



BIRD POPULATION AND VEGETATION TRENDS AT THE LAS VEGAS WASH, 2005-2019



Prepared by:

Great Basin Bird Observatory
1755 E. Plumb Lane #256
Reno, NV 89502

Prepared for:

Las Vegas Wash Coordination Committee
Southern Nevada Water Authority
P.O. Box 99956
Las Vegas, NV 89193-9956

(SNWA Contract No. 01-3631-19100-046-0508)

Annual Report, 23 November 2020

Contents

Abstract	2
Acknowledgments.....	3
Introduction.....	3
Methods.....	4
Study Area	4
Bird Data and Analyses	4
Data Collection Methods	4
Data Analysis	5
Vegetation Measurements.....	7
Data Collection	7
Data Analysis	7
Results.....	8
Species List	8
Species Richness and Total Abundance	9
Species-Specific Abundances	10
Overall Abundance Patterns	10
Breeding Season Species Abundances in Relation to Regional Abundances.....	11
Non-Breeding Season Species Abundances	11
Trends in Species Abundances	12
Vegetation Measurements.....	13
Tree Cover	13
Other Cover Types.....	13
Perennial Plant Height and Vertical Structure	13
Horizontal Perennial Plant Structure	14
Discussion	14
Literature Cited	16
Figures.....	18
Tables.....	40

Cover photo: Las Vegas Wash #30, 18 August 2019. Photo by Ned Bohman.

Abstract

In 2019, Great Basin Bird Observatory completed the 11th year of bird surveys and vegetation assessments along an 8.7-km stretch of the Las Vegas Wash (hereafter: Wash). This effort, conducted on 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 increase native habitat in the Wash. By the fall of 2019, the LVWCC had constructed all 21 planned weirs, greatly reduced tamarisk, and revegetated over 200 ha with native plants.

In this report, we summarize bird species occurrence, trends in richness and abundance, and changes in vegetation over the 14 years of the project. In each of the 11 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 229 bird species have been recorded, constituting approximately 47% of the total bird species richness recorded in Nevada. Of these, 55 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 five most recent years of Wash surveys. Species-specific trends were mixed with six species showing significant declines and 11 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.

Over the 14 years of the project, tree cover has significantly declined, primarily because of the removal of the non-native tamarisk along the Wash. As a result of this large-scale tree removal, vegetation structure under 6 m has declined over the course of the project. 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 since the first six years of the project.

In this report, we note a marked shift in bird recovery along the Wash in the past five years (2014-2019) 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. While major weir construction along the Wash is complete, a stabilization facilities assessment concluded that approximately 26 ha of marsh and riparian habitat would need to be cleared from the channel to ensure facilities function as designed. We provided revegetation recommendations to help protect bird habitat along the Wash while balancing the needs of weir maintenance and recommend continuing the biweekly point counts and detailed annual vegetation monitoring to keep assessing program impacts on the Wash bird community.

Acknowledgments

This study was funded by the Southern Nevada Water Authority through a grant from the Bureau of Reclamation. Thanks to all of our field surveyors of the Nevada Bird Count program who participated in the surveys, particularly David Henderson, Dorothy Crowe, Kelly Colegrove, and Ned Bohman. Many thanks to Debbie Van Dooremolen of the Southern Nevada Water Authority for project administration, coordination, and support. We also thank Debbie, Keiba Crear, and the members of the Research and Environmental Monitoring Study Team for reviewing this document and the Las Vegas Wash Coordination Committee for their support of this project.

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 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 on 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 11 years of surveys: the four years conducted by the museum, and the seven years conducted by the Great Basin Bird Observatory (GBBO; 2009-2011 and 2014-2019, 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 13th year of the project were reported in GBBO (2019a).

Methods

Study Area

The study area encompasses 8.7 km of the Wash from the Upper Diversion Weir to just downstream of the Powerline Crossing Weir (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 evenly-spaced 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 site's upland vegetation falls into the Mojave scrub landcover type, which is dominated by creosote bush (*Larrea tridentata*). Common reed (*Phragmites australis*) is extensive in riparian and wetland areas, with native, non-native, and hybrid genotypes present. Early in the project, the riparian area was dominated by the invasive, non-native tamarisk, but due to vegetation treatments, this cover type has significantly declined. Native vegetation 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 have now become the most abundant tree along the Wash (GBBO 2018).

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 30 ha of revegetation had been installed. Mid-way through the study period (Year 6), 12 weirs and 113 ha of revegetation were in place. By the fall of 2019, all 21 planned weirs were constructed and over 200 ha 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 13, 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 survey points had to be replaced due to 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. In 2018, construction at one survey point (#17) made surveying unsafe, and this point was removed from the survey rotation. In late June 2018, a new survey point (#34) was added to the survey schedule, covering a newly planted riparian revegetation site next to the recently completed Tropicana Weir.

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 frequency. 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 five 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 five years between 5 September 2014 and 29 August 2019. The few seventh-year surveys conducted in 2011 (1 February through 24 April) were not included in most of our analyses, but they were included in a 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 29 August 2019, 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 “flyover” 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 the 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 flyover 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. Flyovers 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 flyovers 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 terms of habitat types and species composition present.

To be able to compare the Wash data to other regional abundance data (see below), 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 by survey visit, and an ANOVA on total richness by stage of project, early (Years 1-6) and late (Years 10-14). For all statistical analysis results in this report, $P < 0.05$ was used as the significance level, unless otherwise noted.

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 exclude nesting of most resident species. Average species 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 represents the percentage of Wash survey points at which the species was detected at any point during a year. This metric provides a measure of how widespread a species is within the study area. Partway through Year 13, one point was dropped and another point was added; this resulted in 32 points used for the frequency calculations, rather than the usual 31 (past point changes have either been close to changes in survey-year, or have been relatively minor shifts in location to accommodate construction).

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 (7,853 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. No similar datasets were available for the non-breeding season, preventing us from making regional comparisons for that period.

Finally, to determine whether population trends over time were significant, we performed negative-binomial regression analyses for count data, using year as a predictor and number of points per visit as an exposure variable. The 20 species for which we performed population analyses were all abundant along the Wash, with estimated densities of at least one detection per 40 ha; represented conservation priority or indicator species for the project (see earlier GBBO reports); and comprised a balanced mix of species representing different seasonal bird use of the Wash.

Vegetation Measurements

Data Collection

Vegetation data were collected at each bird survey point along the Wash during each fall in 2005-2010 and in 2014-2018, 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. (Some points were unable to have all three transects, given their proximity to the Wash.) Data were collected every 2 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 27 points surveyed consistently over the study period. Cover types included in the analyses were categorized as trees, shrubs, grasses, forbs, and cattails. Note that shrub results may differ from past years, since the emergent grass *Phragmites* had been included with riparian shrubs, to

maintain continuity with original reporting. *Phragmites* was separated this year to gain a better understanding of the vegetation on the Wash. Because some vegetation transects ended in the channel, emergent vegetation may be underestimated overall due to its naturally-clustered distribution along the channel shores. ANOVA was used to investigate vegetation cover type differences among years; where significant differences were found, unpaired two-sample t-tests were conducted to compare means of the early (2005-2010) and late (2014-2018) stages of the project. While bird data collected for this report extended into August 2019, the vegetation data analyzed for the most recent project year were collected in the fall of 2018.

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 (*Senegalia greggii*), Fremont cottonwood, ash (*Fraxinus velutina*), honey mesquite, screwbean mesquite, Goodding's willow, sandbar willow, and tamarisk. Catclaw and ash are infrequently recorded, and therefore not separately analyzed.

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 and, if significant, between-stage 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 11 years of data collected, with values increasing as vegetation becomes more evenly distributed.

Results

Species List

Between 12 February 2005 and 29 August 2019, 229 bird species were observed during survey visits to the Wash (Table 2); this total does not include a likely Cackling Goose that was excluded due to the possibility of it being a Lesser Canada Goose. In the 14th year of the project (2018-2019), nine new species were detected for the first time: Bell's Sparrow, Brown Thrasher, Cassin's Kingbird, Eastern Phoebe, Golden Eagle, Gray Catbird, Groove-billed Ani, Swainson's Thrush, and White-throated Sparrow (all scientific names in Table 2). Fifty-seven species that had been detected at least once during previous years' surveys were not found in 2018-2019, including such species as Brewer's Blackbird, Bushtit, Canyon Wren, Horned Lark, Nashville Warbler, Red-naped Sapsucker, Swainson's Hawk, and Western Flycatcher.

Of the 229 species observed during the 11 years of surveys, 194 were recorded during the breeding season (15 March - 31 August), and 171 were recorded during the non-breeding season (1 October - 31 January). While most species were recorded during at least one of the transitional seasons (186), only a small number of species (9) 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-five species recorded at 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-seven of the priority species were recorded during the non-breeding season, and 46 were recorded during the breeding season. Forty-four priority species were detected during the transitional periods, but only four of these were detected exclusively in the transitional seasons.

No new species were confirmed as breeders in 2018-2019, resulting in a total of 45 species confirmed to be nesting at the Wash based primarily on breeding evidence gathered in 2009-2019 (an incidental record of breeding American Avocets, and adult Green Herons and Hooded Orioles with young were not included in the previous report). Eleven conservation priority species were confirmed to nest at the Wash. The full list of birds confirmed as breeders is as follows (conservation priority species in bold):

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

Species Richness and Total Abundance

Species richness varied seasonally throughout the study period. Over the whole study period, it was lowest in June and peaked during September, likely due to migration and juvenile dispersal (Figure 2). However, richness patterns changed after the first six years of the project. In the early years, richness typically was lowest during the non-breeding season/winter transition, with a second shallower dip during June, and it was highest during the late breeding season (August) and fall transition. Over the five most recent years of the study, the lowest species richness was

in June/July, with the peak in August/September continued as in previous years, but then after a small dip, richness increased again and remained high over much of December through April (Figure 2, Table 3). Species richness was similar among the first six years, showing only a slight overall increase, but it was significantly higher in Years 10 through 14 compared to previous years (ANOVA, $R^2 = 0.53$; $P < 0.001$; Figure 3, Table 3).

