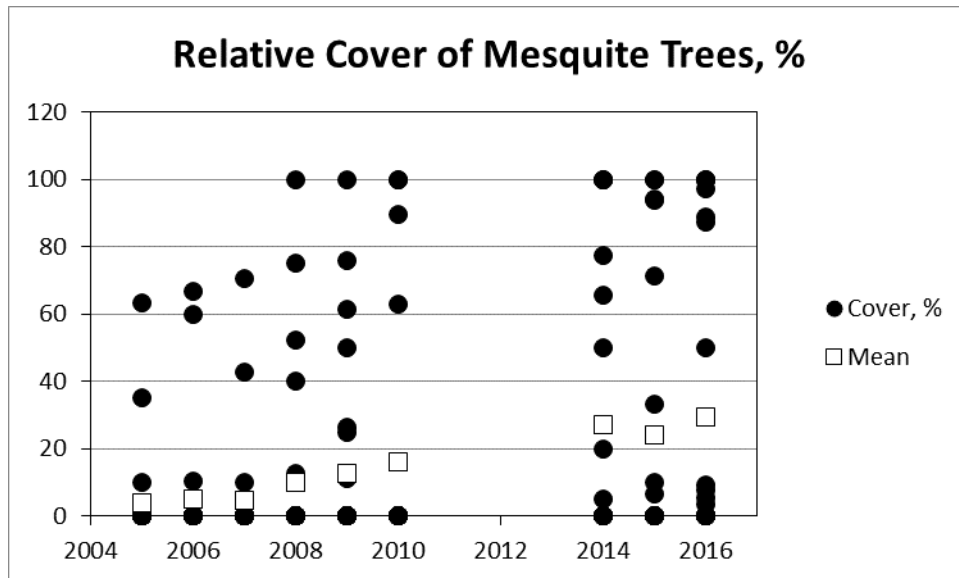
**Figure 12.** Sandbar willow cover (%) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.060$ ;  $P = 0.003$ .



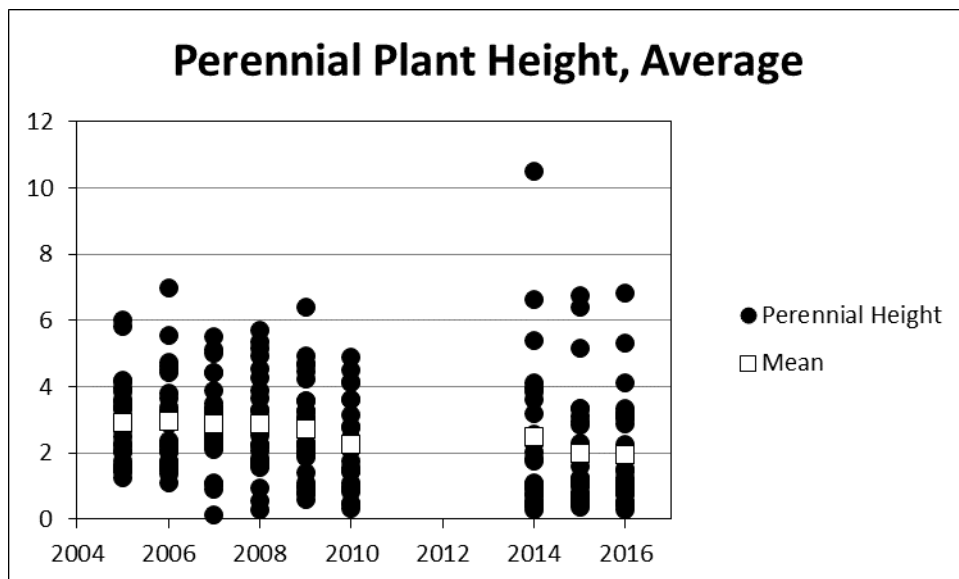
**Figure 13.** Mesquite tree cover (%) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.010$ ;  $P = 0.239$ .



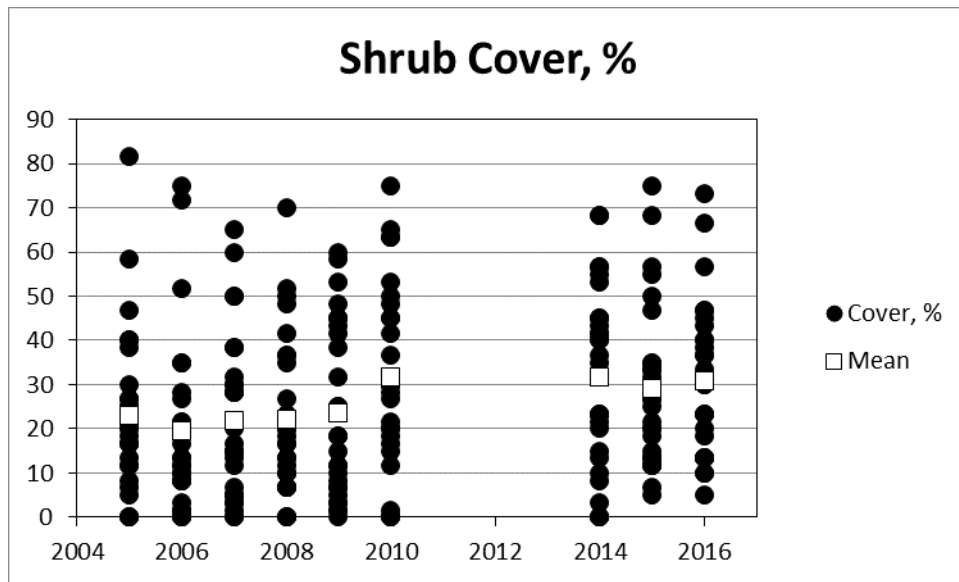
**Figure 14.** Mean proportion of native riparian tree cover relative to total tree cover in the Las Vegas Wash by year, 2005-2016. (This does not include mesquites.) Adjusted  $R^2 = 0.000$ ;  $P = 0.435$ .



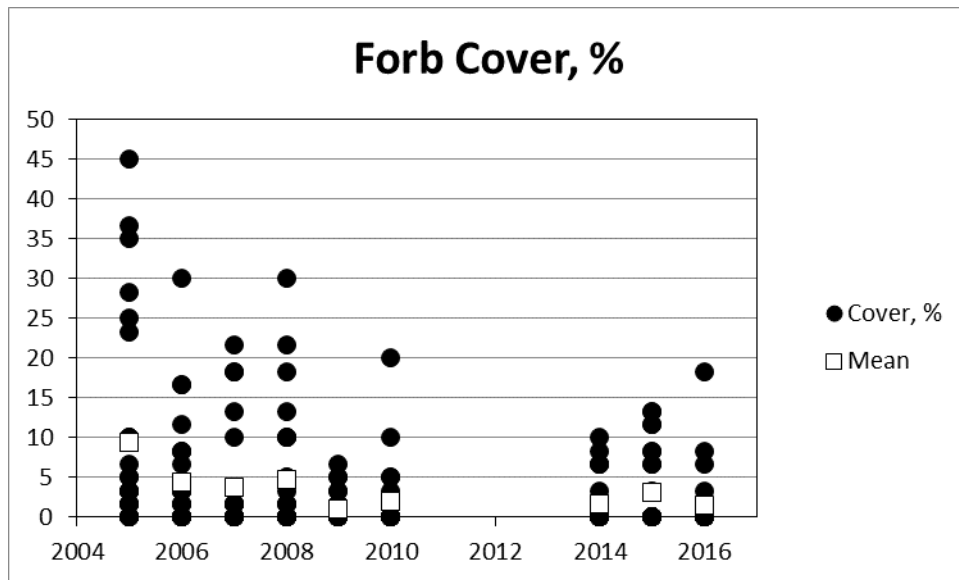
**Figure 15.** Mean proportion of mesquite cover relative to total tree cover in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.061$ ;  $P = 0.006$ .



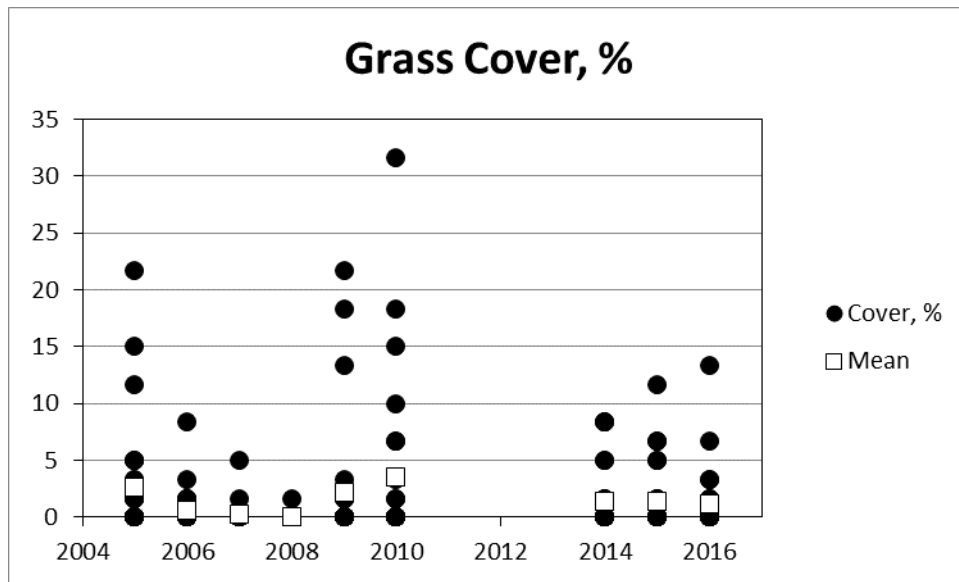
**Figure 16.** Mean maximum perennial plant height (m) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.026$ ;  $P = 0.076$ .



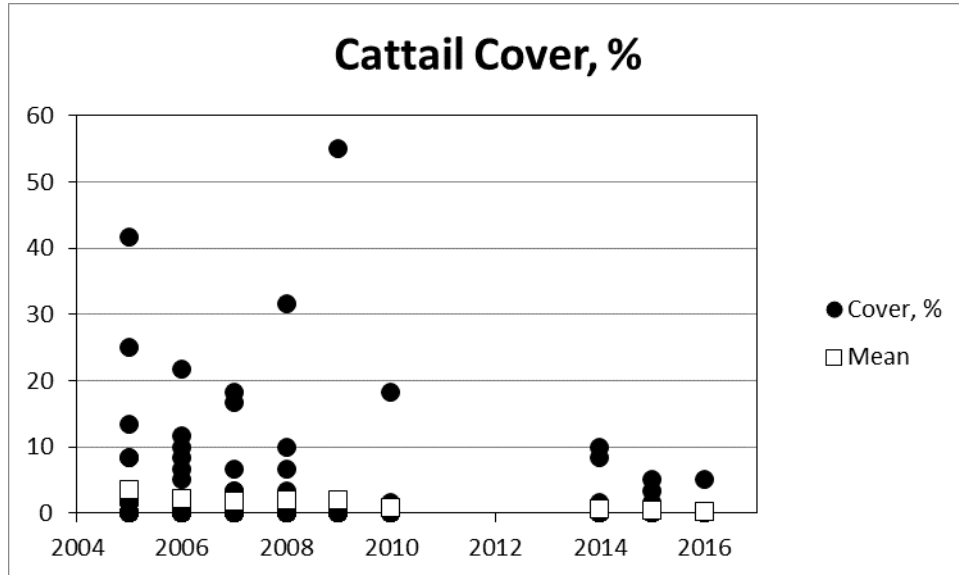
**Figure 17.** Mean shrub cover (%) in the Las Vegas Wash by year, 2005-2016. These results include *Phragmites*. Adjusted  $R^2 = 0.024$ ;  $P = 0.081$ .



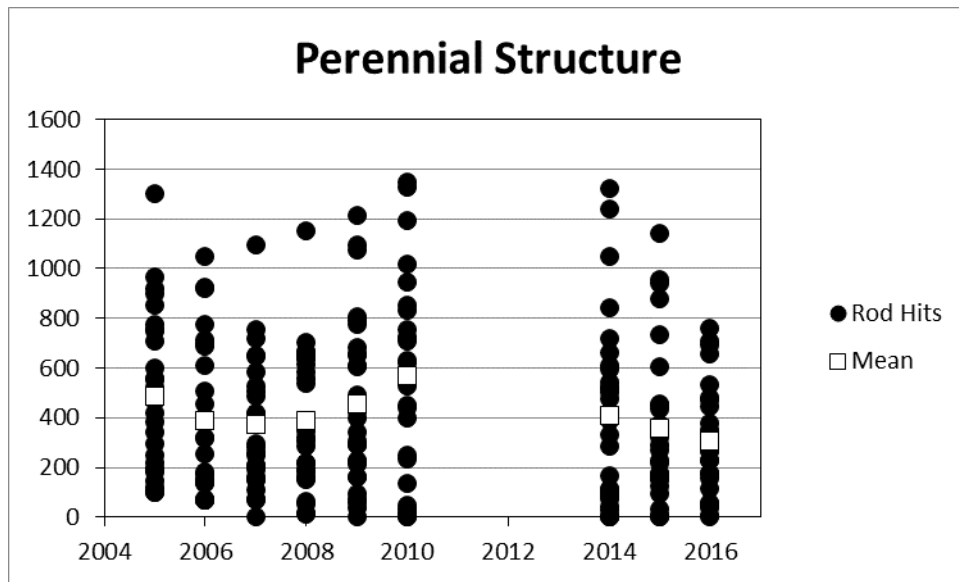
**Figure 18.** Mean forb cover (%) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.096$ ;  $P < 0.001$ .



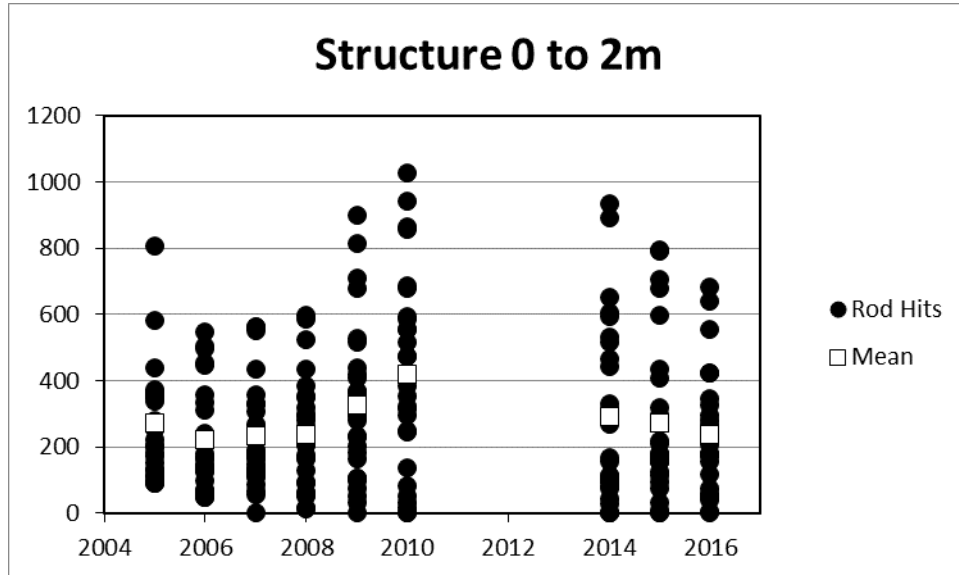
**Figure 19.** Mean grass cover (%) in the Las Vegas Wash by year, 2005-2016. These values do not include *Phragmites*. Adjusted  $R^2 = 0.040$ ;  $P = 0.021$ .