Total bird abundance (bird detections per 40 ha) also varied seasonally, and the pattern changed over time (Figure 4). Over all project years, total abundance was lowest during the late breeding season and fall transition, particularly in August, and highest during the non-breeding season and winter transition. During the first six project years, overall abundance showed a peak in the breeding season (May-July), as well as a larger peak during the early non-breeding season (October-November; Figure 4). Total abundance was the lowest in either February/March or August/September, generally corresponding with the winter and fall transitional periods (Table 4). In contrast, over the most recent five survey years, the lowest abundances were recorded in the breeding season and fall transition (particularly July, August, and September), and the highest abundances were found in the non-breeding and winter transition seasons (December, January, and February; Figure 4, Table 4).

Total bird abundance increased almost every year (Figure 5; Table 4) following an overall significant increasing trend ($R^2 = 0.27$; $P < 0.001$). The largest increases in abundance between the early and late stages of the project were observed during the non-breeding season and the winter transition. Total abundance decreased in Year 14 compared to recent years, and these declines are mostly attributable to a decline in abundances recorded during the non-breeding season (Table 4).

Species-Specific Abundances

Overall Abundance Patterns

For the entire study period, the ten species with the greatest absolute abundances were American Coot, Yellow-rumped Warbler, Red-winged Blackbird, Mallard, Abert's Towhee, Gadwall, Song Sparrow, American Wigeon, Marsh Wren, and White-crowned Sparrow (Table 5). In the five most recent survey years, waterbird abundances increased dramatically from the first six years, particularly American Coot, American Wigeon, Gadwall, and Mallard (Tables 5 and 6). For example, the average estimated density of American Coots over the past five years of surveys was more than six times their estimated density from the first six years of the project. Mallard, Gadwall, and American Wigeon showed similar patterns of increase in recent years but showed declines in 2018-2019, as did the American Coot. While waterbirds made substantial gains in the late project period, several species associated with riparian shrub/tree habitats declined from the early project period, including Abert's Towhee, Bewick's Wren, Lucy's Warbler, and Song Sparrow.

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), and the shifts in waterbirds and riparian shrub birds were apparent here as well. American Coots increased from

approximately 2% to 10% of the total bird abundance between the first and most recent year's surveys. Abert's Towhees, on the other hand, declined from approximately 12% to 3% of total bird abundance over the same period (Table 7).

While wetland and waterbird species were among the most abundant, they were not the most widespread along the Wash, as measured by the percent of total survey points with detections (frequency of occurrence). Yellow-rumped Warbler, Black Phoebe, Abert's Towhee, Verdin, White-crowned Sparrow, Song Sparrow, Black-tailed Gnatcatcher, Common Yellowthroat, Bewick's Wren, and Brown-headed Cowbird had the highest frequencies of occurrence along the Wash over the project period (Table 9). Changes in frequency of occurrence during the project period included Bewick's Wrens, Brown-headed Cowbirds, Ruby-crowned Kinglets, Crissal Thrashers, and Blue Grosbeaks, which were less widespread in the late, compared to the early, project period. Conversely, Great-tailed Grackle, Gambel's Quail, Greater Roadrunner, Mallard, Say's Phoebe, and Yellow Warbler were found to be more widespread along the Wash in the late, compared to the early, project period.

Breeding Season Species Abundances in Relation to Regional Abundances

During the breeding season, the ten most abundant species at the Wash over the course of the study included Red-winged Blackbird, Abert's Towhee, Song Sparrow, Common Yellowthroat, Great-tailed Grackle, American Coot, Verdin, Gambel's Quail, Brown-headed Cowbird, and Black-tailed Gnatcatcher (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, 34 (68%) were also in the 50 most abundant species in the NBC surveys (Table 10), indicating large similarities between the Wash and other, often longer-established, riparian areas of the region.

Differences in bird abundance between the Wash and other riparian areas were found for some species associated with wetland, disturbed, and riparian and riparian/upland interface habitats. Red-winged Blackbird, Song Sparrow, Common Yellowthroat, American Coot, Mallard, Gadwall, Marsh Wren, Great-tailed Grackle, Abert's Towhee, and Black-tailed Gnatcatcher were all detected in greater numbers along the Wash than in regional riparian areas. A few species were found in notably greater numbers in regional riparian areas than along the Wash, and among them were House Finch, Phainopepla, and Black-throated Sparrow (Table 10). While habitat patches containing mesquite have increased over the course of the project due to restoration action, mistletoe infestations are still lower than in longer-established mesquite stands (GBBO pers. obs.), and species such as Phainopepla are known to respond to these infestations.

Non-Breeding Season Species Abundances

During the non-breeding season, the ten most abundant species at the Wash over the entire study period included American Coot, Yellow-rumped Warbler, Gadwall, Mallard, White-crowned Sparrow, American Wigeon, American Pipit, Marsh Wren, Abert's Towhee, 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 in recent years relative to the earlier project period continues to be striking, as waterfowl have become more and more abundant. Over the first three years of the project, the most abundant species were Yellow-rumped Warbler, Abert's Towhee, Red-winged Blackbird, American Coot, White-crowned Sparrow, Song Sparrow, Ruby-crowned Kinglet, Marsh Wren, Bewick's Wren, and Black Phoebe. In the most recent three years of the project, the most abundant species were American Coot, Gadwall, Yellow-rumped Warbler, American Wigeon, Mallard, White-crowned Sparrow, American Pipit, Marsh Wren, Gambel's Quail, and Orange-crowned Warbler. Only four of the ten most abundant species are shared between the two time periods: Yellow-rumped Warbler, American Coot, White-crowned Sparrow, and Marsh Wren. Species no longer as prominent within the community are mostly riparian songbirds, such as Song Sparrows, Ruby-crowned Kinglets and Bewick's Wrens, whereas waterbirds and birds of open areas, such as Gadwall, American Wigeon, Mallard, and American Pipit, are now more prominent members of the Wash bird community.

Trends in Species Abundances

We examined trends in abundance for 20 focal species of the Wash over the 14-year survey period (Figures 6a-e, Table 11). Eleven species showed significant increases, including American Coot, Red-winged Blackbird, Yellow-rumped Warbler, Mallard, Gadwall, Verdin, Black-tailed Gnatcatcher, American Pipit, Gambel's Quail, Orange-crowned Warbler, and Crissal Thrasher. These species are associated with wetland marsh (e.g., Red-winged Blackbird), open water (e.g., American Coot, Mallard, Gadwall), and drier or more open habitat types than cottonwood/willow woodlands (e.g., Black-tailed Gnatcatcher, Verdin, American Pipit, Gambel's Quail, Crissal Thrasher). Orange-crowned Warbler migration and overwintering habitat use is variable, with western individuals primarily associated with riparian corridors (e.g., cottonwood, willow, and tamarisk) and shrubby woodland habitats (Gilbert et al. 2010). In recent years, Yellow-rumped Warblers showed an apparent increase in abundance over the course of the project, but this trend did not become statistically significant until the 2018-2019 surveys. This species' migration and overwintering habitat use is also variable; while it generally avoids arid habitats, it is found in marshes, shrublands, and open forest (Hunt and Flaspohler 1998).

Six of the species showed significant declines in abundance along the Wash, 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., Abert's Towhee, Song Sparrow, Bewick's Wren, Yellow-breasted Chat), deciduous riparian woodlands with shrub understory (Ruby-crowned Kinglet), and in woodlands mature enough to provide nest cavities or cavity-like substrates (Lucy's Warbler). These species likely responded to the initial reduction of such vegetation due to tamarisk removal; if sites recover from this disturbance and revegetated stands mature, these species may increase in abundance.

Marsh Wren, Common Yellowthroat, and Black Phoebe detections remained stable over the course of the study. Marsh Wrens and Common Yellowthroats are most often associated with wetlands, and Black Phoebe habitat use varies, but the species requires close proximity to water (Guzy and Ritchison 1999, Wolf 1997).

Vegetation Measurements

Tree Cover

Based on our measurements, overall tree cover declined significantly over the 14-year period, from 31% in the early phase to 16% in the late phase of the project ($P < 0.001$; Figure 7, Table 12). Tamarisk cover also declined significantly, from 24% in the early phase to 4% in the late phase ($P < 0.001$; Figure 8, Table 12). Native riparian tree cover (e.g., Fremont cottonwood, Goodding's willow, and sandbar willow) was statistically similar among years both collectively and individually (Figures 9-13, Table 12). Although not statistically significant, the mean cover estimate for mesquite increased from 1% in 2005 to 7% in 2018, when it was the most abundant tree along the Wash.

The proportion of overall tree cover provided by native riparian species (not including mesquites) was similar among years throughout the project period (Figure 14, Table 12). However, the proportion of total tree cover provided by mesquites significantly increased from 9% in the early stage of the project to 27% in the late stage ($P < 0.001$; Figure 15, Table 12), which mirrors the finding of a net increase as reported above.

Other Cover Types

Besides tree cover, five other cover types were also evaluated for changes at the Wash over the 14-year study period, including shrubs, forbs, grasses, *Phragmites*, and cattails (Figures 16-20, Table 12). Overall shrub cover increased significantly from 16% in the early stage of the project to 24% in the late stage ($P < 0.001$). This increase was driven primarily by upland shrubs, which increased from 15% early in the project to 23% late in the project ($P < 0.001$). Riparian shrub cover stayed statistically similar over the project period.

Forb cover declined over the study period from 4% to 1% between the early and late project phases ($P < 0.001$; Figure 17, Table 12). Grass cover significantly differed among years (Figure 18), but there was no significant trend among phases of the project ($P < 0.251$). *Phragmites* and cattail cover were statistically similar among years (Figures 19-20, Table 12).