**Figure 20.** Mean cattail cover (%) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.001$ ;  $P = 0.406$ .

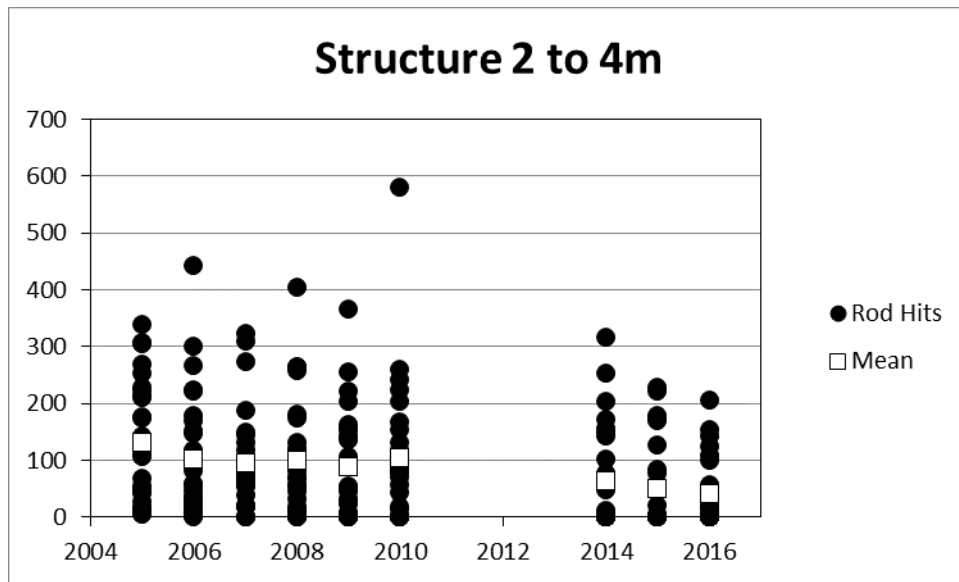


**Figure 21.** Perennial plant structure (number of rod hits) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.022$ ;  $P = 0.099$ .

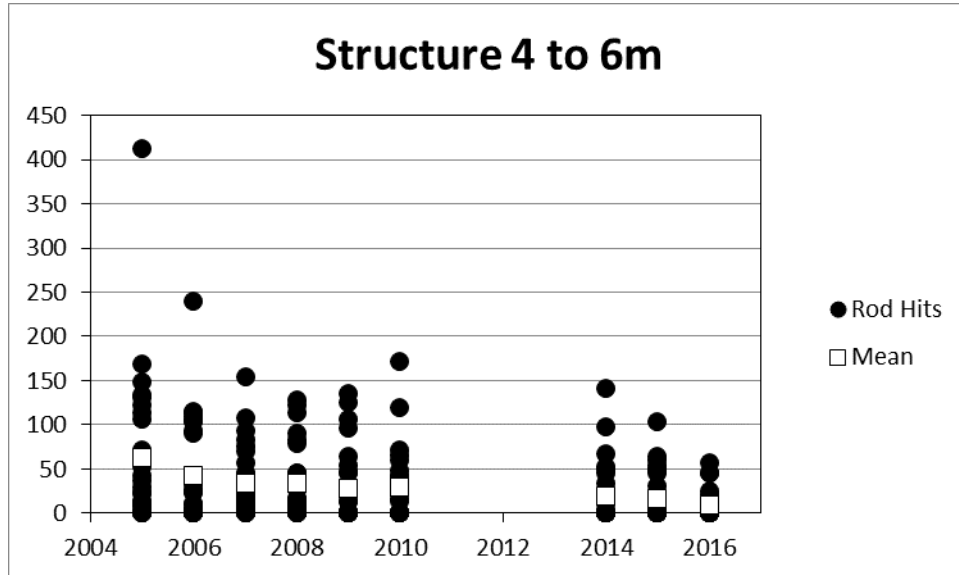


**Figure 22.** Perennial plant structure in the 0-2 m height category (number of rod hits) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.041$ ;  $P = 0.019$ .

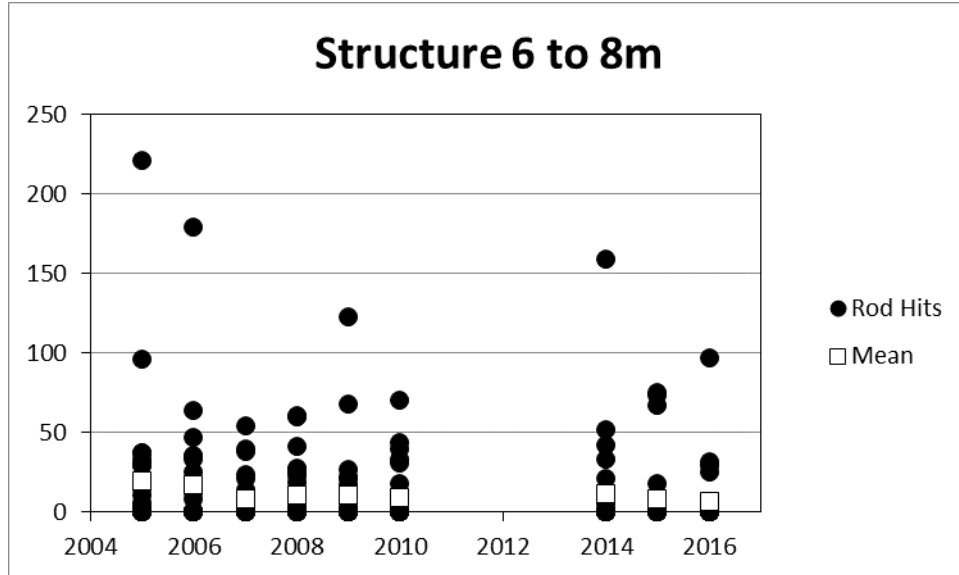




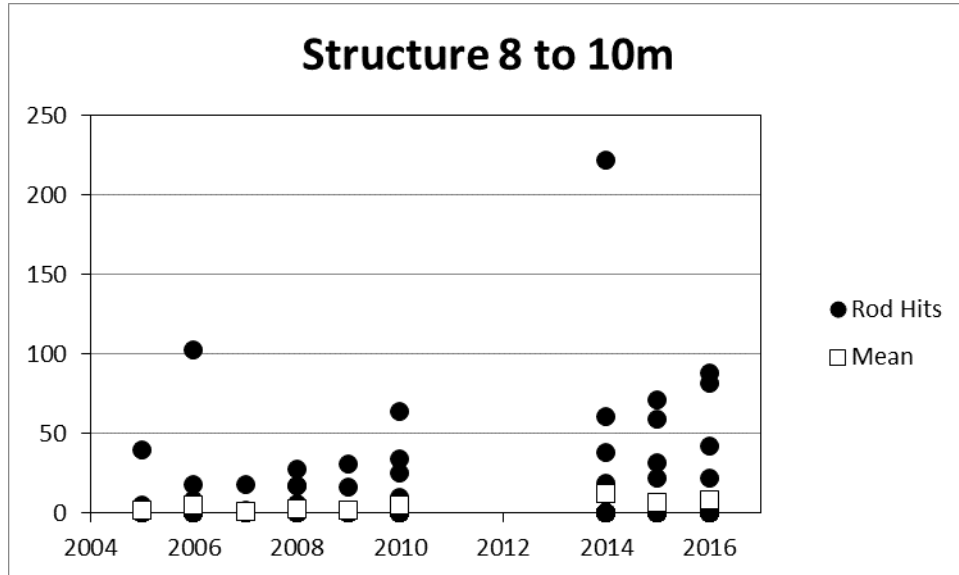
**Figure 23.** Perennial plant structure in the 2-4 m height category (number of rod hits) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.049$ ;  $P = 0.010$ .



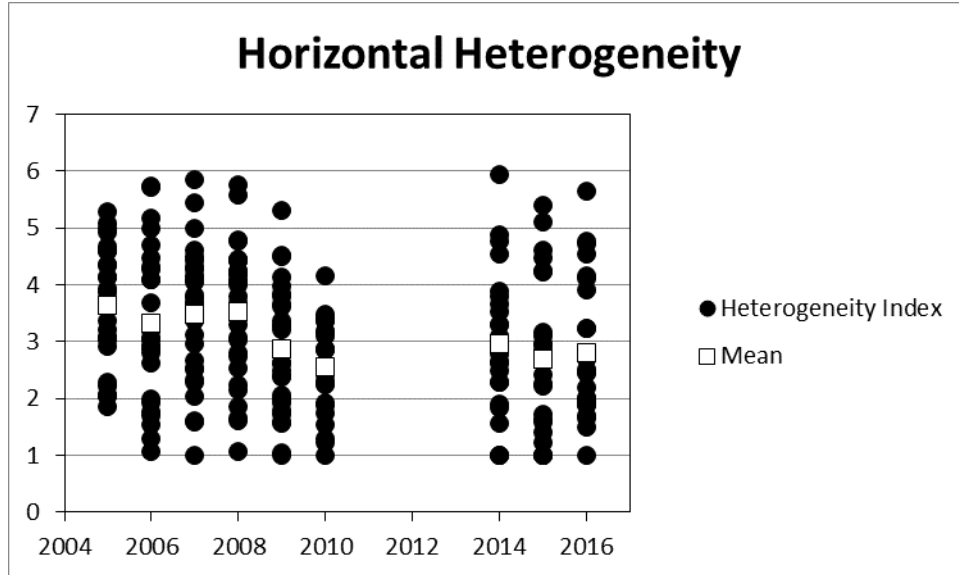
**Figure 24.** Perennial plant structure in the 4-6 m height category (number of rod hits) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.066$ ;  $P = 0.002$ .



**Figure 25.** Perennial plant structure in the 6-8 m height category (number of rod hits) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = -0.011$ ;  $P = 0.721$ .



**Figure 26.** Perennial plant structure in the 8-10 m height category (number of rod hits) in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.000$ ;  $P = 0.447$ .



**Figure 27.** Horizontal vegetation heterogeneity based on the proportional number of hits for each of six vegetation transects per survey point, in the Las Vegas Wash by year, 2005-2016. Adjusted  $R^2 = 0.067$ ;  $P = 0.002$ .

## Tables

**Table 1.** Number of point count surveys conducted per year along the Las Vegas Wash.

Year	Points/Survey	Number of Surveys	Max. Number of Points/Year	Total Number of Survey-Visits
Year 1	26	6	29	26
	28	1		
	29	19		
Year 2	29	22	32	26
	31	3		
	32	1		
Year 3	30	2	31	26
	31	24		
Year 4	30	1	31	26
	31	25		
Year 5	22	1	31	26
	28	1		
	30	2		
	31	22		
Year 6	25	1	31	26
	26	2		
	27	2		
	29	1		
	30	11		
	31	9		
Year 10	30	1	37*	26
	31	25		
Year 11	31	26	33*	26
Year 12	29	2	31	26
	30	10		
	31	14		

\* Numbers are larger than 31 because they include original and replacement points.

**Table 2.** All bird species detected at Las Vegas Wash, February 2005 through August 2017, during breeding, non-breeding, and transitional seasons. Conservation status includes priority species from multiple sources: A (Clark County 2000); B (Bureau of Reclamation 2006); C (GBBO 2010); D (Rosenberg et al 2016, Intermountain Partners in Flight); E (Rosenberg et al 2016, Continental Partners in Flight). X denotes at least one detection in that season (for season definitions, see Methods). Asterisks indicate species that were recorded incidentally, as fly-overs, or >100 m from a survey point. Species listed in taxonomic order.

Common Name	Scientific Name	Conservation Status	Breeding Season	Non-Breeding Season	Transitional
Greater White-fronted Goose	<i>Anser albifrons</i>			X	
Snow Goose	<i>Chen caerulescens</i>		*	*	X
Ross's Goose	<i>Chen rossii</i>			X	
Graylag Goose	<i>Anser anser</i>		*	*	*
Canada Goose	<i>Branta canadensis</i>		X	X	X
Tundra Swan	<i>Cygnus columbianus</i>	C		*	
Wood Duck	<i>Aix sponsa</i>			X	*
Gadwall	<i>Anas strepera</i>		X	X	X
American Wigeon	<i>Anas americana</i>		X	X	X
Mallard	<i>Anas platyrhynchos</i>		X	X	X
Blue-winged Teal	<i>Anas discors</i>		*	X	*
Cinnamon Teal	<i>Anas cyanoptera</i>	C	X	X	X
Northern Shoveler	<i>Anas clypeata</i>		X	X	X
Northern Pintail	<i>Anas acuta</i>	C	*	X	X
Green-winged Teal	<i>Anas crecca</i>		X	X	X
Canvasback	<i>Aythya valisineria</i>	C		*	
Redhead	<i>Aythya americana</i>	C	*	*	X
Ring-necked Duck	<i>Aythya collaris</i>		*	X	X
Lesser Scaup	<i>Aythya affinis</i>	C	X	X	X
Bufflehead	<i>Bucephala albeola</i>		X	X	X
Common Goldeneye	<i>Bucephala clangula</i>		X	X	X
Hooded Merganser	<i>Lophodytes cucullatus</i>		X	X	X
Common Merganser	<i>Mergus merganser</i>		X	X	X
Ruddy Duck	<i>Oxyura jamaicensis</i>		*	X	X
Gambel's Quail	<i>Callipepla gambelii</i>	C	X	X	X
Pied-billed Grebe	<i>Podilymbus podiceps</i>		X	X	X
Horned Grebe	<i>Podiceps auritus</i>		X	X	*
Eared Grebe	<i>Podiceps nigricollis</i>	C	X	X	X
Western Grebe	<i>Aechmophorus occidentalis</i>	C	X	X	*
Clark's Grebe	<i>Aechmophorus clarkii</i>	C	*	*	
Neotropic Cormorant	<i>Phalacrocorax brasilianus</i>		X		X
Double-crested Cormorant	<i>Phalacrocorax auritus</i>		X	X	X
American White Pelican	<i>Pelecanus erythrorhynchos</i>	C	X	X	X

Common Name	Scientific Name	Conservation Status	Breeding Season	Non-Breeding Season	Transitional
American Bittern	<i>Botaurus lentiginosus</i>		X		X
Least Bittern	<i>Ixobrychus exilis</i>	B; C	X	X	X
Great Blue Heron	<i>Ardea herodias</i>		X	X	X
Great Egret	<i>Ardea alba</i>		X	X	X
Snowy Egret	<i>Egretta thula</i>	C	X	X	X
Cattle Egret	<i>Bubulcus ibis</i>		*		X
Green Heron	<i>Butorides virescens</i>		X	X	X
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>		X	X	X
White Ibis	<i>Eudocimus albus</i>		*		
White-faced Ibis	<i>Plegadis chihi</i>	C	X	X	X
Turkey Vulture	<i>Cathartes aura</i>		X	*	X
Osprey	<i>Pandion haliaetus</i>		X	X	X
White-tailed Kite	<i>Elanus leucurus</i>		*		
Northern Harrier	<i>Circus cyaneus</i>		X	X	X
Sharp-shinned Hawk	<i>Accipiter striatus</i>		X	X	X
Cooper's Hawk	<i>Accipiter cooperii</i>		X	X	X
Northern Goshawk	<i>Accipiter gentilis</i>	C		*	
Red-shouldered Hawk	<i>Buteo lineatus</i>		X	X	X
Swainson's Hawk	<i>Buteo swainsoni</i>	C	*		
Red-tailed Hawk	<i>Buteo jamaicensis</i>		X	X	X
Virginia Rail	<i>Rallus limicola</i>		X	X	X
Sora	<i>Porzana carolina</i>		X	X	X
Common Gallinule	<i>Gallinula galeata</i>		X	X	X
American Coot	<i>Fulica americana</i>		X	X	X
Sandhill Crane	<i>Grus canadensis</i>	C		*	*
Black-necked Stilt	<i>Himantopus mexicanus</i>	C	X		*
American Avocet	<i>Recurvirostra americana</i>	C	X	X	X
Semipalmated Plover	<i>Charadrius semipalmatus</i>		X		
Killdeer	<i>Charadrius vociferus</i>		X	X	X
Spotted Sandpiper	<i>Actitis macularius</i>		X	X	X
Greater Yellowlegs	<i>Tringa melanoleuca</i>		X	X	X
Willet	<i>Tringa semipalmata</i>	C	X		
Lesser Yellowlegs	<i>Tringa flavipes</i>		X	*	X
Whimbrel	<i>Numenius phaeopus</i>		*		
Long-billed Curlew	<i>Numenius americanus</i>	C	*		*
Marbled Godwit	<i>Limosa fedoa</i>	C			*
Stilt Sandpiper	<i>Calidris himantopus</i>				*
Dunlin	<i>Calidris alpina</i>		X		
Least Sandpiper	<i>Calidris minutilla</i>	C	X	X	X

Common Name	Scientific Name	Conservation Status	Breeding Season	Non-Breeding Season	Transitional
Pectoral Sandpiper	<i>Calidris melanotos</i>				X
Semipalmated Sandpiper	<i>Calidris pusilla</i>		X		
Western Sandpiper	<i>Calidris mauri</i>	C	X	X	X
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>	C	X	X	X
Wilson's Snipe	<i>Gallinago delicata</i>		X	X	X
Wilson's Phalarope	<i>Phalaropus tricolor</i>	C	*		
Bonaparte's Gull	<i>Chroicocephalus philadelphia</i>		*		
Franklin's Gull	<i>Leucophaeus pipixcan</i>	C	*		
Ring-billed Gull	<i>Larus delawarensis</i>		X	X	X
California Gull	<i>Larus californicus</i>		*	*	*
Lesser Black-backed Gull	<i>Larus fuscus</i>		*		
Caspian Tern	<i>Hydroprogne caspia</i>		*	*	*
Forster's Tern	<i>Sterna forsteri</i>		*		
Rock Pigeon	<i>Columba livia</i>		*	X	*
Eurasian Collared-Dove	<i>Streptopelia decaocto</i>		X	X	*
White-winged Dove	<i>Zenaida asiatica</i>		X	X	X
Mourning Dove	<i>Zenaida macroura</i>		X	X	X
Greater Roadrunner	<i>Geococcyx californianus</i>		X	X	X
Barn Owl	<i>Tyto alba</i>		X	X	X
Great Horned Owl	<i>Bubo virginianus</i>		X	X	X
Long-eared Owl	<i>Asio otus</i>	E			
Lesser Nighthawk	<i>Chordeiles acutipennis</i>		X		X
Vaux's Swift	<i>Chaetura vauxi</i>		*	*	*
White-throated Swift	<i>Aeronautes saxatalis</i>	C	*	*	*
Black-chinned Hummingbird	<i>Archilochus alexandri</i>		X	X	X
Anna's Hummingbird	<i>Calypte anna</i>		X	X	X
Costa's Hummingbird	<i>Calypte costae</i>	C	X	X	X
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>				X
Rufous Hummingbird	<i>Selasphorus rufus</i>	C; E	X		*
Belted Kingfisher	<i>Megasceryle alcyon</i>		X	X	X
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>		X	X	
Ladder-backed Woodpecker	<i>Picoides scalaris</i>		X	X	X
Hairy Woodpecker	<i>Picoides villosus</i>			X	
Northern Flicker	<i>Colaptes auratus</i>		X	X	X
American Kestrel	<i>Falco sparverius</i>		X	X	X
Merlin	<i>Falco columbarius</i>			X	X
Peregrine Falcon	<i>Falco peregrinus</i>	C	X	X	*
Prairie Falcon	<i>Falco mexicanus</i>	C	*	X	*
Olive-sided Flycatcher	<i>Contopus cooperi</i>	C; D; E	X		

Common Name	Scientific Name	Conservation Status	Breeding Season	Non-Breeding Season	Transitional
Western Wood-Pewee	<i>Contopus sordidulus</i>		X		X
Willow Flycatcher	<i>Empidonax traillii</i>	A; B; C	X		
Hammond's Flycatcher	<i>Empidonax hammondi</i>		X		
Gray Flycatcher	<i>Empidonax wrightii</i>	C	X	X	X
Dusky Flycatcher	<i>Empidonax oberholseri</i>		X		X
Western Flycatcher (unidentified)	<i>Empidonax difficilis/occidentalis</i>		X		X
Black Phoebe	<i>Sayornis nigricans</i>		X	X	X
Say's Phoebe	<i>Sayornis saya</i>		X	X	X
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>		X		X
Brown-crested Flycatcher	<i>Myiarchus tyrannulus</i>		X		
Western Kingbird	<i>Tyrannus verticalis</i>		X		X
Eastern Kingbird	<i>Tyrannus tyrannus</i>		X		
Scissor-tailed Flycatcher	<i>Tyrannus forficatus</i>				X
Loggerhead Shrike	<i>Lanius ludovicianus</i>	D	X	X	X
Bell's Vireo	<i>Vireo bellii</i>	A; B; C	X		X
Plumbeous Vireo	<i>Vireo plumbeus</i>		X		
Warbling Vireo	<i>Vireo gilvus</i>		X	X	X
Common Raven	<i>Corvus corax</i>		X	X	X
Horned Lark	<i>Eremophila alpestris</i>	D	X	X	X
Tree Swallow	<i>Tachycineta bicolor</i>		X	X	*
Violet-green Swallow	<i>Tachycineta thalassina</i>		X	*	X
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>		X	*	X
Bank Swallow	<i>Riparia riparia</i>		*		
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>		X	X	X
Barn Swallow	<i>Hirundo rustica</i>		X	*	X
Verdin	<i>Auriparus flaviceps</i>		X	X	X
Bushtit	<i>Psaltiriparus minimus</i>		X	X	X
Red-breasted Nuthatch	<i>Sitta canadensis</i>			X	X
Brown Creeper	<i>Certhia americana</i>			X	
Rock Wren	<i>Salpinctes obsoletus</i>		X	X	X
Canyon Wren	<i>Catherpes mexicanus</i>		X	X	*
House Wren	<i>Troglodytes aedon</i>		X	X	X
Pacific Wren	<i>Troglodytes pacificus</i>			X	X
Marsh Wren	<i>Cistothorus palustris</i>		X	X	X
Bewick's Wren	<i>Thryomanes bewickii</i>		X	X	X
Cactus Wren	<i>Campylorhynchus brunneicapillus</i>			*	X
Blue-gray Gnatcatcher	<i>Poliophtila caerulea</i>		X	X	X
Black-tailed Gnatcatcher	<i>Poliophtila melanura</i>		X	X	X



Common Name	Scientific Name	Conservation Status	Breeding Season	Non-Breeding Season	Transitional
Golden-crowned Kinglet	<i>Regulus satrapa</i>			X	X
Ruby-crowned Kinglet	<i>Regulus calendula</i>		X	X	X
Western Bluebird	<i>Sialia mexicana</i>			X	
Mountain Bluebird	<i>Sialia currucoides</i>			X	
Hermit Thrush	<i>Catharus guttatus</i>		X	X	X
American Robin	<i>Turdus migratorius</i>		X	X	X
Crissal Thrasher	<i>Toxostoma crissale</i>		X	X	X
Northern Mockingbird	<i>Mimus polyglottos</i>		X	X	X
European Starling	<i>Sturnus vulgaris</i>		X	*	X
American Pipit	<i>Anthus rubescens</i>		X	X	X
Cedar Waxwing	<i>Bombycilla cedrorum</i>			X	X
Phainopepla	<i>Phainopepla nitens</i>	A	X	X	X
Ovenbird	<i>Seiurus aurocapilla</i>			X	
Black-and-white Warbler	<i>Mniotilta varia</i>				X
Orange-crowned Warbler	<i>Oreothlypis celata</i>		X	X	X
Lucy's Warbler	<i>Oreothlypis luciae</i>	C	X		X
Nashville Warbler	<i>Oreothlypis ruficapilla</i>		X	X	X
Virginia's Warbler	<i>Oreothlypis virginiae</i>	C; D; E			X
MacGillivray's Warbler	<i>Geothlypis tolmiei</i>		X	X	X
Common Yellowthroat	<i>Geothlypis trichas</i>		X	X	X
Hooded Warbler	<i>Setophaga citrina</i>		*		
Yellow Warbler	<i>Setophaga petechia</i>	B	X	X	X
Blackpoll Warbler	<i>Setophaga striata</i>			X	
Yellow-rumped Warbler	<i>Setophaga coronata</i>		X	X	X
Black-throated Gray Warbler	<i>Setophaga nigrescens</i>		*	X	X
Townsend's Warbler	<i>Setophaga townsendi</i>		X		X
Wilson's Warbler	<i>Cardellina pusilla</i>		X	X	X
Yellow-breasted Chat	<i>Icteria virens</i>		X	X	X
Green-tailed Towhee	<i>Pipilo chlorurus</i>	C	X		X
Spotted Towhee	<i>Pipilo maculatus</i>		X	X	X
Rufous-crowned Sparrow	<i>Aimophila ruficeps</i>		X		
Canyon Towhee	<i>Pipilo fuscus</i>		X		
Abert's Towhee	<i>Melospiza aberti</i>	C	X	X	X
Chipping Sparrow	<i>Spizella passerina</i>		X	X	X
Brewer's Sparrow	<i>Spizella breweri</i>	C	X	X	X
Vesper Sparrow	<i>Pooecetes gramineus</i>		X		X
Lark Sparrow	<i>Chondestes grammacus</i>		X		X
Black-throated Sparrow	<i>Amphispiza bilineata</i>		X	*	*
Sagebrush Sparrow	<i>Artemisiospiza nevadensis</i>	C	*	X	

Common Name	Scientific Name	Conservation Status	Breeding Season	Non-Breeding Season	Transitional
Savannah Sparrow	<i>Passerculus sandwichensis</i>		X	X	X
Song Sparrow	<i>Melospiza melodia</i>		X	X	X
Lincoln's Sparrow	<i>Melospiza lincolnii</i>		X	X	X
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>		X	X	X
Dark-eyed Junco	<i>Junco hyemalis</i>		X	X	X
Summer Tanager	<i>Piranga rubra</i>	A; B			X
Western Tanager	<i>Piranga ludoviciana</i>		X		X
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>		X		X
Blue Grosbeak	<i>Passerina caerulea</i>	A	X	X	X
Lazuli Bunting	<i>Passerina amoena</i>		X	*	X
Indigo Bunting	<i>Passerina cyanea</i>		X		
Red-winged Blackbird	<i>Agelaius phoeniceus</i>		X	X	X
Western Meadowlark	<i>Sturnella neglecta</i>		X	X	X
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>		X	X	X
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	D	X	X	*
Great-tailed Grackle	<i>Quiscalus mexicanus</i>		X	X	X
Brown-headed Cowbird	<i>Molothrus ater</i>		X	X	X
Bullock's Oriole	<i>Icterus bullockii</i>		X	X	X
Hooded Oriole	<i>Icterus cucullatus</i>		X	*	
House Finch	<i>Haemorhous mexicanus</i>		X	X	X
Red Crossbill	<i>Loxia curvirostra</i>			X	
Pine Siskin	<i>Spinus pinus</i>	D	X	X	*
Lesser Goldfinch	<i>Spinus psaltria</i>		X	X	X
American Goldfinch	<i>Spinus tristis</i>		X	X	
House Sparrow	<i>Passer domesticus</i>		X	X	*
<b>Species Richness</b>	<b>213</b>	<b>51</b>	<b>184</b>	<b>160</b>	<b>171</b>
<b>Conservation Priority Species Richness</b>	<b>51</b>	<b>51</b>	<b>43</b>	<b>35</b>	<b>39</b>

**Table 3.** Average bird species richness along the Las Vegas Wash, by season and year, with numbers of weirs and revegetated acres.

<b>Year</b>	<b>Breeding</b>	<b>Fall Transition</b>	<b>Non-Breeding</b>	<b>Winter Transition</b>	<b>COMBINED (avg # species/survey)</b>	<b># Weirs</b>	<b># Acres Reveg</b>
Year 1	34.0	34.0	31.7	26.3	32.3	9	75
Year 2	32.9	40.0	30.3	32.7	32.5	10	135
Year 3	35.3	34.5	35.2	29.0	34.5	10	175
Year 4	33.8	39.5	31.2	39.3	34.0	11	195
Year 5	34.8	44.5	34.0	31.3	34.8	12	260
Year 6	33.1	45.5	33.9	30.7	34.2	12	280
Year 10	46.2	41.5	43.9	44.7	44.8	19	440
Year 11	45.9	47.5	48.1	50.0	47.3	19	470
Year 12	44.9	50.0	46.2	47.3	46.0	19	510
<b>COMBINED</b>	<b>37.9</b>	<b>41.9</b>	<b>37.2</b>	<b>36.8</b>	<b>37.8</b>	<b>13.4</b>	<b>282</b>

**Table 4.** Average total bird abundance along the Las Vegas Wash, by season and year, with numbers of weirs and revegetated acres.

<b>Year</b>	<b>Breeding</b>	<b>Fall Transition</b>	<b>Non-Breeding</b>	<b>Winter Transition</b>	<b>COMBINED (avg # birds per 40 ha/survey)</b>	<b># Weirs</b>	<b># Acres Reveg</b>
Year 1	134.9	106.7	131.1	78.5	124.9	9	75
Year 2	132.3	123.8	126.2	114.7	127.5	10	135
Year 3	127.0	91.4	157.2	146.9	137.0	10	175
Year 4	143.8	109.3	151.9	156.3	145.4	11	195
Year 5	148.1	217.5	173.4	137.9	161.0	12	260
Year 6	131.3	141.7	192.1	121.4	152.0	12	280
Year 10	171.0	203.7	292.1	341.9	235.1	19	440
Year 11	193.2	167.4	302.7	452.9	259.1	19	470
Year 12	209.0	150.1	367.2	351.0	275.6	19	510
<b>COMBINED</b>	<b>154.5</b>	<b>145.7</b>	<b>210.4</b>	<b>211.3</b>	<b>179.7</b>	<b>13.4</b>	<b>282</b>

**Table 5.** Estimated species-specific densities (birds per 40 ha) for survey visits overall, among seasons from the full dataset (2005-2017), and overall values by survey year. Species are in descending order of overall abundance. Conservation status includes priority species from multiple sources: A (Clark County 2000); B (Bureau of Reclamation 2006); C (GBBO 2010); D (Rosenberg et al 2016, Intermountain Partners in Flight); E (Rosenberg et al 2016, Continental Partners in Flight). An “X” indicates the species was recorded, but not within 100m of a point; no entry means that the species was not detected.