Perennial Plant Height and Vertical Structure

Mean perennial plant height was statistically similar among years (Figure 21, Table 12). Overall perennial plant structure differed among years (Figure 22, Table 12), with the number of foliage hits on the survey rod decreasing from a mean of 439 rod hits in the early phase of the project to 330 hits in the late stage ($P = 0.003$). When analyzed by height interval, significant differences among years were observed in the 0-2 m, 2-4 m, and 4-6 m height intervals (Figures 23-25,

Table 12). While the mean number of rod hits in the 0-2 m height interval differed among years, it was statistically similar between the phases of the project ($P = 0.254$). In the 2-4 m height interval, mean rod hits decreased from 103 in the early phase to 43 in the late phase ($P < 0.001$). Similarly, in the 4-6 m height interval, mean rod hits decreased from 37 early in the project to 13 late in the project ($P < 0.001$). These results reflect the large number of survey points that were cleared and under construction beginning in 2010. There were, however, no significant differences among years in the 6-8 m and 8-10 m height intervals over the study period (Figures 26-27).

Horizontal Perennial Plant Structure

Horizontal structure of perennials was evaluated using a proportional plant diversity measure based on rod hits by stems along the vegetation transect line. The horizontal heterogeneity index declined significantly, from a mean of 3.3 hits early in the project to 2.8 hits late in the project ($P = 0.003$; Figure 28, Table 12).

Discussion

As discussed in previous reports (GBBO 2011a, 2011b, 2018, 2019a), the bird community of the Wash is particularly diverse, featuring approximately 47% of all bird species recorded in Nevada and providing habitat for 55 conservation priority species, 11 of which were confirmed to be nesting on the site.

The Wash's bird community shifts seasonally throughout the year, with bird species richness being at its lowest in June and peaking during September. Interestingly, species richness patterns changed over the course of the project, with the peaks in richness not only increasing over time, but also shifting to the transition periods and non-breeding season. This illustrates the importance of year-round monitoring when monitoring the effectiveness of restoration projects, as many of the benefits to birds may lie in the reliable availability of high-quality migration stopover and wintering habitat rather than in adding breeding season support.

Seasonal patterns of bird abundance also changed dramatically over the course of the project. Total bird abundance increased throughout the project period, and while abundances remained highest during the winter months, they were mostly due to landbird contributions (e.g., large flocks of wintering American Pipits in October/November) in the early project phase, while in the late phase, they were mostly driven by wintering waterbirds.

In comparison to other riparian areas of the Mojave Desert region, the Wash is becoming increasingly similar to long-established perennial riparian areas regardless of the fact that historically, the Wash was ephemeral. The stabilization of the channel and permanent flows of the Wash have therefore created an environment that is similar to natural perennial streams, while also creating significant open water and marsh habitat types due to multiple impoundments. With the vegetation shifting overall to native shrub and tree cover types (due to

extensive active revegetation), the main microhabitat types that appear to be still in recovery and may be actively promoted by additional management, include riparian-obligate shrubs, cavity-producing trees, and mistletoe-infected mesquite, a finding that both the bird monitoring data and the vegetation assessment data support.

Over the past fourteen years, vegetation covers have changed substantially along the Wash. Based on our vegetation assessments, tree cover was significantly lower in the most recent five years relative to the first six years of the project, primarily driven by the dramatic reduction in tamarisk. While there were no statistical trends in total mesquite cover, the proportion of tree cover represented by mesquite increased significantly between the two phases. Although shrub cover significantly increased, this trend was primarily driven by an increase in upland desert shrubs, such as four-wing saltbush, one of the common restoration plant species; forb cover declined between the two phases. Vertical vegetation structure below 6 m significantly decreased between the two phases, likely also reflecting (at least in part) the removal of tamarisk.

As vegetation covers at the Wash changed with construction, stabilization, and restoration activities, species richness and total abundance of the bird community also changed. Richness was significantly higher in the late phase of the project relative to the first six years, and abundance showed a significant increasing trend over the course of the project. Interestingly, however, in Year 14, the overall number of birds decreased to their lowest point in the most recent five years, primarily due to a large decline in the number of birds recorded during the non-breeding season. It is unclear why this may have occurred, but it is possible that changes in water levels elsewhere in the region could have resulted in shifts in local use by waterbirds. Recent increases in species richness and total abundance were particularly associated with birds of aquatic and wetland habitat types, such as Red-winged Blackbirds, American Coots, Mallards, and Gadwalls. The replacement of dry tamarisk sites by upland shrubs and mesquites has also resulted in significant increases in several species, including Black-tailed Gnatcatcher, Verdin, Gambel's Quail, and Crissal Thrasher. However, several species requiring denser riparian shrub habitats and larger stems have declined over the course of the project, including Song Sparrow, Lucy's Warbler, and Yellow-breasted Chat. We attribute these declines to the initial responses of these species to vegetation removal. Active revegetation is ongoing, but it takes time to grow a dense riparian shrub layer and trees of sufficient stem diameter to support cavities.

Finally, while major weir construction along the Wash is complete, a stabilization facilities assessment concluded that approximately 26 ha of marsh and riparian habitat would need to be cleared from the channel to ensure facilities function as designed. The goal is to have the weirs and associated areas returned to benchmark conditions, then maintained (i.e., cleared of vegetation) every two years. We worked with SNWA to develop additional revegetation recommendations to help protect bird habitat along the Wash while balancing the needs of weir maintenance (GBBO 2019b). Two new sites were identified but these have had to be discarded due to various challenges that make them unworkable for the foreseeable future. SNWA is working to identify additional sites for habitat creation outside of the weir impact zone, but there may be a net loss of riparian habitat. One potential benefit of the program is that it may be possible to use this periodic weir maintenance to mimic natural disturbance and enhance early successional habitat. Given the changes that are expected, we recommend continuing the

biweekly point counts and detailed annual vegetation monitoring to keep assessing program impacts on the Wash bird community.

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
- 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. <https://www.gbbo.org/bird-conservation-plan>
- (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. 2018. Bird population and vegetation trends at the Las Vegas Wash, 2005-2017. Unpubl. Report Submitted to the Southern Nevada Water Authority, Las Vegas, Nevada.

- (GBBO) Great Basin Bird Observatory. 2019a. Bird population trends and habitat treatment effects at the Las Vegas Wash, 2005-2018. Unpubl. Report Submitted to the Southern Nevada Water Authority, Las Vegas, Nevada.
- (GBBO) Great Basin Bird Observatory. 2019b. Additional revegetation recommendations for the Las Vegas Wash project. 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>
- Guzy, M.J., and G. Ritchison. 1999. Common Yellowthroat (*Geothlypis trichas*), 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.448>
- Hunt, P.D., and D.J. Flaspohler. 1998. Yellow-rumped Warbler (*Setophaga coronata*), version 2.0. In The Birds of North America (A.F. Poole and F.B. Gill, eds). Cornell Lab of Ornithology, Ithaca, NY. <https://doi.org/10.2173/bna.376>
- (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
- Wolf, B.O. 1997. Black Phoebe (*Sayornis nigricans*), 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.268>

Figures



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

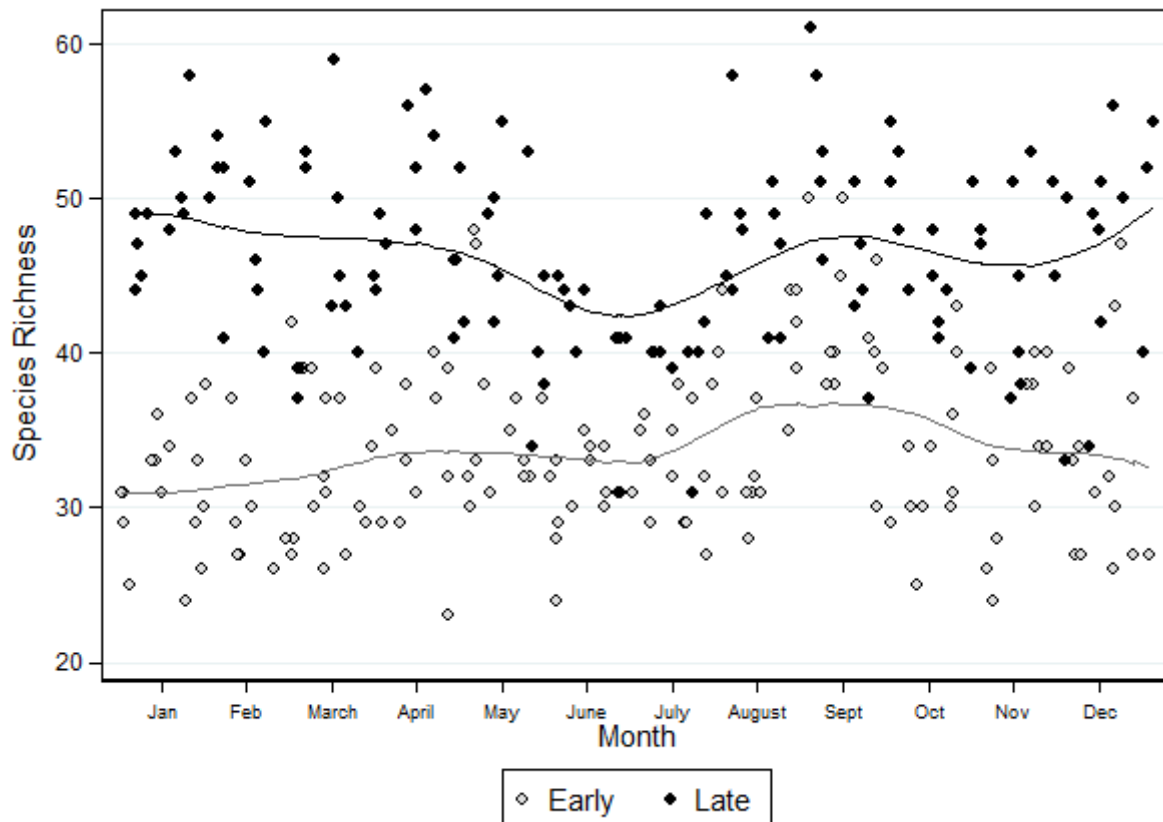


Figure 2. Seasonal bird richness per survey visit from 286 surveys of the Las Vegas Wash (2005-2019), by stage of project: Early (Years 1 to 6) and Late (Years 10 to 14). Curves represent LOWESS smoothed fits for variation in richness among survey visits.