Species (Conservation Status)	Overall	Breeding	Non-Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12
American Coot	17.55	6.90	28.21	2.23	8.74	10.06	5.37	4.80	3.71	34.77	43.11	45.14
Red-winged Blackbird	11.16	15.96	7.86	7.03	7.37	9.67	9.92	12.30	6.92	15.63	17.33	14.28
Abert's Towhee (C)	11.00	11.22	10.23	15.58	14.31	10.21	10.82	11.50	10.92	8.65	8.10	8.88
Yellow-rumped Warbler	10.19	1.25	24.33	6.13	3.16	11.52	10.68	13.70	14.44	13.33	8.64	10.11
Mallard	9.70	4.35	15.04	0.98	2.15	4.58	4.01	8.37	6.26	17.97	24.55	18.42
Song Sparrow	8.96	10.94	6.93	12.18	12.78	10.53	9.37	7.65	9.19	5.85	6.41	6.65
Gadwall	8.22	1.95	12.75	0.70	1.08	1.61	1.52	2.05	2.55	12.91	20.76	30.86
Marsh Wren	7.47	4.80	9.76	4.47	5.48	7.52	9.87	9.19	8.96	7.60	7.30	6.80
White-crowned Sparrow	6.32	0.77	14.70	4.21	4.28	5.51	5.82	8.30	8.69	6.73	5.73	7.61
American Wigeon	6.25	2.42	9.65	X	0.07	0.22	0.21	0.28	0.67	11.15	21.47	22.22
Bewick's Wren	5.69	5.76	4.96	7.40	8.00	4.94	6.81	6.67	5.42	4.65	4.04	3.31
Great-tailed Grackle	5.21	8.07	2.41	0.72	1.49	3.69	4.12	4.29	3.31	7.81	10.66	10.75
Verdin	5.12	5.63	4.42	3.54	4.46	3.92	4.94	5.65	5.40	5.91	5.51	6.71
Common Yellowthroat	5.02	9.87	0.19	4.15	4.64	4.63	5.97	4.77	4.51	4.86	5.36	6.33
Black-tailed Gnatcatcher	4.97	5.16	4.60	4.58	5.43	3.26	4.27	5.49	5.31	5.76	5.31	5.31
American Pipit	4.72	0.69	9.57	1.34	2.72	2.10	5.83	6.02	4.87	11.36	3.51	4.75
Gambel's Quail (C)	4.17	5.18	3.32	1.71	1.10	0.98	1.65	3.35	8.62	6.30	5.73	8.10
Black Phoebe	3.98	2.36	5.32	3.86	4.39	3.39	3.85	3.69	3.82	4.90	3.89	4.04
Brown-headed Cowbird	2.95	6.37	0.01	3.33	3.78	3.61	4.42	3.12	2.99	2.06	1.64	1.58
Ruby-crowned Kinglet	2.79	0.46	5.69	4.66	4.15	3.35	2.25	2.26	2.45	2.26	1.99	1.77
Lucy's Warbler (C)	2.34	5.00		5.00	3.24	2.46	2.92	1.83	1.62	1.17	1.31	1.46
Orange-crowned Warbler	2.15	0.38	3.71	1.70	1.08	1.82	2.04	1.71	2.66	1.20	2.97	4.21
Mourning Dove	1.96	3.89	0.18	5.10	1.77	1.71	1.36	2.24	2.14	1.22	0.74	1.33
Yellow-breasted Chat	1.95	4.11	0.01	3.18	2.85	2.20	3.36	1.10	1.51	1.01	1.52	0.81
House Finch	1.84	1.35	2.46	0.93	1.34	1.39	1.28	4.00	2.82	0.92	2.40	1.45

Species (Conservation Status)	Overall	Breeding	Non-Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12
Yellow Warbler (B)	1.70	3.41	0.02	1.05	0.98	1.33	2.75	2.38	2.23	1.08	1.66	1.83
Crissal Thrasher	1.65	1.48	1.80	1.90	1.43	0.82	1.20	1.81	1.87	1.61	1.97	2.25
Blue Grosbeak (A)	1.43	2.91	0.01	2.32	1.65	1.56	1.67	1.05	0.96	0.90	1.17	1.57
Yellow-headed Blackbird	1.09	1.22	0.05	0.91	0.27	0.05	0.32	0.35	0.10	5.41	1.69	0.72
Killdeer	1.00	1.19	0.76	1.71	0.86	0.35	0.78	0.92	0.33	2.05	1.33	0.71
Say's Phoebe	0.92	0.70	1.19	0.55	0.64	0.35	1.00	1.69	1.13	0.79	1.06	1.06
Greater Roadrunner	0.87	1.19	0.44	0.67	0.57	0.55	0.57	0.50	0.61	1.03	1.37	1.97
Great Blue Heron	0.77	0.65	0.86	0.19	0.27	0.28	0.24	0.68	0.39	1.42	1.69	1.81
Lesser Goldfinch	0.75	0.43	0.72	0.36	0.66	0.25	0.60	1.11	2.77	0.33	0.41	0.22
Brewer's Sparrow (C)	0.73	0.53	0.16	0.27	0.51	1.01	1.03	2.01	0.92	0.17	0.41	0.22
Northern Flicker	0.73	0.05	1.60	0.42	0.52	0.85	0.87	0.60	0.68	1.00	0.85	0.81
Eared Grebe (C)	0.63	1.34	0.03	0.02		0.22		0.05	X	0.05	2.04	3.32
Western Kingbird	0.61	1.15		0.22	0.34	0.62	0.44	0.55	0.39	1.13	0.58	1.24
Dark-eyed Junco	0.56	0.05	1.26	0.14	0.22	1.64	0.88	0.89	0.43	0.33	0.41	0.13
Wilson's Warbler	0.56	1.07	0.04	1.14	0.81	0.63	0.46	0.48	0.21	1.03	0.13	0.18
Northern Pintail (C)	0.52	X	1.21	X	0.02		X	X	0.06	1.56	1.50	1.53
Double-crested Cormorant	0.51	0.28	0.71	0.03	0.08	0.58	0.21	0.14	0.02	0.68	0.65	2.22
Spotted Sandpiper	0.45	0.58	0.26	0.31	0.56	0.10	0.35	0.55	0.23	0.79	0.63	0.55
Lincoln's Sparrow	0.42	0.15	0.80	0.83	0.22	0.52	0.35	0.27	0.29	0.30	0.36	0.63
Northern Mockingbird	0.41	0.45	0.38	0.03	0.22	0.16	0.06	0.24	0.16	0.54	1.06	1.24
Anna's Hummingbird	0.39	0.47	0.24	0.14	0.03	0.02	0.05	0.11	0.03	0.62	0.98	1.50
Northern Shoveler	0.39	0.05	0.71	0.07	0.03			0.05	X	0.43	1.45	1.44
Loggerhead Shrike (D)	0.37	0.31	0.40	0.42	0.22	0.13	0.22	0.58	0.24	0.46	0.57	0.49
Canada Goose	0.36	0.21	0.18		X	0.22		0.03	0.08	0.52	0.54	1.83
Least Sandpiper (C)	0.35	0.30	0.58					1.09	0.40	1.47	0.13	0.05
Black-chinned Hummingbird	0.34	0.69	0.03	0.15	0.30	0.33	0.27	0.35	0.31	0.40	0.49	0.48
Bushtit	0.33	0.02	0.67	0.63	0.37	0.24	0.02	1.15	0.54			
Northern Rough-winged Swallow	0.32	0.58	X	0.20	0.20	0.16	1.03	0.35	0.13	0.14	0.39	0.31
Ring-billed Gull	0.32	0.00	0.68	X	0.63	1.25	X	0.03	X	0.13	0.85	0.02
Bufflehead	0.31	0.05	0.55			0.17	0.32	0.03	0.08	0.71	1.06	0.39

Species (Conservation Status)	Overall	Breeding	Non-Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12
Savannah Sparrow	0.30	0.16	0.33	0.11		0.33	0.47	0.27	0.26	0.17	0.51	0.59
Green Heron	0.29	0.52	0.08	0.28	0.54	0.28	0.25	0.20	0.23	0.44	0.14	0.28
Common Gallinule	0.27	0.33	0.17	0.12	0.17	0.16	0.09	0.20	0.18	0.49	0.43	0.57
Greater Yellowlegs	0.27	0.13	0.40	0.27	0.25	0.09	0.17	0.16	0.26	0.46	0.60	0.13
Pied-billed Grebe	0.27	0.23	0.38	0.07	0.11	0.47	0.17	0.11	0.13	0.10	0.49	0.79
Green-winged Teal	0.24	0.08	0.31		0.15	0.30	0.14	0.08	0.07	0.51	0.70	0.22
Belted Kingfisher	0.23	0.07	0.42	0.22	0.17	0.19	0.21	0.21	0.15	0.24	0.39	0.33
Blue-gray Gnatcatcher	0.23	0.24	0.14	0.39	0.46	0.21	0.55	0.08	0.14	0.19		0.03
Western Meadowlark	0.22	0.02	0.36	X	0.03		0.02	0.09	0.14	0.21	0.33	1.15
White-winged Dove	0.22	0.46	0.01	0.31	0.19	0.33	0.32	0.38	0.23	0.16	0.03	X
Snowy Egret (C)	0.19	0.19	0.15	0.17	0.05	0.28	0.03	0.10	0.10	0.30	0.28	0.39
Common Merganser	0.18	0.11	0.17	0.04	0.02	0.08	0.05	0.09	0.02	0.24	0.44	0.63
Cooper's Hawk	0.18	0.14	0.21	0.05	0.10	0.11	0.06	0.06	0.14	0.28	0.41	0.35
Bullock's Oriole	0.16	0.31	0.01	0.02	0.14	0.08		0.07	0.16	0.19	0.36	0.41
White-faced Ibis (C)	0.16	0.26	0.05	0.07	0.24	X	0.02	0.03	0.05	0.41	0.16	0.45
Barn Swallow	0.14	0.29	X	X	X	1.18	0.06	X	X	X	X	X
Chipping Sparrow	0.14	0.17	0.07	0.08	0.10	0.13	0.08	0.73	0.10	X	0.02	0.06
Rock Wren	0.14	0.09	0.23	0.08	0.13	0.06	0.16	0.30	0.31	0.05	0.09	0.03
Black-crowned Night-Heron	0.13	0.09	0.16	0.05	0.10	0.06	0.03	0.03	0.11	0.22	0.14	0.38
Cinnamon Teal (C)	0.13	0.19	0.05	0.09	X	X	0.03	0.19		0.27	0.46	0.11
Costa's Hummingbird (C)	0.13	0.20	0.05	0.07	0.15	0.17	0.11	0.08	0.16	0.21	0.14	0.06
Great Egret	0.12	0.08	0.16	0.09	0.03	0.08	0.06	0.17	0.10	0.06	0.17	0.29
Brewer's Blackbird (D)	0.11	0.02	0.29		X		0.44	0.13	0.41			
Osprey	0.11	0.10	0.09	0.02	0.03	0.03	0.02	0.05	0.03	0.35	0.22	0.22
Spotted Towhee	0.11	0.02	0.23	0.09	0.08	0.19	0.29	0.09	0.07	0.09	0.05	
Western Wood-Pewee	0.11	0.20		0.07	0.08	0.06	0.16	0.03	0.24	0.25	0.06	0.06
Cliff Swallow	0.10	0.19	0.01	X	X	0.09	0.68	0.11	X	X	X	X
Phainopepla (A)	0.10	0.00	0.25	0.17	0.21	0.06	0.19	0.11	0.05	0.05	0.08	X
Warbling Vireo	0.10	0.13	0.01	0.08	0.07	0.05	0.06	0.17	0.05	0.11	0.17	0.11
American Kestrel	0.09	0.13	0.06	0.08	0.03	0.03	0.02	0.03	0.12	0.18	0.22	0.08

Species (Conservation Status)	Overall	Breeding	Non-Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12
Horned Lark (D)	0.09	0.14	0.06	0.06		0.30	0.29	0.02	0.02	0.14		X
Indigo Bunting	0.09	0.19						0.11	0.07	0.09	0.24	0.27
Northern Harrier	0.09	0.02	0.16	0.03	0.11	0.25	0.11	0.05	X	0.05	0.08	0.08
Pine Siskin (D)	0.09	0.02	0.23	0.10		0.25			0.23		0.21	
Red-tailed Hawk	0.09	0.02	0.21	0.07	0.03	0.06	0.06	0.03	0.14	0.22	0.11	0.11
Sharp-shinned Hawk	0.09	0.00	0.20	0.17	0.03	0.05	0.09	0.14	0.08	0.08	0.09	0.05
Sora	0.09	0.06	0.16	0.03	0.05	0.03	0.05	0.02	0.10	0.08	0.14	0.36
Western Sandpiper (C)	0.09	0.17	0.03	0.36	0.02			0.24	0.10	0.08		
Lesser Scaup (C)	0.08	0.02	0.06							0.16	0.05	0.53
Virginia Rail	0.08	0.07	0.11	0.07	0.05	0.09	0.06	0.05	0.17	0.06	0.08	0.13
American White Pelican (C)	0.07	0.06	0.07				0.03	X	0.02	0.30	0.27	0.05
Ring-necked Duck	0.07	X	0.12				X	X		0.11	0.38	0.14
American Avocet (C)	0.06	0.09	0.01	0.20				0.05	X	0.30	0.02	0.02
Bell's Vireo (ABC)	0.06	0.13		0.17		0.08			0.07	0.06	0.16	0.03
Ladder-backed Woodpecker	0.06	0.03		0.02			0.02	0.03	0.21	0.08	0.14	0.06
Lazuli Bunting	0.06	0.07	X	0.11	0.12	0.05	0.17	0.02	X	0.03	0.03	0.02
American Robin	0.05	0.00	0.13	0.03	0.02	0.09	0.11	0.03	0.02	0.03	0.09	0.06
Ash-throated Flycatcher	0.05	0.08		0.07	0.02	0.09	0.02	X	0.09	0.06	0.05	0.08
Black-headed Grosbeak	0.05	0.07		0.12	0.07	0.03		0.03	0.09	0.02	0.03	0.05
Common Goldeneye	0.05	0.02	0.04			0.05	0.08	0.03	X	0.05	0.09	0.13
Hermit Thrush	0.05	0.01	0.08	0.12	0.20	0.02	0.02	0.02		0.02	0.05	
Hooded Merganser	0.05	0.01	0.07							0.02	0.25	0.19
House Wren	0.05	0.01	0.10	0.04	0.02			0.02		0.05	0.09	0.21
Long-billed Dowitcher (C)	0.05	0.08	0.01		0.07					0.11	0.11	0.16
Great Horned Owl	0.04	0.03	0.04		0.02	0.02		0.06	0.10	0.02	0.08	0.05
Least Bittern (BC)	0.04	0.07	0.02	0.02	0.02	0.06	0.08	X	0.03	0.08	0.05	0.03
Red-shouldered Hawk	0.04	0.01	0.05					X	0.02	0.03	0.11	0.16
Western Tanager	0.04	0.06		0.05	0.02	0.03	0.02	0.05	0.06	0.02	0.09	0.05
Black-necked Stilt (C)	0.03	0.07		0.07	X			0.07	X	0.09	0.02	0.05
Common Raven	0.03	0.03	0.04	X	X	0.09	X	0.02	X	0.06	X	0.13

Species (Conservation Status)	Overall	Breeding	Non-Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12
Lark Sparrow	0.03	0.06				0.03	0.03	0.02	0.07	0.05	0.02	0.06
Nashville Warbler	0.03	0.03	0.02			0.05	0.05	0.02	0.05	0.05	0.05	0.05
Western Flycatcher (Unidentified)	0.03	0.05		0.02	0.05	0.08	0.02		X	0.08		0.03
Dusky Flycatcher	0.02	0.04		0.02	0.03	0.13		0.02		0.02		
Eurasian Collared-Dove	0.02	0.03	0.02					0.02	X	0.05	0.05	0.06
Golden-crowned Kinglet	0.02		0.06	0.02		0.09	0.03	0.03	0.02			
Gray Flycatcher (C)	0.02	0.04	0.01	0.02		0.08		0.05	0.02		0.03	0.02
Horned Grebe	0.02	0.02	0.02							0.03	0.08	0.05
Lesser Nighthawk	0.02	0.02		X	0.02	X	X	0.02	X	0.03	0.02	0.06
MacGillivray's Warbler	0.02	0.02	0.01	0.02	0.02	0.02			0.05	0.02		0.08
Neotropic Cormorant	0.02	0.04								0.03	0.16	X
Pacific Wren	0.02		0.03	0.03	0.02				0.03	0.02	0.02	0.03
Ruddy Duck	0.02	X	0.05						X	0.16	0.03	
Townsend's Warbler	0.02	0.03							0.08	0.08		
American Goldfinch	0.01	0.00	0.02					0.05		0.03		
Barn Owl	0.01	0.02	0.01	0.07	0.03	0.02		0.02		X		X
Black-throated Sparrow	0.01	0.03	X		0.02				0.10			
Cedar Waxwing	0.01		0.01	0.05	0.02			X				
Dunlin	0.01	0.02								0.08		
Eastern Kingbird	0.01	0.01							0.02		0.02	0.02
Green-tailed Towhee (C)	0.01	0.01					0.02	0.02				0.02
Hooded Oriole	0.01	0.02	X			0.05						0.03
Lesser Yellowlegs	0.01	0.01	X					0.02		0.03	X	
Merlin	0.01		0.01		0.02			0.02	X		0.02	
Olive-sided Flycatcher (CDE)	0.01	0.03		0.02		0.02			0.02	0.02	0.02	0.03
Plumbeous Vireo	0.01	0.01					0.02			0.02	0.02	
Red-breasted Nuthatch	0.01		0.01			0.02	0.02			0.02	0.03	
Redhead (C)	0.01	X	X				0.03		X	0.02	X	X
Red-naped Sapsucker	0.01	0.00	0.04	0.04	0.05	0.02				0.02	0.02	
Rock Pigeon	0.01	X	0.02	X	X	0.03	0.02	X	X			X



Species (Conservation Status)	Overall	Breeding	Non-Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12
Sagebrush Sparrow (C)	0.01	X	0.02								0.03	0.03
Semipalmated Sandpiper	0.01	0.02	X		0.07							
Solitary Vireo (Unidentified)	0.01	0.03	X	X	0.02	0.02	0.08					
Tree Swallow	0.01	0.01	0.01			0.03	0.05	X	X	X	X	X
Vesper Sparrow	0.01	0.01	X					0.03	0.05	0.02		
Violet-green Swallow	0.01	0.02	X		X	0.03	0.05	0.02	X	X	X	
Western Bluebird	0.01	X	0.02	0.05	X			X				
Western Grebe (C)	0.01	0.01	0.02	X		0.02				0.05	0.05	X
Willow Flycatcher (ABC)	0.01	0.01					0.03		0.02			
Wilson's Snipe	0.01	0.01	0.01					0.02	X	0.02	0.05	
American Bittern	0.00	0.00			0.02			0.02				X
Black-And-white Warbler	0.00											0.03
Blackpoll Warbler	0.00		0.01								0.02	
Black-throated Gray Warbler	0.00	X	0.01					0.02				0.02
Blue-winged Teal	0.00	X	0.01	X						X	0.02	
Broad-tailed Hummingbird	0.00								0.02			
Brown Creeper	0.00		0.01							0.02		
Brown-crested Flycatcher	0.00	0.01		0.03				X				
Cactus Wren	0.00		X					X			0.03	
Canyon Towhee	0.00	0.00			0.02							
Canyon Wren	0.00	0.00	0.01	0.02	0.02	X	X			X		
Cattle Egret	0.00	X								X	0.02	
European Starling	0.00	0.00	X				X	X	0.02		0.02	
Greater White-fronted Goose	0.00		0.01						X			0.03
Hairy Woodpecker	0.00		0.01		0.02							
Hammond's Flycatcher	0.00	0.00								0.02		
House Sparrow	0.00	0.00	0.01	0.02		X				0.02		
Mountain Bluebird	0.00		0.01				0.02					
Ovenbird	0.00		0.01						0.02			
Pectoral Sandpiper	0.00							0.02				

Species (Conservation Status)	Overall	Breeding	Non-Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12
Peregrine Falcon (C)	0.00	0.00	0.01	X	X	X	0.02	0.02	X	X	X	X
Prairie Falcon (C)	0.00	X	0.01	X	X			0.02	X	X	X	X
Red Crossbill	0.00	X	0.01								0.02	
Ross's Goose	0.00	X	0.01					X				0.02
Rufous Hummingbird (CE)	0.00	0.01						X	0.03			
Rufous-crowned Sparrow	0.00	0.00				0.02						
Scissor-tailed Flycatcher	0.00								0.02			
Semipalmated Plover	0.00	0.00		0.02								
Snow Goose	0.00	X	X	X				X	X		0.02	
Summer Tanager (AB)	0.00			X						0.02		
Turkey Vulture	0.00	0.00	X	X	X	X	0.02	X	X	X	X	0.02
Virginia's Warbler (CDE)	0.00					0.02						
Willet (C)	0.00	0.00								X	0.02	
Wood Duck	0.00		0.01				0.02			X		X
Bank Swallow	X	X						X			X	
Bonaparte's Gull	X	X								X	X	
California Gull	X	X	X					X	X	X		X
Canvasback (C)	X		X								X	
Caspian Tern	X	X	X				X			X	X	
Clark's Grebe (C)	X	X	X				X			X	X	
Forster's Tern	X	X									X	
Franklin's Gull (C)	X	X									X	
Graylag Goose	X	X	X					X	X	X		
Hooded Warbler	X	X								X		
Lesser Black-backed Gull	X	X								X		
Long-billed Curlew (C)	X	X									X	X
Long-eared Owl (E)	X	X		X								
Marbled Godwit (C)	X										X	
Northern Goshawk (C)	X		X						X			
Sandhill Crane (C)	X		X						X		X	

Species (Conservation Status)	Overall	Breeding	Non-Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12
Stilt Sandpiper	X											X
Swainson's Hawk (C)	X	X				X			X		X	X
Tundra Swan (C)	X		X									X
Vaux's Swift	X	X	X			X		X				
Whimbrel	X	X								X		
White Ibis	X	X										X
White-tailed Kite	X	X								X		
White-throated Swift (C)	X	X	X	X	X	X	X	X	X	X	X	X
Wilson's Phalarope (C)	X	X									X	

**Table 6.** Breeding and non-breeding abundances (birds per 40 ha) by species for each of nine survey years (2005-2017). Species listed are in descending order of overall abundance. An “X” indicates the species was recorded, but not within 100m of a point; no entry means that the species was not detected.

Species (Conservation Status)	Breeding Season/Year									Non-Breeding Season/Year								
	1	2	3	4	5	6	10	11	12	1	2	3	4	5	6	10	11	12
American Coot	1.17	1.35	5.54	3.29	1.30	1.07	10.51	17.49	20.38	4.49	16.77	9.63	6.03	7.71	6.67	61.06	58.60	82.91
Red-winged Blackbird	5.30	8.74	11.75	15.09	15.65	14.11	25.42	23.99	23.60	12.88	8.80	11.09	4.41	8.21	0.61	4.43	14.38	5.89
Abert's Towhee (C)	17.39	15.81	9.87	11.09	11.01	10.84	7.78	7.53	9.65	13.07	12.60	10.50	9.31	11.14	9.91	8.76	8.85	7.96
Yellow-rumped Warbler	0.28	1.10	1.73	0.72	0.92	0.41	1.16	1.75	3.15	16.59	6.06	25.33	27.11	32.26	39.58	32.04	18.98	21.04
Mallard	0.46	0.44	1.99	2.40	4.77	3.14	6.80	11.50	7.64	1.27	5.17	6.57	4.79	11.32	11.10	31.40	33.45	30.31
Song Sparrow	14.15	15.18	12.13	12.01	9.13	10.88	7.93	7.87	9.14	10.20	9.69	9.49	5.85	6.75	7.66	2.92	5.16	4.67
Gadwall	0.08	0.04	0.27	0.48	0.65	0.17	0.68	5.44	9.77	1.71	2.47	2.10	1.73	2.74	4.61	18.62	29.34	51.46
Marsh Wren	1.97	2.89	4.75	8.21	7.56	6.87	4.08	3.39	3.49	7.12	7.64	9.72	10.96	10.54	11.18	9.90	10.50	10.24
White-crowned Sparrow	0.61	1.39	0.28	0.17	0.58	0.68	0.82	1.20	1.24	10.39	6.45	13.51	15.00	19.17	21.24	15.70	13.69	17.17
American Wigeon		X	0.07	0.27	X	X	2.53	11.98	6.96	X	X	0.27	0.09	0.32	0.59	17.52	23.91	44.14
Bewick's Wren	7.10	8.96	4.77	7.02	6.65	3.82	4.59	5.03	3.89	6.78	6.14	4.65	6.97	5.02	6.89	3.47	2.51	2.19
Great-tailed Grackle	0.60	1.98	5.15	5.92	7.20	4.45	13.44	17.04	16.89	1.17	1.24	2.60	2.83	1.23	2.88	2.78	3.19	3.74
Verdin	3.85	5.93	4.25	5.00	6.03	5.64	6.21	5.78	8.01	2.98	2.33	3.79	4.73	5.52	4.62	5.75	4.88	5.14
Common Yellowthroat	8.06	8.85	9.35	11.29	10.13	9.00	9.40	10.54	12.21	0.05		0.05	0.23		0.14	0.55	0.32	0.37
Black-tailed Gnatcatcher	4.95	6.77	3.23	4.18	5.20	4.81	6.17	5.20	5.94	3.56	4.61	3.15	4.40	5.66	5.38	4.61	5.52	4.49
American Pipit	X	0.11	0.38	X	3.76	0.44	1.13	0.27	0.07	3.81	6.69	3.61	12.95	8.67	12.26	20.54	9.13	8.44
Gambel's Quail (C)	3.16	1.76	1.48	1.68	4.55	9.64	6.16	7.39	10.79	0.63	0.75	0.59	1.81	1.60	8.92	6.53	3.97	5.06
Black Phoebe	2.33	2.67	2.10	2.29	2.34	2.04	3.40	2.09	1.96	4.93	5.62	4.34	5.86	4.15	5.62	5.70	5.39	6.26
Brown-headed Cowbird	7.21	8.16	7.82	9.55	6.72	6.44	4.43	3.56	3.41		X		0.05			0.05		
Ruby-crowned Kinglet	0.77	0.84	0.52	0.44	0.21	0.12	0.38	0.27	0.56	10.10	7.66	7.44	4.11	5.39	4.80	3.88	4.43	3.44
Lucy's Warbler (C)	10.84	6.99	5.23	6.16	3.89	3.52	2.40	2.81	3.16									
Orange-crowned Warbler	0.35	0.37	0.38	0.14	0.34	0.44	0.21	0.34	0.85	2.88	1.96	3.15	4.03	2.56	4.49	1.37	4.88	8.03
Mourning Dove	10.50	3.48	3.12	2.77	4.28	4.51	2.34	1.20	2.82	0.29	X	0.32	0.09	0.23	X	0.41	0.27	0.05
Yellow-breasted Chat	6.77	6.11	4.55	6.91	2.38	3.19	2.09	3.29	1.68			0.05						
House Finch	1.26	1.06	0.89	1.06	4.31	1.65	0.69	0.58	0.66	0.34	1.88	2.65	1.87	1.19	4.07	1.64	5.52	2.93
Yellow Warbler (B)	2.27	2.05	2.77	5.58	4.79	4.63	2.12	3.29	3.21							0.09		0.05
Crissal Thrasher	1.50	1.68	0.55	1.03	1.66	1.42	1.79	1.54	2.17	2.44	0.87	0.96	1.52	2.01	2.23	1.28	2.37	2.55

Species (Conservation Status)	Breeding Season/Year									Non-Breeding Season/Year								
	1	2	3	4	5	6	10	11	12	1	2	3	4	5	6	10	11	12
Blue Grosbeak (A)	4.40	3.48	3.29	3.49	2.26	1.94	1.96	2.26	3.16						0.05			
Yellow-headed Blackbird	1.94	0.18	0.10	0.41	0.68	0.21	4.90	1.44	1.12	0.05			0.32	X			0.05	X
Killdeer	2.26	0.99	0.38	0.44	1.61	0.53	2.19	1.44	0.84	1.07	0.38	0.23	1.01	0.18	0.09	2.01	1.23	0.60
Say's Phoebe	0.41	0.73	0.48	1.10	1.15	0.68	0.93	0.38	0.42	0.59	0.48	0.23	1.19	2.33	1.12	0.96	1.92	1.94
Greater Roadrunner	0.86	0.95	0.96	0.65	0.70	0.91	1.72	1.57	2.42	0.44	0.09	0.18	0.37	0.18	0.09	0.41	0.87	1.35
Great Blue Heron	0.19	0.11	0.27	0.14	0.76	0.35	1.51	1.51	0.98	0.20	0.38	0.27	0.19	0.64	0.42	1.37	1.69	2.60
Lesser Goldfinch	0.07	0.44	0.24	0.14	0.48	1.82	0.34	0.10	0.21	0.20	0.10	0.23	0.83	0.64	3.56	0.27	0.32	0.37
Brewer's Sparrow (C)		0.66	1.68	0.31	0.62	1.21	0.17	0.03	0.07	0.29			0.46	0.41		0.05	0.27	X
Northern Flicker	X		0.07	0.10		0.04	0.03	0.10	0.14	0.93	1.11	2.10	1.89	1.05	1.73	1.96	1.96	1.69
Eared Grebe (C)	0.04		0.48		0.08		X	4.42	7.06						X	0.14	X	0.14
Western Kingbird	0.44	0.70	1.20	0.75	0.95	0.51	2.30	0.96	2.52									
Dark-eyed Junco	0.11			0.31			0.07			0.10	0.53	4.65	1.37	2.46	0.61	0.37	1.00	0.28
Wilson's Warbler	2.06	1.68	1.27	0.55	0.97	0.39	2.19	0.14	0.35	0.34							0.05	
Northern Pintail (C)							X		X	X			X	X	0.18	4.29	3.06	3.37
Double-crested Cormorant	0.04	0.07	0.24	0.14	0.17	0.04	0.51	0.55	0.81	X	0.13	1.28	0.14	0.09	X	0.27	0.91	3.55
Spotted Sandpiper	0.45	0.88	0.14	0.51	0.68	0.21	1.03	0.82	0.46	0.20	0.24		0.14	0.18	0.19	0.50	0.46	0.46
Lincoln's Sparrow	0.12	0.07	0.35	0.07	0.07	0.04	0.07	0.21	0.35	1.85	0.19	0.91	0.69	0.55	0.70	0.78	0.55	1.02
Northern Mockingbird	0.07	0.26	0.21	0.03	0.24	0.18	0.76	1.23	1.05		0.23	0.05	0.09	0.32	0.19	0.37	0.82	1.39
Anna's Hummingbird	0.22	0.07		0.07	0.10	0.04	0.69	1.23	1.85	0.05			0.05	0.09		0.32	0.59	1.02
Northern Shoveler					0.07		0.14	0.10	0.14	0.20					X	0.64	1.55	3.97
Loggerhead Shrike (D)	0.55	0.29	0.07	0.27	0.53	0.11	0.38	0.07	0.53	0.24	0.14	0.14	0.14	0.59	0.33	0.64	0.78	0.56
Canada Goose			0.21		X	0.15	1.03	0.34	0.21			0.37		0.09	X	0.05	0.18	0.96
Least Sandpiper (C)					1.20	0.68	0.51	0.27	X					1.55	0.05	3.51	X	0.14
Black-chinned Hummingbird	0.33	0.66	0.72	0.55	0.72	0.64	0.62	1.03	0.98				0.05			0.14	0.05	0.05
Bushtit	0.08					0.08				1.61	0.96	0.14		3.33				
Northern Rough-winged Swallow	0.23	0.40	0.27	1.99	0.73	X	0.21	0.75	0.67	X			X	X	X	X	X	X
Ring-billed Gull	X	X		X	X	X	0.03	X	X	X	1.83	3.06	X	0.09	X	0.18	0.96	0.05
Bufflehead			0.03				0.14	0.03	0.21			0.46	X	0.09	0.24	1.46	2.05	0.67