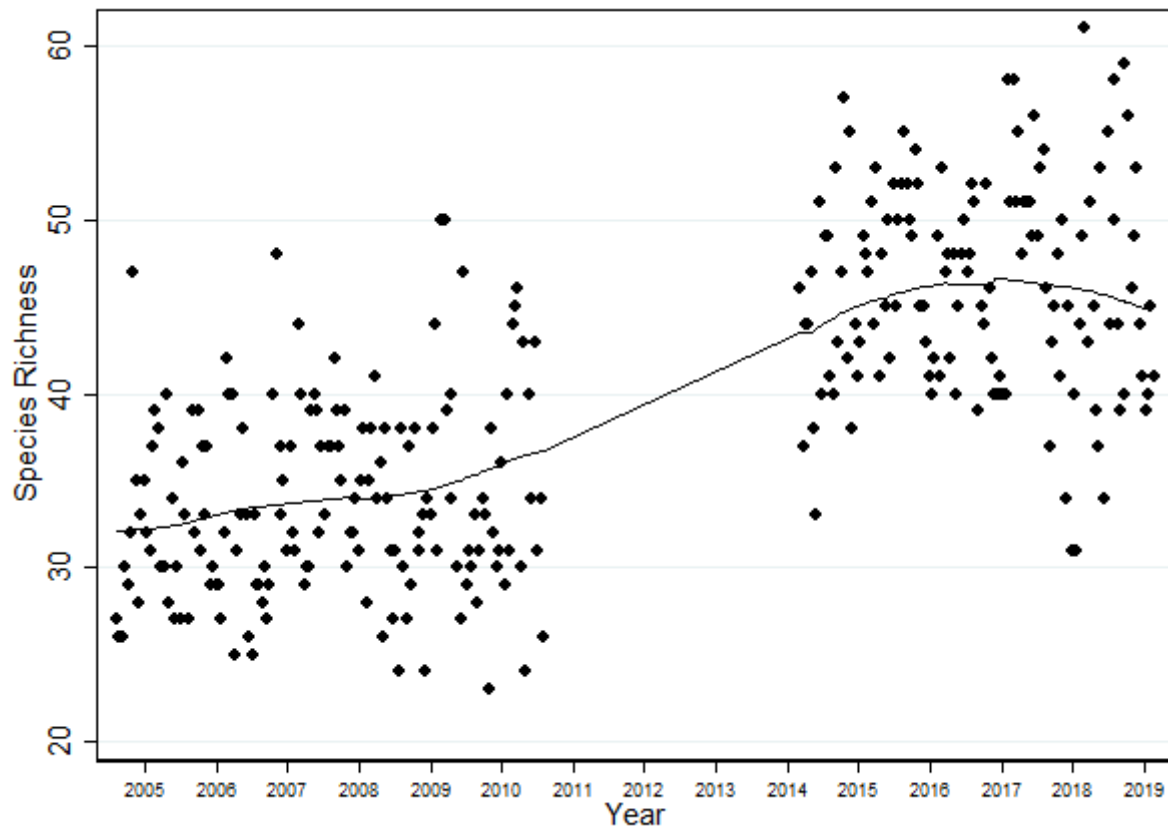


Figure 3. Trend in species richness from 286 surveys of the Las Vegas Wash (2005-2019). Curve represents a LOWESS smoothed fit for variation in richness among survey visits.

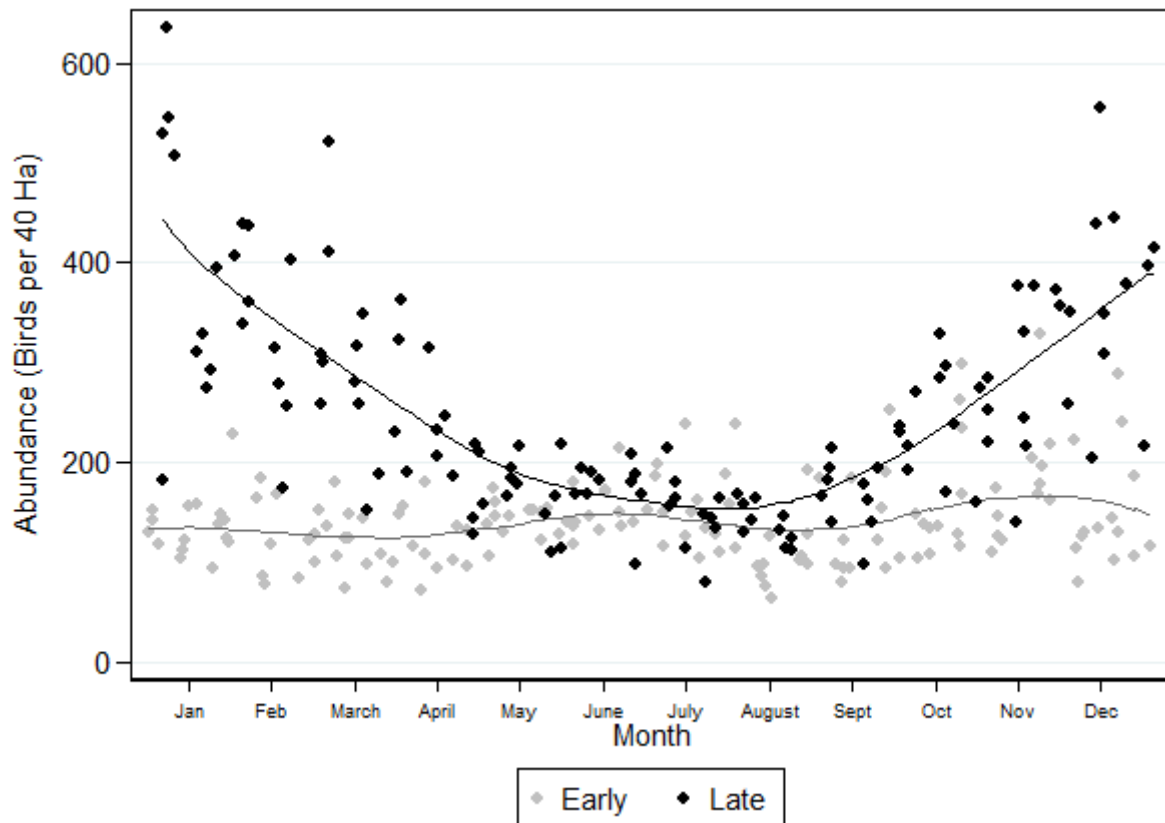


Figure 4. Seasonal total bird abundance per survey visit from 286 surveys of the Las Vegas Wash (2005-2019), by stage of project: Early (Years 1 to 6) and Late (Years 10 to 14). Curves represent LOWESS smoothed fits for variation in abundance among survey visits.

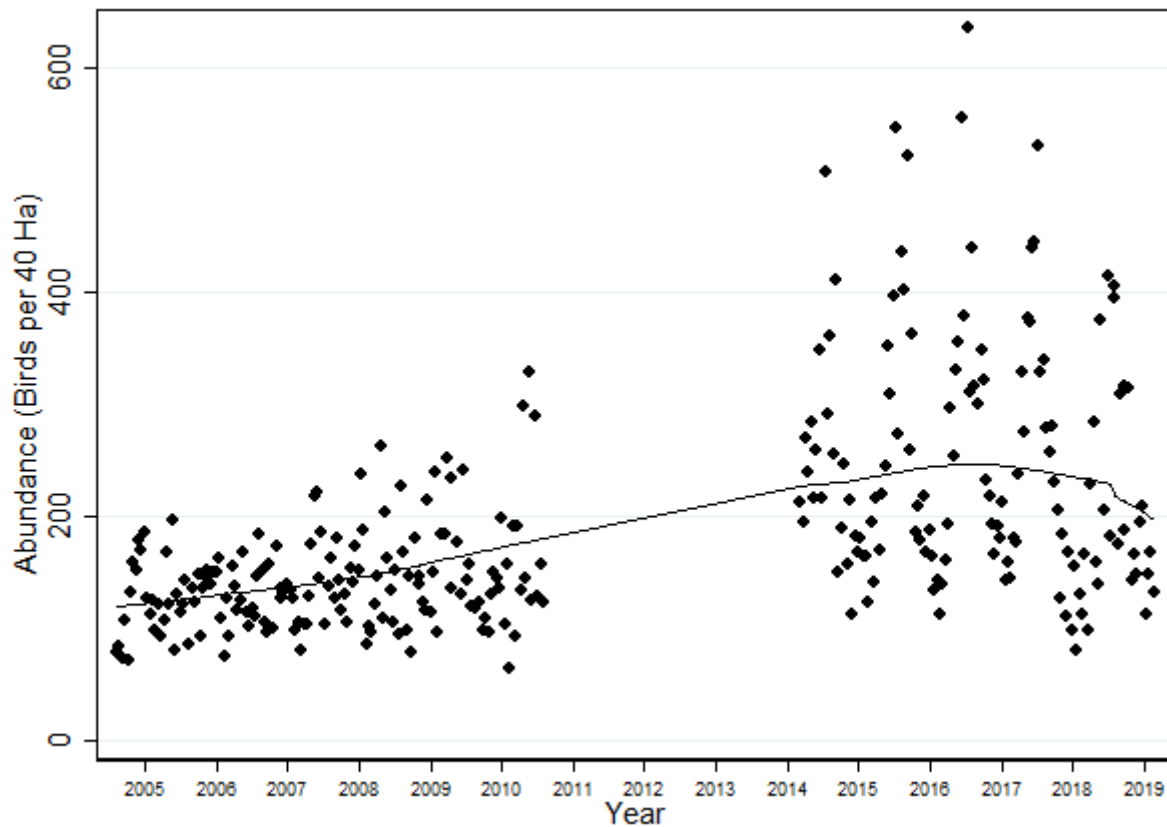


Figure 5. Trend in estimated total bird abundance from 286 surveys of the Las Vegas Wash (2005-2019). Curve represents a LOWESS smoothed fit for variation in abundance among survey visits.