Species (Conservation Status)	Breeding Season/Year									Non-Breeding Season/Year								
	1	2	3	4	5	6	10	11	12	1	2	3	4	5	6	10	11	12
Savannah Sparrow	0.24		0.38	0.21	0.03	0.11	0.21	0.14	0.11			0.23	0.64	0.46	0.41	0.14	0.50	0.57
Green Heron	0.46	0.84	0.44	0.51	0.37	0.39	0.93	0.31	0.39	0.10	0.24	0.09		0.05	0.09		X	0.14
Common Gallinule	0.15	0.22	0.21	0.10	0.30	0.28	0.65	0.48	0.59	0.15	0.19		0.09	0.14	0.14	0.23	0.37	0.23
Greater Yellowlegs	X	0.07		0.03	0.14	0.28	0.31	0.34	0.04	0.68	0.24	0.27	0.28	0.18	0.14	0.50	1.05	0.28
Pied-billed Grebe		0.04	0.45	0.27	0.17	0.07	0.07	0.51	0.46	0.20	0.23	0.68	X	0.09	0.28	0.14	0.50	1.31
Green-winged Teal		0.04	X	0.10	X	0.08	0.21	0.24	0.04		0.27	0.32	0.09	0.18	0.09	0.32	1.19	0.37
Belted Kingfisher	0.04	0.07	0.03	X	0.03	0.07	0.10	0.17	0.07	0.54	0.24	0.41	0.32	0.14	0.14	0.46	0.68	0.87
Blue-gray Gnatcatcher	0.59	0.33	0.34	0.86					0.07	0.34			0.05	0.23	0.37	0.27		
Western Meadowlark		0.04					0.07	X	0.11				0.05	0.27	0.09	0.18	0.82	1.85
White-winged Dove	0.63	0.40	0.72	0.68	0.79	0.50	0.34	0.07	X	0.05								
Snowy Egret (C)	0.26	X	0.24	0.03	0.07	X	0.42	0.41	0.31	X	0.14	0.50	X	0.05	0.05	0.05	0.09	0.49
Common Merganser	0.08	X		0.03	X	X	0.21	0.21	0.49	X	0.05	0.14	0.05	X	0.05	0.23	0.46	0.57
Cooper's Hawk	0.04		0.03	0.07	0.03	X	0.34	0.41	0.31	X	0.14	0.23	0.05	0.14	0.28	0.27	0.41	0.42
Bullock's Oriole	0.04	0.29	0.17		0.11	0.21	0.42	0.68	0.83						0.05			
White-faced Ibis (C)	0.15	0.51	X	0.03	0.03	0.11	0.69	0.24	0.56	X	X		X				X	0.46
Barn Swallow		X	2.57	X	X	X	X	X	X			X	X	X	X		X	X
Chipping Sparrow	0.07		0.24		0.99	0.21							0.14	0.50		X		
Rock Wren	0.04	0.11	0.03	0.21	0.24	0.15	0.04	X		0.20	0.19	0.09	0.14	0.50	0.56	0.09	0.18	0.09
Black-crowned Night-Heron	0.11	0.07	0.03	0.03	X	0.04	0.17	0.10	0.28	X	0.19	0.14	0.05	X	0.28	0.27	0.14	0.42
Cinnamon Teal (C)	0.20	X	X	0.07	0.14		0.07	0.99	0.24					0.09		0.32	X	X
Costa's Hummingbird (C)	0.15	0.22	0.34	0.17	0.18	0.21	0.24	0.21	0.07			X	0.05		0.05	0.18	0.09	0.05
Great Egret	0.04	X	X	0.03	0.21	0.10	0.10	0.03	0.21	0.15	0.05	0.23	0.05	0.14	0.09	X	0.23	0.51
Brewer's Blackbird (D)					0.17						X		1.28	0.14	1.18			
Osprey	X	0.07	0.03	X	0.07	0.03	0.21	0.34	0.17	X			0.05	X	X	0.55	0.14	0.09
Spotted Towhee	0.08		0.03	0.07		0.04				0.15	0.20	0.46	0.60	0.14	0.14	0.23	0.14	
Western Wood-Pewee	0.15	0.15	0.10	0.21	0.04	0.41	0.55	0.10	0.10									
Cliff Swallow	X	X	0.21	1.47	0.03	X	X	X	X			X	X	0.05				X
Phainopepla (A)						0.04	X		X	0.49	0.51	0.09	0.46	0.32	0.05	0.14	0.18	X
Warbling Vireo	0.18	0.11	0.07	0.07	0.27	0.11	0.21	0.03	0.10							X		0.09

Species (Conservation Status)	Breeding Season/Year									Non-Breeding Season/Year								
	1	2	3	4	5	6	10	11	12	1	2	3	4	5	6	10	11	12
American Kestrel	0.15	0.07	0.07		0.07	0.08	0.31	0.31	0.07	X	X		X	X	0.23	X	0.18	0.09
Horned Lark (D)	0.12		0.58	0.34	0.03		0.14		X			0.09	0.38		0.05			
Indigo Bunting					0.23	0.15	0.21	0.51	0.59									
Northern Harrier		0.04	0.07	X	0.03	X	X	X	X	0.10	0.23	0.59	0.09	0.09	X	0.14	0.05	0.19
Pine Siskin (D)	X							0.17		0.29		0.73			0.66		0.37	
Red-tailed Hawk	X	0.04		0.03	X	X	0.10	X	X	0.20	X	0.18	0.14	0.09	0.37	0.41	0.23	0.28
Sharp-shinned Hawk	X	X	X		0.03	X	X	X	X	0.44	0.05	0.09	0.23	0.23	0.23	0.18	0.18	0.14
Sora		0.04	0.03	0.03		0.10	0.03	0.07	0.25	0.10	0.09	0.05	0.09	0.05	0.09	0.18	0.23	0.61
Western Sandpiper (C)	0.77				0.51	0.21	X								X	0.23		
Lesser Scaup (C)							X	0.10	0.07							0.46	X	0.10
Virginia Rail	0.04	0.04	0.03	0.03		0.16	0.07	0.07	0.17	0.10	0.10	0.14	0.09	0.09	0.28	X	0.09	0.14
American White Pelican (C)				0.07		0.04	0.31	0.14							X	0.46	0.18	X
Ring-necked Duck							X	X					X	X		0.14	0.59	0.32
American Avocet (C)	0.44				0.07	X	0.31	X	X							0.05	X	X
Bell's Vireo (ABC)	0.37		0.17			0.15	0.10	0.34	0.03									
Ladder-backed Woodpecker	0.04			0.03		0.07	0.07	X	0.07					0.09	0.33	0.14	0.32	
Lazuli Bunting	0.12	0.18	0.10	0.03	0.03	X	0.07	0.07	0.04		X							
American Robin								0.03		0.10	0.05	0.27	0.23	0.09		0.09	0.14	0.18
Ash-throated Flycatcher	0.11	X	0.17	0.03		0.19	0.10	0.07	0.07									
Black-headed Grosbeak	0.23	0.11			0.07	0.08	0.03	0.07	0.07									
Common Goldeneye							X	0.07	0.11			0.14		0.09	X	0.05	0.05	X
Hermit Thrush	0.04	0.04								0.29	0.23	0.05	0.05				0.09	
Hooded Merganser							X	0.03	0.07							X	0.37	0.23
House Wren		0.04					0.03		0.03	0.05				0.05		0.09	0.23	0.46
Long-billed Dowitcher (C)		0.07					0.24	0.14	0.28							X	X	0.10
Great Horned Owl			0.03		0.07	0.11	0.04		0.07					0.05	0.05	X	0.18	0.05
Least Bittern (BC)	0.04		0.07	0.14	X	0.07	0.17	0.10	0.07		0.05	0.09						X
Red-shouldered Hawk							X	0.03	0.04					X		0.05	0.18	0.19

Species (Conservation Status)	Breeding Season/Year									Non-Breeding Season/Year								
	1	2	3	4	5	6	10	11	12	1	2	3	4	5	6	10	11	12
Western Tanager	0.11	0.04	0.07		0.10	0.12	0.03	0.07	0.04									
Black-necked Stilt (C)	0.15	X			0.15	X	0.21	0.03	0.10									
Common Raven	X	X		X	X	X	0.10	X	0.17	X	X	0.27	X	X	X	0.05	X	X
Lark Sparrow			0.07	0.07	0.03	0.14	0.03	0.03	0.14									
Nashville Warbler			0.10			0.03	0.07	X	0.04						0.05		0.05	0.05
Western Flycatcher (Unidentified)		0.04	0.17	0.03		X	0.17		0.07									
Dusky Flycatcher	0.04	0.04	0.27				0.03											
Eurasian Collared-Dove					0.03	X	0.10	0.03	0.07								0.09	0.09
Golden-crowned Kinglet										0.05		0.27	0.09	0.09	0.05			
Gray Flycatcher (C)	0.04		0.17		0.07			0.03	0.04								0.05	
Horned Grebe							0.03	0.07	0.10							0.05	0.14	X
Lesser Nighthawk	X	0.04	X	X	0.03	X	0.07	X	0.04									
MacGillivray's Warbler	0.04		0.03			0.04	0.03		0.04									0.05
Neotropic Cormorant							0.03	0.34	X									
Pacific Wren										0.10					0.09	0.05		X
Ruddy Duck							X								X	0.32	0.09	
Townsend's Warbler						0.18	0.14											
American Goldfinch					0.03		X							0.09		0.09		
Barn Owl	0.11	0.07			0.03		X					0.05		X				X
Black-throated Sparrow		0.04				0.21									X			
Cedar Waxwing										0.05				X				
Dunlin							0.17											
Eastern Kingbird						0.04		0.03	0.04									
Green-tailed Towhee (C)				0.03					0.03									
Hooded Oriole			0.10						0.07			X						
Lesser Yellowlegs							0.07							X				
Merlin											0.05			0.05	X		X	
Olive-sided Flycatcher (CDE)	0.04		0.03			0.04	0.03	0.03	0.07									
Plumbeous Vireo				0.03			0.03	0.03										



Species (Conservation Status)	Breeding Season/Year									Non-Breeding Season/Year								
	1	2	3	4	5	6	10	11	12	1	2	3	4	5	6	10	11	12
Red-breasted Nuthatch													0.05				0.05	
Redhead (C)							X		X						X		X	
Red-naped Sapsucker	0.04									0.05	0.15	0.05				0.05	0.05	
Rock Pigeon	X	X	X	X	X				X			0.09	0.05					
Sagebrush Sparrow (C)									X								0.09	0.09
Semipalmated Sandpiper		0.15																
Solitary Vireo (Unidentified)	X	0.04	0.03	0.17														
Tree Swallow				0.10	X	X	X	X	X			0.09			X			X
Vesper Sparrow					0.07	0.04												
Violet-green Swallow		X	0.07	0.10	X	X	X	X					X	X			X	
Western Bluebird										0.15	X			X				
Western Grebe (C)							0.10	X	X	X		0.05				X	0.14	
Willow Flycatcher (ABC)				0.07		0.04												
Wilson's Snipe					0.05	X	0.03	0.03									0.05	
American Bittern		0.04																
Blackpoll Warbler																	0.05	
Black-throated Gray Warbler									X					0.05				
Blue-winged Teal	X						X	X		X							0.05	
Brown Creeper																0.05		
Brown-crested Flycatcher	0.07				X													
Cactus Wren														X				
Canyon Towhee		0.04																
Canyon Wren	0.04			X							0.05							
Cattle Egret							X											
European Starling								0.03						X	X		X	
Greater White-fronted Goose															X			0.10
Hairy Woodpecker											0.05							
Hammond's Flycatcher							0.03											

Species (Conservation Status)	Breeding Season/Year									Non-Breeding Season/Year								
	1	2	3	4	5	6	10	11	12	1	2	3	4	5	6	10	11	12
House Sparrow							0.03			0.05								
Mountain Bluebird													0.05					
Ovenbird															0.05			
Peregrine Falcon (C)			X	0.03	X	X	X	X	X	X				0.05	X	X	X	X
Prairie Falcon (C)						X			X					0.05	X	X	X	
Red Crossbill																	0.05	
Ross's Goose														X				0.05
Rufous Hummingbird (CE)						0.07												
Rufous-crowned Sparrow			0.03															
Semipalmated Plover	0.04																	
Snow Goose	X					X								X	X		X	
Turkey Vulture		X	X	X	X	X	X	X	0.03								X	X
Willet (C)							X	0.03										
Wood Duck													0.05			X		X
Bank Swallow					X			X										
Bonaparte's Gull							X	X										
California Gull						X	X							X	X	X		X
Canvasback (C)																	X	
Caspian Tern				X			X	X									X	
Clark's Grebe (C)				X				X								X	X	
Forster's Tern								X										
Franklin's Gull (C)								X										
Graylag Goose						X								X	X			
Hooded Warbler							X											
Lesser Black-backed Gull							X											
Long-billed Curlew (C)									X									
Long-eared Owl (E)	X																	
Northern Goshawk (C)															X			
Sandhill Crane (C)															X			

Species (Conservation Status)	Breeding Season/Year									Non-Breeding Season/Year								
	1	2	3	4	5	6	10	11	12	1	2	3	4	5	6	10	11	12
Swainson's Hawk (C)			X			X		X	X									
Tundra Swan (C)																		X
Vaux's Swift			X											X				
Whimbrel							X											
White Ibis									X									
White-tailed Kite							X											
White-throated Swift (C)	X	X	X	X	X	X	X	X	X		X							X
Wilson's Phalarope (C)								X										

**Table 7.** Relative species abundance (percent of total bird abundance) for all nine years (overall), among seasons, and by survey year (2005-2017). Only species that represent at least 1% of the overall bird abundances in one or more periods are listed (in descending order of overall relative abundance). “X” indicates the species was only detected outside of the survey period or beyond 100m of a point. No entry means that the species was not detected.

Species (Conservation Status)	Overall	Breeding	Non- Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12
American Coot	9.76	4.47	13.41	1.79	6.85	7.34	3.69	2.98	2.44	14.79	16.64	16.38
Red-winged Blackbird	6.21	10.33	3.74	5.63	5.78	7.06	6.82	7.64	4.55	6.65	6.69	5.18
Abert's Towhee (C)	6.12	7.26	4.86	12.47	11.22	7.45	7.44	7.14	7.18	3.68	3.13	3.22
Yellow-rumped Warbler	5.67	0.81	11.56	4.91	2.48	8.41	7.35	8.51	9.50	5.67	3.34	3.67
Mallard	5.40	2.82	7.15	0.78	1.69	3.34	2.76	5.20	4.12	7.64	9.48	6.68
Song Sparrow	4.99	7.08	3.29	9.75	10.02	7.69	6.44	4.75	6.05	2.49	2.47	2.41
Gadwall	4.57	1.26	6.06	0.56	0.85	1.18	1.05	1.27	1.68	5.49	8.01	11.20
Marsh Wren	4.16	3.11	4.64	3.58	4.30	5.49	6.79	5.71	5.90	3.23	2.82	2.47
White-crowned Sparrow	3.52	0.50	6.99	3.37	3.36	4.02	4.00	5.15	5.72	2.86	2.21	2.76
American Wigeon	3.48	1.57	4.59	X	0.05	0.16	0.14	0.17	0.44	4.74	8.29	8.06
Bewick's Wren	3.17	3.73	2.36	5.92	6.27	3.61	4.68	4.14	3.57	1.98	1.56	1.20
Great-tailed Grackle	2.90	5.22	1.15	0.58	1.17	2.69	2.83	2.66	2.18	3.32	4.11	3.90
Verdin	2.85	3.64	2.10	2.83	3.50	2.86	3.40	3.51	3.55	2.51	2.13	2.43
Common Yellowthroat	2.79	6.39	0.09	3.32	3.64	3.38	4.11	2.96	2.97	2.07	2.07	2.30
Black-tailed Gnatcatcher	2.77	3.34	2.19	3.67	4.26	2.38	2.94	3.41	3.49	2.45	2.05	1.93
American Pipit	2.63	0.45	4.55	1.07	2.13	1.53	4.01	3.74	3.20	4.83	1.35	1.72
Gambel's Quail (C)	2.32	3.35	1.58	1.37	0.86	0.72	1.13	2.08	5.67	2.68	2.21	2.94
Black Phoebe	2.21	1.53	2.53	3.09	3.44	2.47	2.65	2.29	2.51	2.08	1.50	1.47
Brown-headed Cowbird	1.64	4.12	0.00	2.67	2.96	2.63	3.04	1.94	1.97	0.88	0.63	0.57
Ruby-crowned Kinglet	1.55	0.30	2.70	3.73	3.25	2.45	1.55	1.40	1.61	0.96	0.77	0.64
Lucy's Warbler (C)	1.30	3.24		4.00	2.54	1.80	2.01	1.14	1.07	0.50	0.51	0.53
Orange-crowned Warbler	1.20	0.25	1.76	1.36	0.85	1.33	1.40	1.06	1.75	0.51	1.15	1.53
Mourning Dove	1.09	2.52	0.09	4.08	1.39	1.25	0.94	1.39	1.41	0.52	0.29	0.48
Yellow-breasted Chat	1.08	2.66	0.00	2.55	2.24	1.61	2.31	0.68	0.99	0.43	0.59	0.29
House Finch	1.02	0.87	1.17	0.74	1.05	1.01	0.88	2.48	1.86	0.39	0.93	0.53
Yellow Warbler (B)	0.95	2.21	0.01	0.84	0.77	0.97	1.89	1.48	1.47	0.46	0.64	0.66
Crissal Thrasher	0.92	0.96	0.86	1.52	1.12	0.60	0.83	1.12	1.23	0.68	0.76	0.82

Species (Conservation Status)	Overall	Breeding	Non- Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12
Blue Grosbeak (A)	0.80	1.88	0.00	1.86	1.29	1.14	1.15	0.65	0.63	0.38	0.45	0.57
Yellow-headed Blackbird	0.61	0.79	0.02	0.73	0.21	0.04	0.22	0.22	0.07	2.30	0.65	0.26
Killdeer	0.56	0.77	0.36	1.37	0.67	0.26	0.54	0.57	0.22	0.87	0.51	0.26
Say's Phoebe	0.51	0.45	0.57	0.44	0.50	0.26	0.69	1.05	0.74	0.34	0.41	0.38
Lesser Goldfinch	0.42	0.28	0.34	0.29	0.52	0.18	0.41	0.69	1.82	0.14	0.16	0.08
Brewer's Sparrow (C)	0.41	0.34	0.08	0.22	0.40	0.74	0.71	1.25	0.61	0.07	0.16	0.08
Eared Grebe (C)	0.35	0.87	0.01	0.02		0.16		0.03	X	0.02	0.79	1.20
Dark-eyed Junco	0.31	0.03	0.60	0.11	0.17	1.20	0.61	0.55	0.28	0.14	0.16	0.05

**Table 8.** Breeding and non-breeding relative species abundances (percent of total bird abundance) for each of nine survey years (2005-2017). Only species that represent at least 1% of the overall bird abundances in one or more periods are listed (in descending order of overall relative abundance). “X” indicates the species was only detected outside of the survey period or beyond 100m of a point. No entry means that the species was not detected.