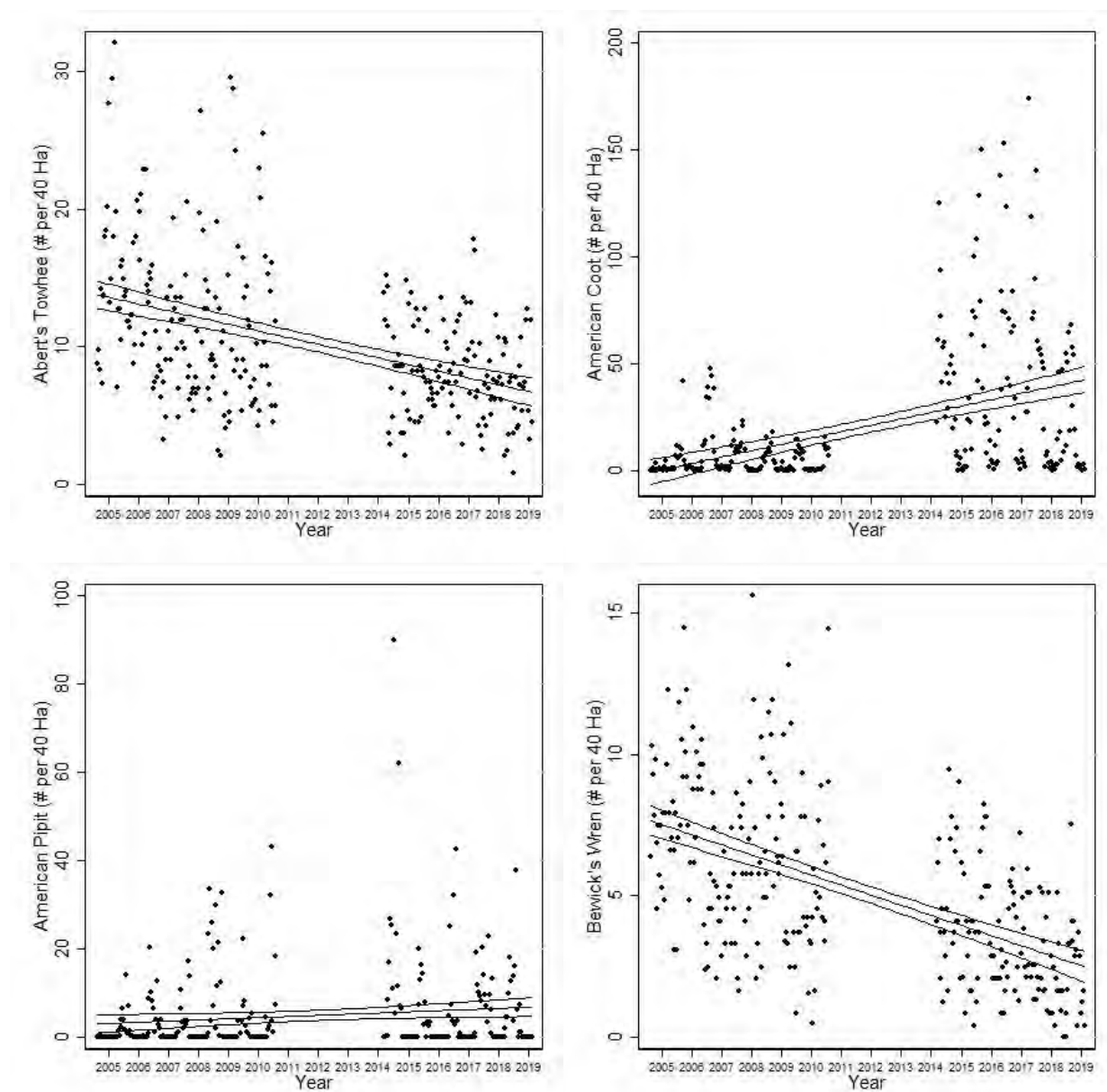


Figure 6a. Population trends of four common species along the Las Vegas Wash, by year (2005-2019). See Table 11 for statistical analysis results.

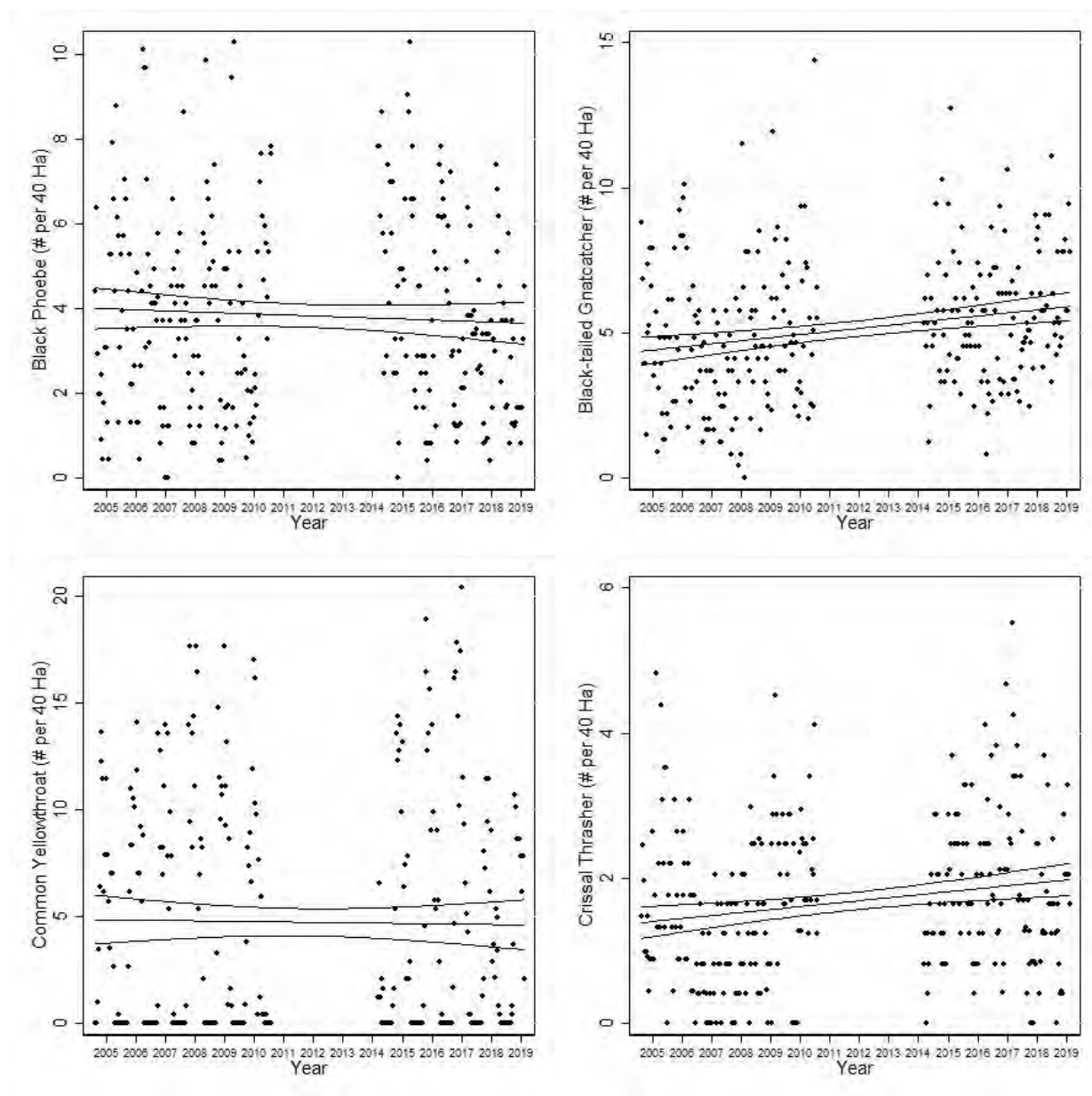


Figure 6b. Population trends of four common species along the Las Vegas Wash, by year (2005-2019). See Table 11 for statistical analysis results.

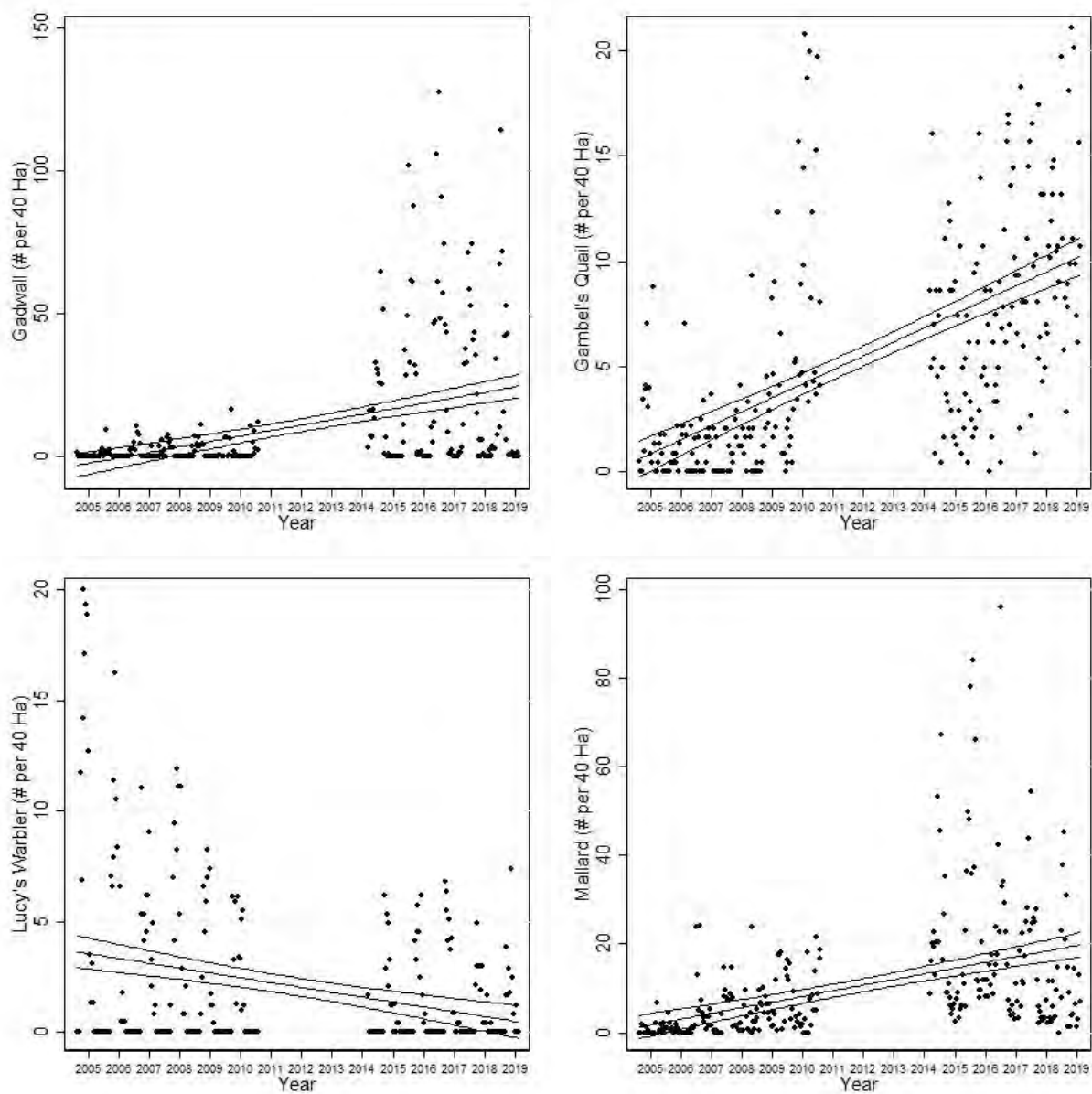


Figure 6c. Population trends of four common species along the Las Vegas Wash, by year (2005-2019). See Table 11 for statistical analysis results.

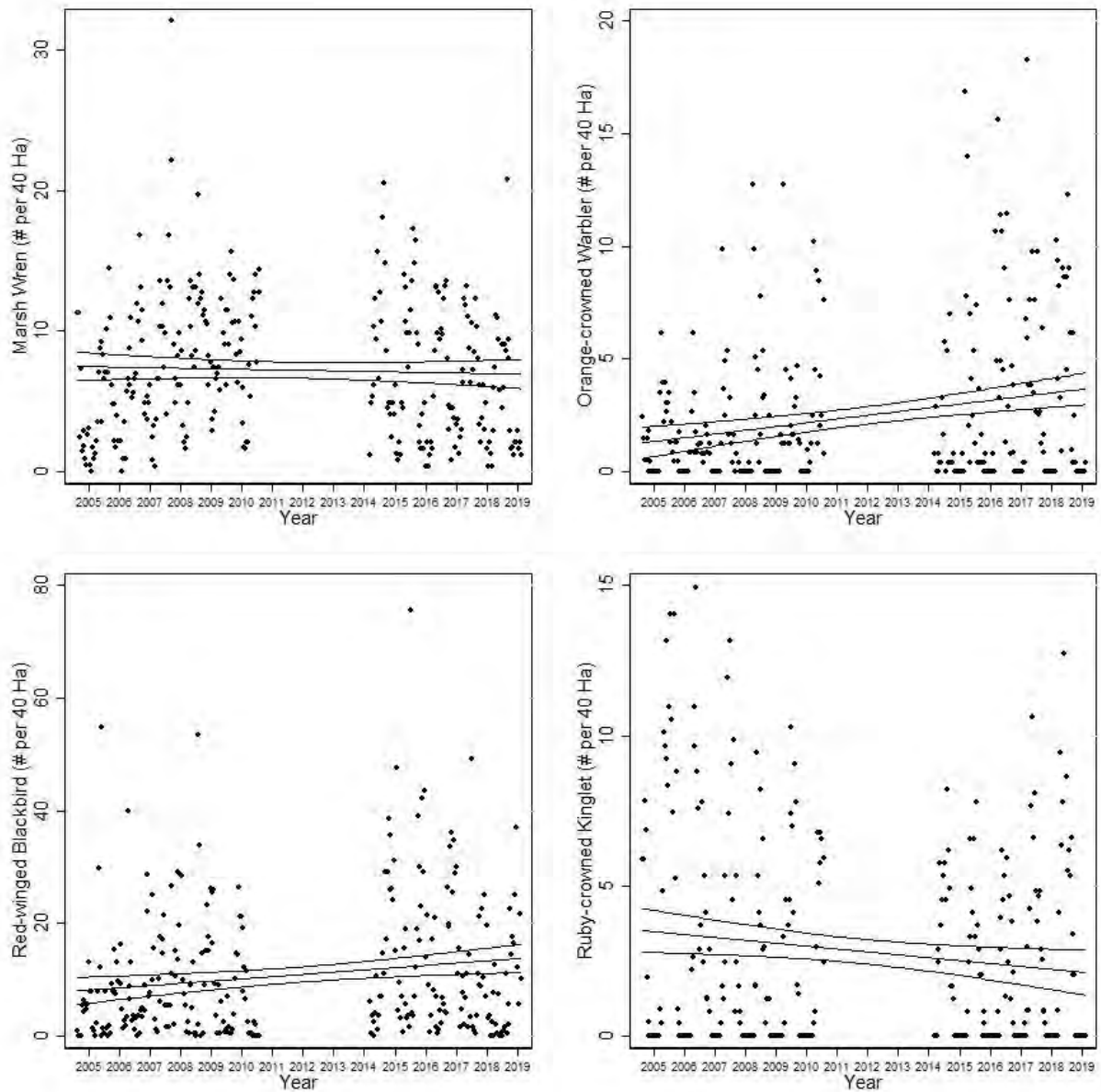


Figure 6d. Population trends of four common species along the Las Vegas Wash, by year (2005-2019). See Table 11 for statistical analysis results.

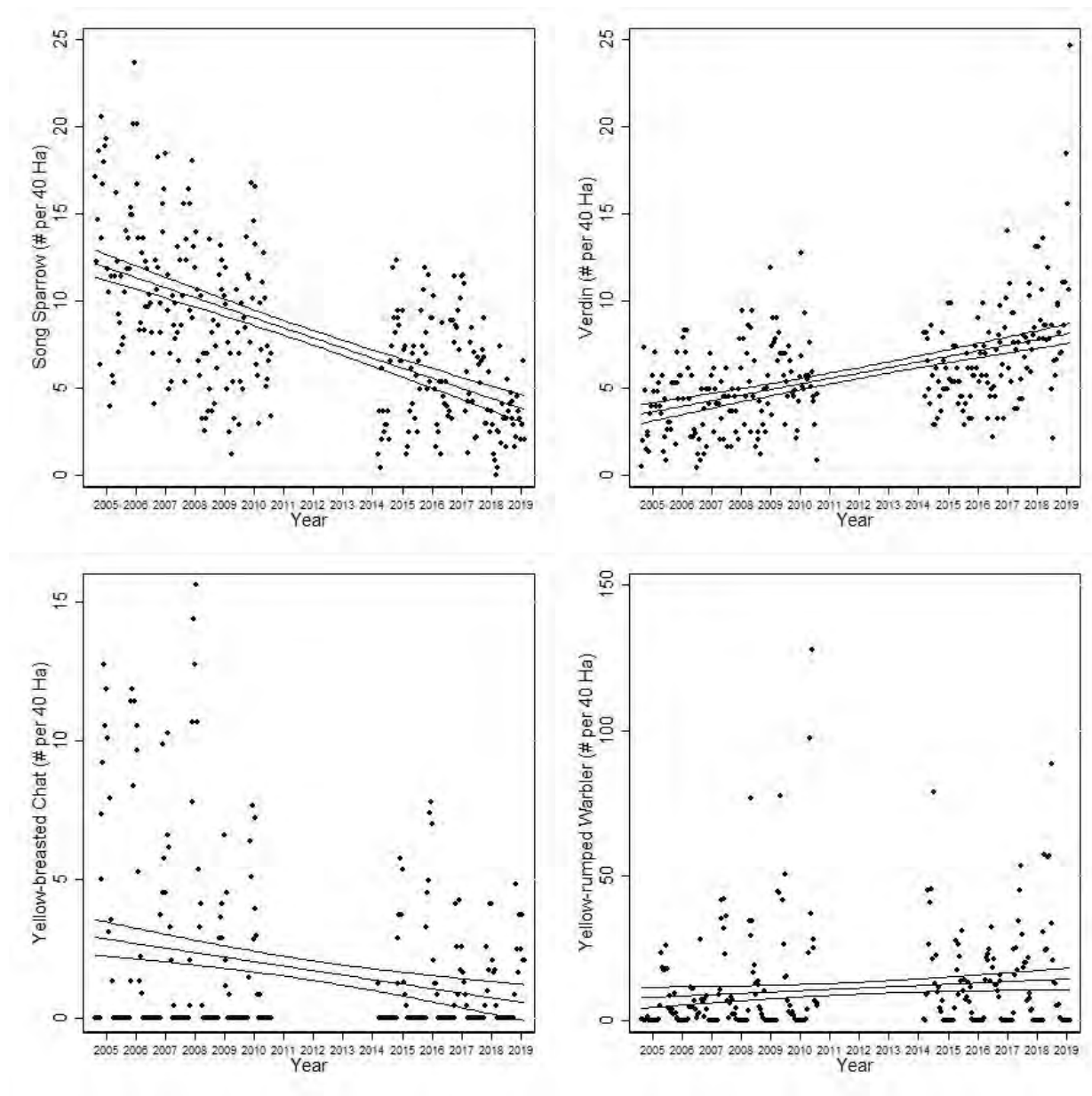


Figure 6e. Population trends of four common species along the Las Vegas Wash, by year (2005-2019). See Table 11 for statistical analysis results.