Species (Conservation Status)	Breeding Season/Year									Non-Breeding Season/Year								
	1	2	3	4	5	6	10	11	12	1	2	3	4	5	6	10	11	12
American Coot	0.86	1.02	4.37	2.28	0.87	0.82	6.15	9.05	9.75	3.42	13.29	6.13	3.97	4.45	3.47	20.90	19.36	22.58
Red-winged Blackbird	3.93	6.61	9.25	10.50	10.56	10.75	14.87	12.42	11.30	9.82	6.97	7.06	2.91	4.74	0.32	1.52	4.75	1.60
Abert's Towhee (C)	12.89	11.95	7.77	7.71	7.43	8.26	4.55	3.90	4.62	9.97	9.98	6.68	6.13	6.42	5.16	3.00	2.93	2.17
Yellow-rumped Warbler	0.21	0.83	1.36	0.50	0.62	0.32	0.68	0.90	1.51	12.65	4.80	16.11	17.85	18.61	20.60	10.97	6.27	5.73
Mallard	0.34	0.33	1.57	1.67	3.22	2.39	3.98	5.95	3.66	0.97	4.10	4.18	3.15	6.53	5.78	10.75	11.05	8.25
Song Sparrow	10.49	11.48	9.55	8.35	6.16	8.29	4.64	4.08	4.37	7.78	7.68	6.04	3.85	3.89	3.99	1.00	1.70	1.27
Gadwall	0.06	0.03	0.22	0.33	0.44	0.13	0.40	2.82	4.68	1.30	1.96	1.34	1.14	1.58	2.40	6.37	9.70	14.02
Marsh Wren	1.46	2.19	3.74	5.71	5.10	5.24	2.38	1.75	1.67	5.43	6.05	6.18	7.21	6.08	5.82	3.39	3.47	2.79
White-crowned Sparrow	0.45	1.05	0.22	0.12	0.39	0.51	0.48	0.62	0.59	7.92	5.11	8.59	9.88	11.05	11.05	5.37	4.52	4.68
American Wigeon		X	0.05	0.19	X	X	1.48	6.20	3.33	X	X	0.17	0.06	0.18	0.31	6.00	7.90	12.02
Bewick's Wren	5.27	6.78	3.76	4.88	4.49	2.91	2.69	2.60	1.86	5.17	4.86	2.96	4.59	2.89	3.59	1.19	0.83	0.60
Great-tailed Grackle	0.44	1.49	4.06	4.12	4.86	3.39	7.86	8.82	8.08	0.89	0.98	1.66	1.86	0.71	1.50	0.95	1.06	1.02
Verdin	2.85	4.48	3.35	3.47	4.07	4.30	3.63	2.99	3.83	2.27	1.85	2.41	3.12	3.18	2.40	1.97	1.61	1.40
Common Yellowthroat	5.97	6.69	7.36	7.85	6.84	6.85	5.50	5.46	5.84	0.04		0.03	0.15		0.07	0.19	0.11	0.10
Black-tailed Gnatcatcher	3.67	5.12	2.54	2.90	3.51	3.66	3.61	2.69	2.84	2.72	3.65	2.00	2.90	3.26	2.80	1.58	1.82	1.22
American Pipit	X	0.08	0.30	X	2.54	0.34	0.66	0.14	0.03	2.90	5.30	2.29	8.53	5.00	6.38	7.03	3.02	2.30
Gambel's Quail (C)	2.34	1.33	1.17	1.17	3.07	7.34	3.61	3.83	5.16	0.48	0.59	0.38	1.19	0.92	4.64	2.23	1.31	1.38
Black Phoebe	1.72	2.02	1.65	1.59	1.58	1.56	1.99	1.08	0.94	3.76	4.45	2.76	3.86	2.39	2.93	1.95	1.78	1.70
Brown-headed Cowbird	5.35	6.17	6.15	6.64	4.54	4.91	2.59	1.84	1.63		X		0.03			0.02		
Ruby-crowned Kinglet	0.57	0.64	0.41	0.31	0.14	0.09	0.22	0.14	0.27	7.70	6.07	4.73	2.71	3.11	2.50	1.33	1.46	0.94
Lucy's Warbler (C)	8.04	5.28	4.12	4.28	2.63	2.68	1.40	1.45	1.51									
Orange-crowned Warbler	0.26	0.28	0.30	0.10	0.23	0.34	0.12	0.18	0.41	2.19	1.55	2.00	2.66	1.47	2.34	0.47	1.61	2.19
Mourning Dove	7.79	2.63	2.45	1.93	2.89	3.43	1.37	0.62	1.35	0.22	X	0.20	0.06	0.13	X	0.14	0.09	0.01
Yellow-breasted Chat	5.02	4.62	3.58	4.81	1.61	2.43	1.22	1.70	0.80			0.03						
House Finch	0.93	0.80	0.70	0.74	2.91	1.25	0.40	0.30	0.32	0.26	1.49	1.68	1.23	0.68	2.12	0.56	1.82	0.80

Species (Conservation Status)	Breeding Season/Year									Non-Breeding Season/Year								
	1	2	3	4	5	6	10	11	12	1	2	3	4	5	6	10	11	12
Yellow Warbler (B)	1.68	1.55	2.18	3.88	3.23	3.53	1.24	1.70	1.54							0.03		0.01
Crissal Thrasher	1.11	1.27	0.43	0.71	1.12	1.08	1.04	0.80	1.04	1.86	0.69	0.61	1.00	1.16	1.16	0.44	0.78	0.69
Blue Grosbeak (A)	3.26	2.63	2.59	2.43	1.53	1.48	1.15	1.17	1.51						0.02			
Yellow-headed Blackbird	1.44	0.14	0.08	0.29	0.46	0.16	2.87	0.74	0.54	0.04			0.21	X			0.02	X
Killdeer	1.68	0.75	0.30	0.31	1.08	0.41	1.28	0.74	0.40	0.82	0.30	0.15	0.67	0.11	0.05	0.69	0.41	0.16
Say's Phoebe	0.31	0.55	0.38	0.76	0.78	0.52	0.54	0.19	0.20	0.45	0.38	0.15	0.78	1.34	0.58	0.33	0.63	0.53
Greater Roadrunner	0.64	0.72	0.76	0.45	0.47	0.69	1.01	0.82	1.16	0.33	0.07	0.12	0.25	0.11	0.05	0.14	0.29	0.37
Lesser Goldfinch	0.05	0.33	0.19	0.10	0.32	1.38	0.20	0.05	0.10	0.15	0.08	0.15	0.55	0.37	1.85	0.09	0.11	0.10
Brewer's Sparrow (C)		0.50	1.32	0.21	0.42	0.92	0.10	0.02	0.03	0.22			0.30	0.24		0.02	0.09	X
Northern Flicker	X		0.05	0.07		0.03	0.02	0.05	0.07	0.71	0.88	1.34	1.24	0.61	0.90	0.67	0.65	0.46
Eared Grebe (C)	0.03		0.38		0.06		X	2.29	3.38						X	0.05	X	0.04
Western Kingbird	0.33	0.53	0.94	0.52	0.64	0.39	1.35	0.50	1.21									
Dark-eyed Junco	0.08			0.21			0.04			0.07	0.42	2.96	0.90	1.42	0.32	0.12	0.33	0.08
Wilson's Warbler	1.53	1.27	1.00	0.38	0.66	0.29	1.28	0.07	0.17	0.26							0.02	
Northern Pintail (C)							X		X	X			X	X	0.10	1.47	1.01	0.92
Lincoln's Sparrow	0.09	0.06	0.27	0.05	0.05	0.03	0.04	0.11	0.17	1.41	0.15	0.58	0.45	0.32	0.37	0.27	0.18	0.28
Northern Shoveler					0.05		0.08	0.05	0.07	0.15					X	0.22	0.51	1.08
Least Sandpiper (C)					0.81	0.52	0.30	0.14	X					0.89	0.02	1.20	X	0.04
Bushtit	0.06					0.06				1.23	0.76	0.09		1.92				
Northern Rough-winged Swallow	0.17	0.30	0.22	1.38	0.49	X	0.12	0.39	0.32	X			X	X	X	X	X	X
Ring-billed Gull	X	X		X	X	X	0.02	X	X	X	1.45	1.95	X	0.05	X	0.06	0.32	0.01
Barn Swallow		X	2.02	X	X	X	X	X	X			X	X	X	X		X	X
Cliff Swallow	X	X	0.16	1.02	0.02	X	X	X	X			X	X	0.03				X

**Table 9.** Relative frequencies (percent of survey points with detections on any of 26 surveys) of bird species in each of the nine years of surveys in the Las Vegas Wash (February 2005 – August 2017). Number of survey points increased from 29 to 31 after the second year (see Methods; Table 1). Birds recorded incidentally, as fly-overs, or > 100 m from the survey point are excluded. Species listed in descending order of average frequency.

Species (Conservation Status)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 11	Year 12	Average Frequency
Yellow-rumped Warbler	100	97	100	97	100	90	97	100	97	97
Abert's Towhee (C)	100	100	97	97	97	94	90	97	97	96
Black Phoebe	100	100	100	94	94	90	100	97	94	96
White-crowned Sparrow	93	100	97	97	97	84	94	97	100	95
Song Sparrow	100	97	97	97	100	87	87	90	90	94
Verdin	93	97	90	97	100	87	90	94	94	93
Bewick's Wren	97	100	90	97	97	90	84	77	77	90
Black-tailed Gnatcatcher	93	97	94	90	100	81	84	84	90	90
Common Yellowthroat	93	90	94	90	90	81	90	90	94	90
Brown-headed Cowbird	97	97	94	94	94	84	77	84	84	89
Red-winged Blackbird	72	86	97	94	94	84	81	90	81	86
Ruby-crowned Kinglet	100	97	94	87	90	74	68	71	74	84
Marsh Wren	93	83	81	87	81	81	77	87	74	83
Orange-crowned Warbler	93	83	77	87	74	81	68	90	94	83
Blue Grosbeak (A)	97	86	81	84	74	68	68	61	65	76
Crissal Thrasher	90	83	77	77	90	77	61	61	68	76
American Coot	59	69	74	74	77	74	84	77	87	75
Gambel's Quail (C)	76	52	48	71	58	84	84	84	84	71
Greater Roadrunner	66	66	68	71	65	58	77	68	90	70
Great-tailed Grackle	34	41	55	71	84	68	90	100	84	70
Lucy's Warbler (C)	93	90	77	84	74	68	55	42	48	70
Mourning Dove	90	76	87	71	84	84	48	52	42	70
Mallard	31	45	81	68	81	71	81	77	84	69
Yellow-breasted Chat	90	76	77	84	61	65	45	58	45	67
Say's Phoebe	52	48	35	68	97	77	68	71	81	66
House Finch	59	76	68	68	68	68	42	68	61	64
Yellow Warbler (B)	59	48	55	61	74	68	55	74	84	64



Species (Conservation Status)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 11	Year 12	Average Frequency
American Pipit	59	62	77	61	52	65	52	45	68	60
Northern Flicker	59	66	65	77	55	52	58	58	45	59
Wilson's Warbler	76	66	65	48	35	29	58	23	26	47
Gadwall	31	34	42	48	55	52	45	48	58	46
Great Blue Heron	24	41	32	29	42	42	61	65	77	46
Western Kingbird	24	17	55	32	45	39	87	42	68	45
Killdeer	55	55	29	48	32	19	55	48	45	43
Lincoln's Sparrow	66	28	61	39	29	29	35	39	58	43
Loggerhead Shrike (D)	52	31	13	35	58	35	48	65	48	43
Brewer's Sparrow (C)	21	28	42	58	65	55	19	39	16	38
Spotted Sandpiper	31	34	10	32	32	29	45	55	52	36
Green Heron	21	55	32	29	19	29	52	29	35	34
Belted Kingfisher	38	28	26	29	32	23	35	39	48	33
Lesser Goldfinch	24	34	32	39	45	48	39	19	13	33
Black-chinned Hummingbird	17	38	35	32	32	32	32	39	29	32
Dark-eyed Junco	21	24	61	45	39	29	23	29	13	32
Northern Mockingbird	7	31	23	13	29	19	32	52	68	30
Blue-gray Gnatcatcher	52	62	29	58	10	19	23	0	3	28
American Wigeon	0	3	19	13	13	13	42	68	55	25
Greater Yellowlegs	31	10	13	16	13	19	32	52	19	23
Common Gallinule	10	10	16	13	19	23	29	26	52	22
Double-crested Cormorant	3	14	35	23	19	3	29	26	42	22
Anna's Hummingbird	24	3	3	10	16	6	35	39	48	21
White-winged Dove	45	21	39	29	16	23	13	3	0	21
Northern Rough-winged Swallow	21	21	13	45	19	16	13	23	13	20
Pied-billed Grebe	7	17	26	19	16	13	16	32	35	20
Savannah Sparrow	14	0	19	16	19	32	19	29	32	20
Bullock's Oriole	3	21	16	0	13	23	19	35	39	19
Cooper's Hawk	10	14	16	10	10	26	26	32	29	19
Western Wood-Pewee	10	17	13	26	6	29	42	13	10	18

Species (Conservation Status)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 11	Year 12	Average Frequency
Yellow-headed Blackbird	10	7	10	16	10	6	35	32	26	17
Costa's Hummingbird (C)	14	17	26	16	6	23	19	16	6	16
Snowy Egret (C)	7	3	23	6	13	13	16	29	32	16
Great Egret	14	7	13	6	13	16	13	26	26	15
Rock Wren	14	14	10	16	23	29	6	13	6	15
Spotted Towhee	17	14	16	39	13	10	16	10	0	15
Black-crowned Night-Heron	10	10	13	3	3	10	23	19	35	14
Red-tailed Hawk	14	7	13	10	6	16	23	19	16	14
Sharp-shinned Hawk	24	7	10	19	23	13	13	10	10	14
Northern Harrier	7	14	35	19	6	0	10	13	13	13
Phainopepla (A)	21	31	6	23	16	6	3	10	0	13
Warbling Vireo	17	14	10	10	19	6	10	19	16	13
American Kestrel	14	7	6	3	6	13	23	26	13	12
Common Merganser	7	3	10	6	6	3	16	19	35	12
Eared Grebe (C)	3	0	3	0	6	0	6	42	45	12
Indigo Bunting	0	0	0	0	16	10	16	26	39	12
Virginia Rail	14	7	6	6	6	23	10	16	16	12
Western Meadowlark	0	7	0	3	10	13	19	19	39	12
Green-winged Teal	0	17	13	6	6	6	19	19	10	11
Lazuli Bunting	17	24	6	29	3	0	6	6	3	11
Osprey	3	3	6	3	10	6	29	19	19	11
Sora	3	7	6	10	3	10	13	19	29	11
Bushtit	31	21	6	3	16	10	0	0	0	10
Chipping Sparrow	17	7	16	10	23	10	0	3	3	10
Ash-throated Flycatcher	14	3	16	3	0	13	13	10	10	9
Canada Goose	0	0	10	0	3	10	23	16	23	9
Ladder-backed Woodpecker	3	0	0	3	6	23	10	23	10	9
White-faced Ibis (C)	7	7	0	3	6	6	16	16	23	9
American Robin	7	3	16	13	6	3	6	10	10	8
Bell's Vireo (ABC)	21	0	10	0	0	6	13	16	6	8