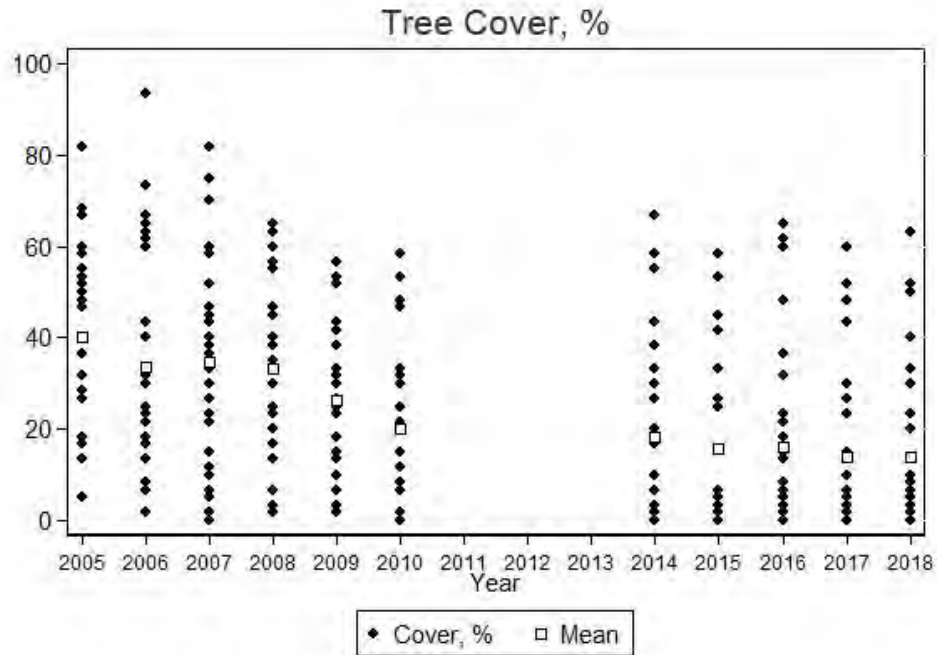


Figure 7. Tree cover (% cover of all trees) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.180$; $P < 0.001$.

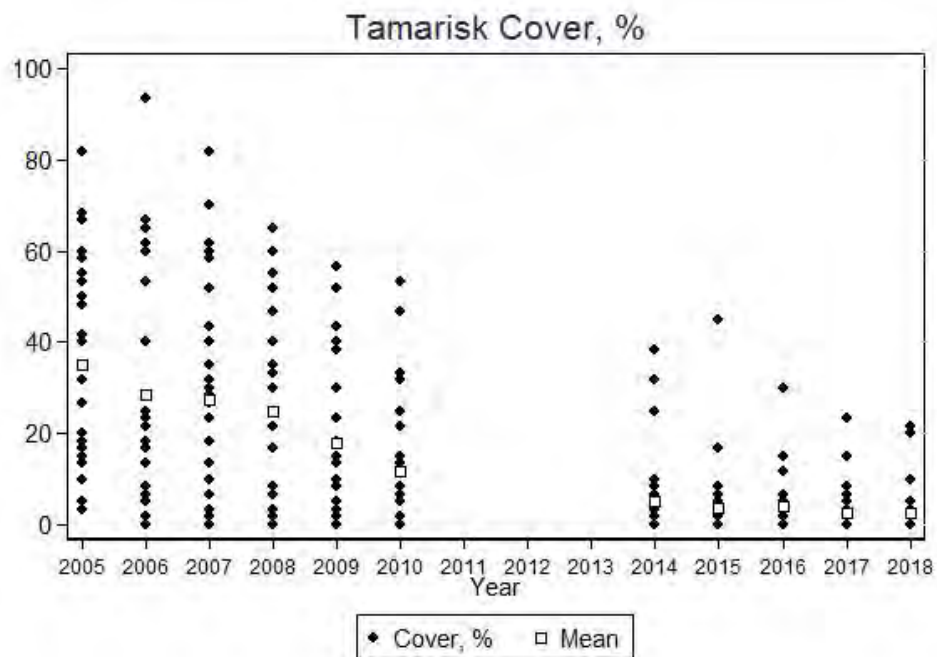


Figure 8. Tamarisk tree cover (%) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.343$; $P < 0.001$.

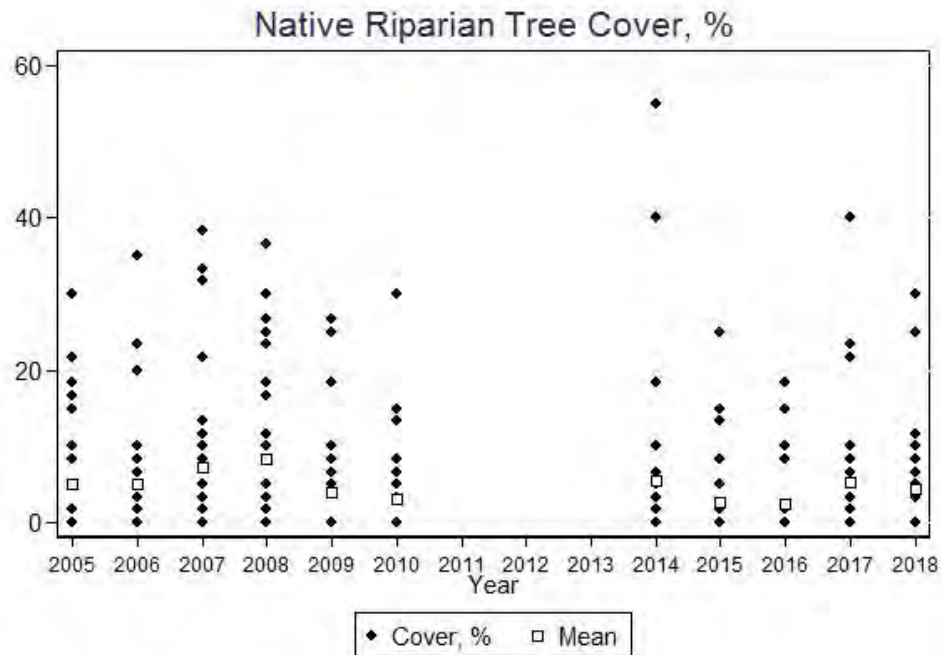


Figure 9. Native riparian tree cover (%) in the Las Vegas Wash by year, 2005-2018. (This does not include mesquites). Adjusted $R^2 = 0.038$; $P = 0.351$.

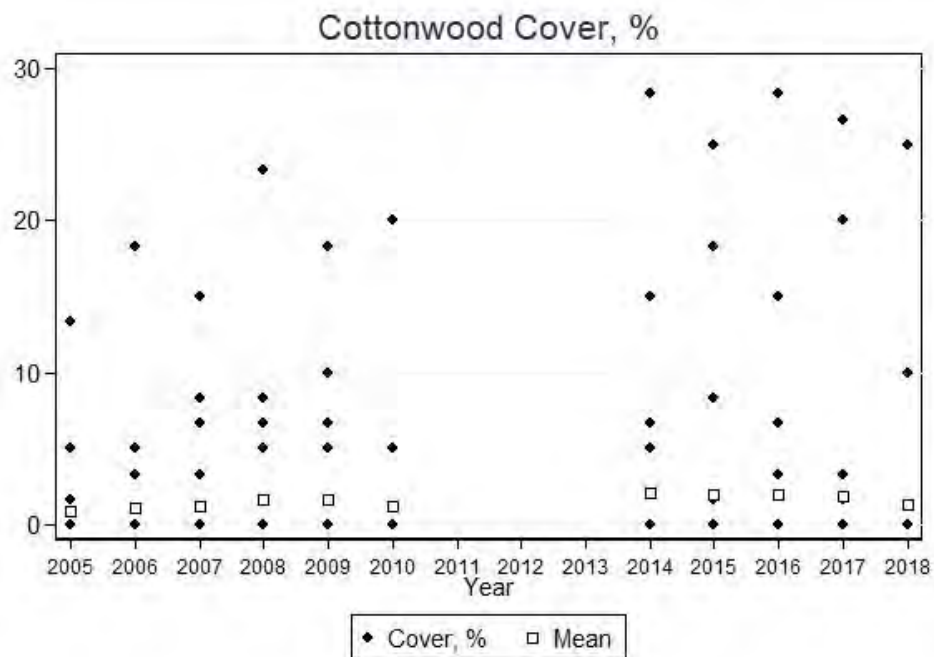


Figure 10. Cottonwood tree cover (%) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.006$; $P = 0.997$.