Species (Conservation Status)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 11	Year 12	Average Frequency
Black-headed Grosbeak	14	14	6	0	6	13	3	6	10	8
Bufflehead	0	0	6	3	3	3	19	13	23	8
Hermit Thrush	14	28	3	3	3	0	3	6	0	7
Northern Pintail (C)	0	3	0	0	0	3	23	16	19	7
Western Tanager	10	3	6	3	10	10	3	13	6	7
Cinnamon Teal (C)	3	0	0	3	10	0	19	13	3	6
Great Horned Owl	0	3	3	0	10	19	3	6	3	5
House Wren	7	3	0	0	3	0	3	13	16	5
Least Bittern (BC)	3	3	6	6	0	6	6	6	6	5
Nashville Warbler	0	0	3	6	3	6	10	10	10	5
Red-shouldered Hawk	0	0	0	0	0	3	6	16	16	5
Ring-billed Gull	0	3	16	0	3	0	6	13	3	5
Western Flycatcher (Unidentified)	3	7	13	3	0	0	16	0	6	5
American Avocet (C)	7	0	0	0	6	0	13	3	3	4
Common Goldeneye	0	0	6	6	3	0	6	6	10	4
Common Raven	0	0	10	0	3	0	6	0	13	4
Dusky Flycatcher	3	7	23	0	3	0	3	0	0	4
Horned Lark (D)	3	0	10	6	3	3	6	0	0	4
Lark Sparrow	0	0	6	3	3	6	10	3	3	4
Least Sandpiper (C)	0	0	0	0	3	10	19	3	3	4
MacGillivray's Warbler	3	3	3	0	0	10	3	0	16	4
Northern Shoveler	3	3	0	0	6	0	6	13	6	4
Pine Siskin (D)	7	0	6	0	0	13	0	10	0	4
Ring-necked Duck	0	0	0	0	0	0	6	19	6	4
American White Pelican (C)	0	0	0	3	0	3	10	10	3	3
Barn Owl	10	7	3	0	3	0	0	0	0	3
Black-necked Stilt (C)	3	0	0	0	3	0	10	3	6	3
Cliff Swallow	0	0	6	10	10	0	0	0	0	3
Eurasian Collared-Dove	0	0	0	0	3	0	10	6	6	3
Golden-crowned Kinglet	3	0	10	3	3	3	0	0	0	3

Species (Conservation Status)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 11	Year 12	Average Frequency
Gray Flycatcher (C)	3	0	6	0	6	3	0	6	3	3
Hooded Merganser	0	0	0	0	0	0	3	13	10	3
Horned Grebe	0	0	0	0	0	0	6	10	6	3
Olive-sided Flycatcher (CDE)	3	0	3	0	0	3	3	3	6	3
Pacific Wren	7	3	0	0	0	3	3	3	6	3
Red-naped Sapsucker	7	10	3	0	0	0	3	3	0	3
Solitary Vireo (Unidentified)	0	3	3	16	0	0	0	0	0	3
Townsend's Warbler	0	0	0	0	0	13	13	0	0	3
Western Sandpiper (C)	10	3	0	0	6	3	3	0	0	3
Brewer's Blackbird (D)	0	0	0	3	10	3	0	0	0	2
Cedar Waxwing	10	3	0	0	0	0	0	0	0	2
Lesser Nighthawk	0	3	0	0	3	0	3	3	3	2
Lesser Scaup (C)	0	0	0	0	0	0	3	3	10	2
Long-billed Dowitcher (C)	0	3	0	0	0	0	6	6	3	2
Neotropic Cormorant	0	0	0	0	0	0	6	10	0	2
Red-breasted Nuthatch	0	0	3	3	0	0	3	6	0	2
Wilson's Snipe	0	0	0	0	3	0	3	10	0	2
American Bittern	0	3	0	0	3	0	0	0	0	1
American Goldfinch	0	0	0	0	6	0	3	0	0	1
Barn Swallow	0	0	3	3	0	0	0	0	0	1
Black-throated Gray Warbler	0	0	0	0	3	0	0	0	3	1
Black-throated Sparrow	0	3	0	0	0	6	0	0	0	1
Brown-crested Flycatcher	7	0	0	0	0	0	0	0	0	1
Cactus Wren	0	0	0	0	0	0	0	6	0	1
Canyon Wren	3	3	0	0	0	0	0	0	0	1
Eastern Kingbird	0	0	0	0	0	3	0	3	3	1
European Starling	0	0	0	0	0	3	0	3	0	1
Green-tailed Towhee (C)	0	0	0	3	3	0	0	0	3	1
Hooded Oriole	0	0	6	0	0	0	0	0	6	1
House Sparrow	3	0	0	0	0	0	3	0	0	1

Species (Conservation Status)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 11	Year 12	Average Frequency
Lesser Yellowlegs	0	0	0	0	3	0	6	0	0	1
Merlin	0	3	0	0	3	0	0	3	0	1
Peregrine Falcon (C)	0	0	0	3	3	0	0	0	0	1
Plumbeous Vireo	0	0	0	3	0	0	3	3	0	1
Redhead (C)	0	0	0	3	0	0	3	0	0	1
Rock Pigeon	0	0	3	3	0	0	0	0	0	1
Ruddy Duck	0	0	0	0	0	0	6	6	0	1
Rufous Hummingbird (CE)	0	0	0	0	0	6	0	0	0	1
Sagebrush Sparrow (C)	0	0	0	0	0	0	0	3	6	1
Tree Swallow	0	0	6	3	0	0	0	0	0	1
Turkey Vulture	0	0	0	3	0	0	0	0	3	1
Vesper Sparrow	0	0	0	0	3	6	3	0	0	1
Violet-green Swallow	0	0	3	6	3	0	0	0	0	1
Western Grebe (C)	0	0	3	0	0	0	6	3	0	1
Willow Flycatcher (ABC)	0	0	0	3	0	3	0	0	0	1
Black-and-white Warbler	0	0	0	0	0	0	0	0	3	0
Blackpoll Warbler	0	0	0	0	0	0	0	3	0	0
Blue-winged Teal	0	0	0	0	0	0	0	3	0	0
Broad-tailed Hummingbird	0	0	0	0	0	3	0	0	0	0
Brown Creeper	0	0	0	0	0	0	3	0	0	0
Canyon Towhee	0	3	0	0	0	0	0	0	0	0
Cattle Egret	0	0	0	0	0	0	0	3	0	0
Dunlin	0	0	0	0	0	0	3	0	0	0
Greater White-fronted Goose	0	0	0	0	0	0	0	0	3	0
Hairy Woodpecker	0	3	0	0	0	0	0	0	0	0
Hammond's Flycatcher	0	0	0	0	0	0	3	0	0	0
Mountain Bluebird	0	0	0	3	0	0	0	0	0	0
Ovenbird	0	0	0	0	0	3	0	0	0	0
Pectoral Sandpiper	0	0	0	0	3	0	0	0	0	0
Prairie Falcon (C)	0	0	0	0	3	0	0	0	0	0

Species (Conservation Status)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 11	Year 12	Average Frequency
Red Crossbill	0	0	0	0	0	0	0	3	0	0
Ross's Goose	0	0	0	0	0	0	0	0	3	0
Rufous-crowned Sparrow	0	0	3	0	0	0	0	0	0	0
Scissor-tailed Flycatcher	0	0	0	0	0	3	0	0	0	0
Semipalmated Plover	3	0	0	0	0	0	0	0	0	0
Semipalmated Sandpiper	0	3	0	0	0	0	0	0	0	0
Snow Goose	0	0	0	0	0	0	0	3	0	0
Summer Tanager	0	0	0	0	0	0	3	0	0	0
Virginia's Warbler	0	0	3	0	0	0	0	0	0	0
Western Bluebird	3	0	0	0	0	0	0	0	0	0
Willet (C)	0	0	0	0	0	0	0	3	0	0
Wood Duck	0	0	0	3	0	0	0	0	0	0

**Table 10.** Estimated densities (birds per 40 ha) and abundance ranks for Nevada Bird Count (NBC) Mojave lowland riparian transects within Clark County (2005-2014) compared to Las Vegas Wash breeding season data (2005-2017). Species are listed in descending order of abundance from the NBC data, and include the 50 most abundant species from each of the datasets.

Species (Conservation Status)	NBC		Wash	
	Abundance	Rank	Breeding	Rank
Gambel's Quail (C)	7.68	1	5.18	10
Abert's Towhee (C)	7.49	2	11.22	2
Lucy's Warbler (C)	6.14	3	5	12
Mourning Dove	4.96	4	3.89	16
Brown-headed Cowbird	4.58	5	6.37	7
Yellow Warbler (B)	4.2	6	3.41	17
Verdin	3.97	7	5.63	9
House Finch	3.93	8	1.35	23
Red-winged Blackbird	3.88	9	15.96	1
Song Sparrow	3.62	10	10.94	3
Bewick's Wren	3.59	11	5.76	8
Yellow-breasted Chat	3.19	12	4.11	15
Phainopepla (A)	2.82	13	0	141
Northern Rough-winged Swallow	2.42	14	0.58	37
Black-tailed Gnatcatcher	2.24	15	5.16	11
Cliff Swallow	2.17	16	0.19	60
Black-throated Sparrow	2.14	17	0.03	105
Common Yellowthroat	2.05	18	9.87	4
Ash-throated Flycatcher	2	19	0.08	79
Crissal Thrasher	1.37	20	1.48	22
Blue Grosbeak (A)	1.32	21	2.91	18
Blue-gray Gnatcatcher	1.1	22	0.24	53
Bell's Vireo (ABC)	1.01	23	0.13	71
Lesser Goldfinch	0.98	24	0.43	44
Spotted Towhee	0.97	25	0.02	111
Great-tailed Grackle	0.96	26	8.07	5
Mallard	0.83	27	4.35	14
Say's Phoebe	0.78	28	0.7	32
Northern Mockingbird	0.75	29	0.45	43
Bullock's Oriole	0.74	30	0.31	48
Brewer's Sparrow (C)	0.7	31	0.53	38
American Coot	0.64	32	6.9	6

Species (Conservation Status)	NBC		Wash	
	Abundance	Rank	Breeding	Rank
White-winged Dove	0.62	33	0.46	42
Wilson's Warbler	0.6	34	1.07	30
Rock Wren	0.56	35	0.09	74
Black-chinned Hummingbird	0.54	36	0.69	34
Killdeer	0.53	37	1.19	27
White-crowned Sparrow	0.53	38	0.77	31
Western Scrub-Jay (Unidentified)	0.53	39		
White-faced Ibis (C)	0.52	40	0.26	52
Western Kingbird	0.52	41	1.15	29
Yellow-rumped Warbler	0.51	42	1.25	25
Lazuli Bunting	0.5	43	0.07	83
House Sparrow	0.49	44	0	151
Eurasian Collared-Dove	0.45	45	0.03	103
Western Meadowlark	0.44	46	0.02	109
Cactus Wren	0.43	47		
Black Phoebe	0.43	48	2.36	20
Canyon Wren	0.39	49	0	148
Common Raven	0.39	50	0.03	101
Marsh Wren	0.39		4.8	13
Greater Roadrunner	0.31		1.19	28
Anna's Hummingbird	0.24		0.47	40
Loggerhead Shrike (D)	0.18		0.31	47
Spotted Sandpiper	0.18		0.58	36
Yellow-headed Blackbird	0.16		1.22	26
Orange-crowned Warbler	0.1		0.38	45
Ruby-crowned Kinglet	0.06		0.46	41
Great Blue Heron	0.05		0.65	35
Green Heron	0.05		0.52	39
Eared Grebe (C)	0.03		1.34	24
Barn Swallow	0.01		0.29	50
Least Sandpiper (C)	0		0.3	49
American Pipit			0.69	33
American Wigeon			2.42	19
Common Gallinule			0.33	46
Gadwall			1.95	21



**Table 11.** Summary trends from negative binomial regression statistics for 20 species that were detected within 100 m of survey points at the Las Vegas Wash during at least 40 (of a total of 234) survey visits between February 2005 and August 2017. Species listed in descending order of detections. Dark gray shading indicates significantly negative trends (six species), and light gray shading indicates significantly positive trends (eight species).

Species	No. of Visits with Detections	Total No. of Birds Detected	Overall Density Estimate (Birds/40 ha)	Incident Rate Ratio	P
Red-winged Blackbird	219	6218	11.16	1.08	<0.001
Abert's Towhee	234	6090	11.00	0.95	<0.001
Yellow-rumped Warbler	150	5733	10.19	1.04	0.093
Mallard	201	5471	9.70	1.27	<0.001
Song Sparrow	234	4929	8.96	0.94	<0.001
Gadwall	115	4639	8.22	1.40	<0.001
Marsh Wren	232	4169	7.47	1.01	0.271
White-crowned Sparrow	144	3542	6.32	1.04	0.136
Bewick's Wren	234	3147	5.69	0.94	<0.001
Verdin	234	2850	5.12	1.04	<0.001
Common Yellowthroat	141	2781	5.02	1.02	0.261
Black-tailed Gnatcatcher	233	2763	4.97	1.02	0.009
American Pipit	107	2659	4.72	1.10	0.008
Gambel's Quail	194	2327	4.17	1.18	<0.001
Ruby-crowned Kinglet	139	1547	2.79	0.93	<0.001
Lucy's Warbler	106	1272	2.34	0.90	<0.001
Orange-crowned Warbler	155	1206	2.15	1.07	0.002
Yellow-breasted Chat	94	1073	1.95	0.90	<0.001
Yellow Warbler	103	943	1.70	1.01	0.605
Blue Grosbeak	88	789	1.43	0.96	0.138

**Table 12.** Results of Anova analysis evaluating differences in vegetation measurements among years of riparian bird monitoring along the Las Vegas Wash.

<b>Habitat Variable</b>	<b>F-statistic</b>	<b>P</b>	<b>DF</b>
<b><i>Overall Tree Cover</i></b>	<b>6.16</b>	<b>&lt;0.001</b>	<b>8, 242</b>
Native Riparian Trees (not including Mesquites)	1.37	0.210	8, 242
<b><i>Tamarisk</i></b>	<b>12.55</b>	<b>&lt;0.001</b>	<b>8, 242</b>
Cottonwood Trees	0.22	0.988	8, 242
Goodding's Willows	0.28	0.973	8, 242
<b><i>Sandbar Willows</i></b>	<b>3.00</b>	<b>0.003</b>	<b>8, 242</b>
Mesquite Trees	1.31	0.239	8, 242
Native Riparian Tree Proportion (not including Mesquites)	1.00	0.435	8, 214
<b><i>Mesquite Proportion</i></b>	<b>2.81</b>	<b>0.006</b>	<b>8, 214</b>
Perennial Height	1.81	0.076	8, 238
Overall Shrub Cover	1.78	0.081	8, 242
Riparian Shrub Cover	0.18	0.993	8, 242
<b><i>Upland Shrub Cover</i></b>	<b>2.30</b>	<b>0.022</b>	<b>8, 242</b>
<b><i>Forb Cover</i></b>	<b>4.32</b>	<b>&lt;0.001</b>	<b>8, 242</b>
<b><i>Grass Cover</i></b>	<b>2.30</b>	<b>0.021</b>	<b>8, 242</b>
Cattail Cover	1.04	0.406	8, 242
Perennial Structure	1.70	0.099	8, 242
<b><i>0-2 m</i></b>	<b>2.34</b>	<b>0.019</b>	<b>8, 242</b>
<b><i>2-4 m</i></b>	<b>2.60</b>	<b>0.010</b>	<b>8, 242</b>
<b><i>4-6 m</i></b>	<b>3.22</b>	<b>0.002</b>	<b>8, 242</b>
6-8 m	0.67	0.721	8, 242
8-10 m	0.99	0.447	8, 242
<b><i>Horizontal Heterogeneity</i></b>	<b>3.18</b>	<b>0.002</b>	<b>8, 242</b>