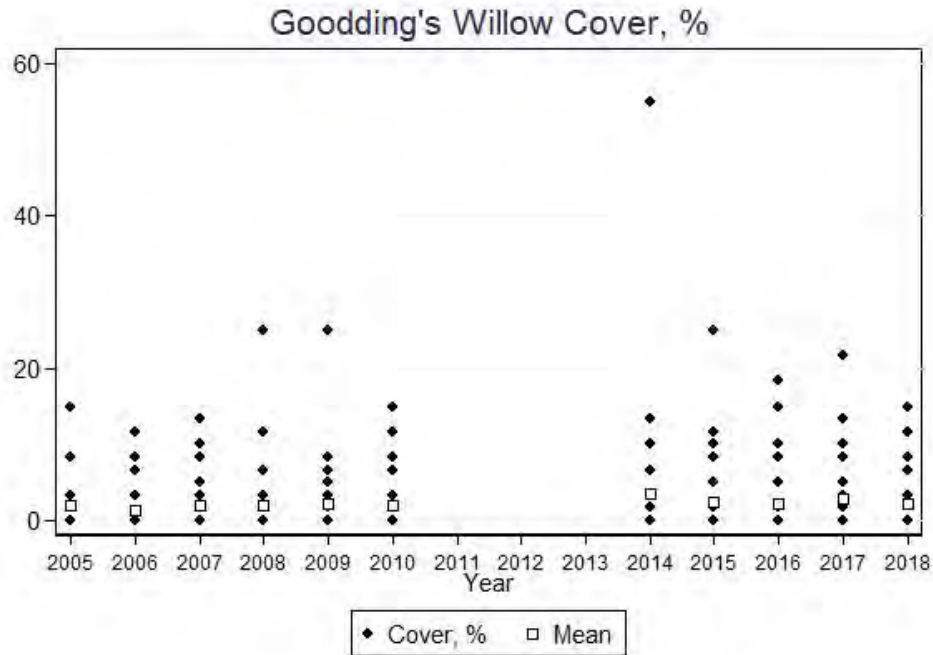


Figure 11. Goodding's willow tree cover (%) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.010$; $P = 0.986$.

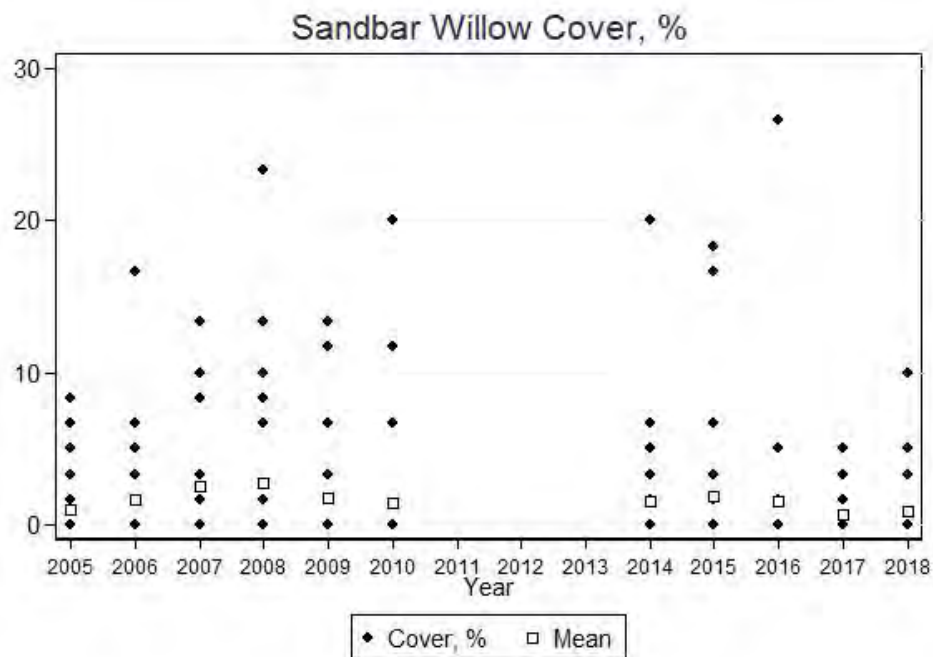


Figure 12. Sandbar willow cover (%) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.024$; $P = 0.734$.

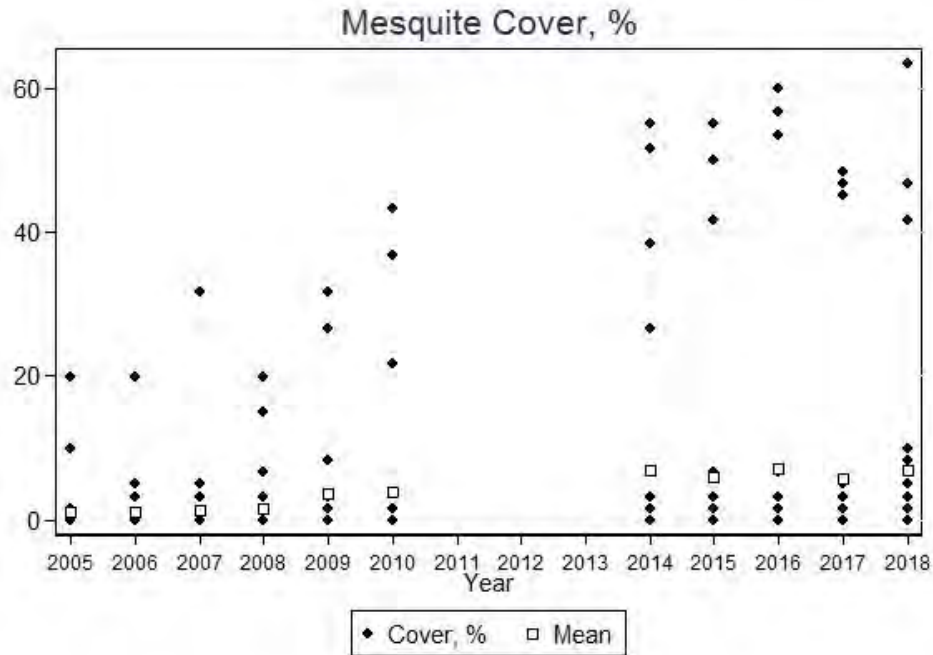


Figure 13. Mesquite tree cover (%) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.004$; $P = 0.327$.

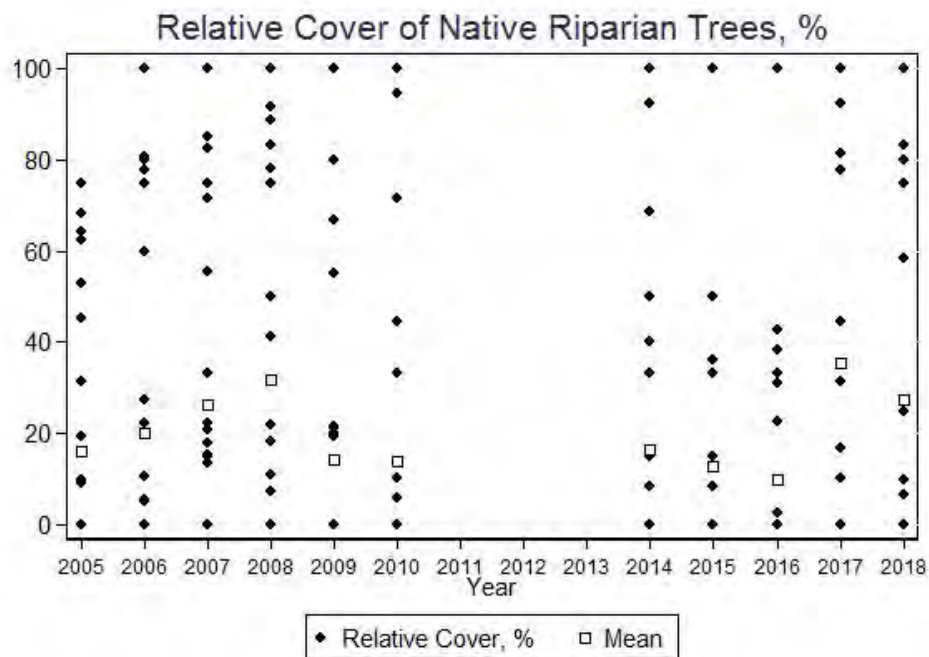


Figure 14. Mean proportion of native riparian tree cover relative to total tree cover in the Las Vegas Wash by year, 2005-2018. (This does not include mesquites.) Adjusted $R^2 = 0.045$; $P = 0.291$.

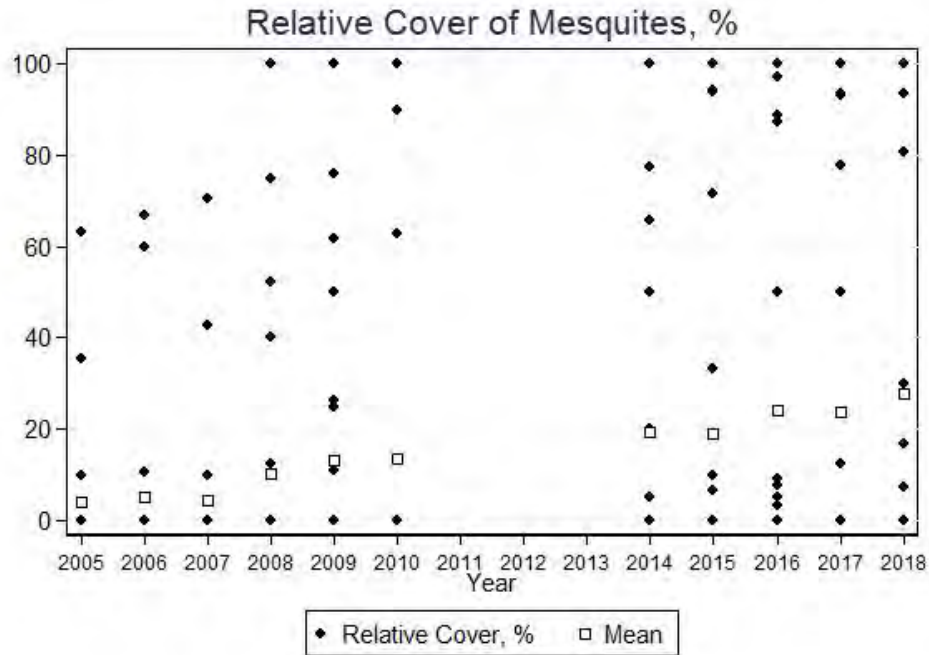


Figure 15. Mean proportion of mesquite cover relative to total tree cover in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.090$; $P = 0.006$.

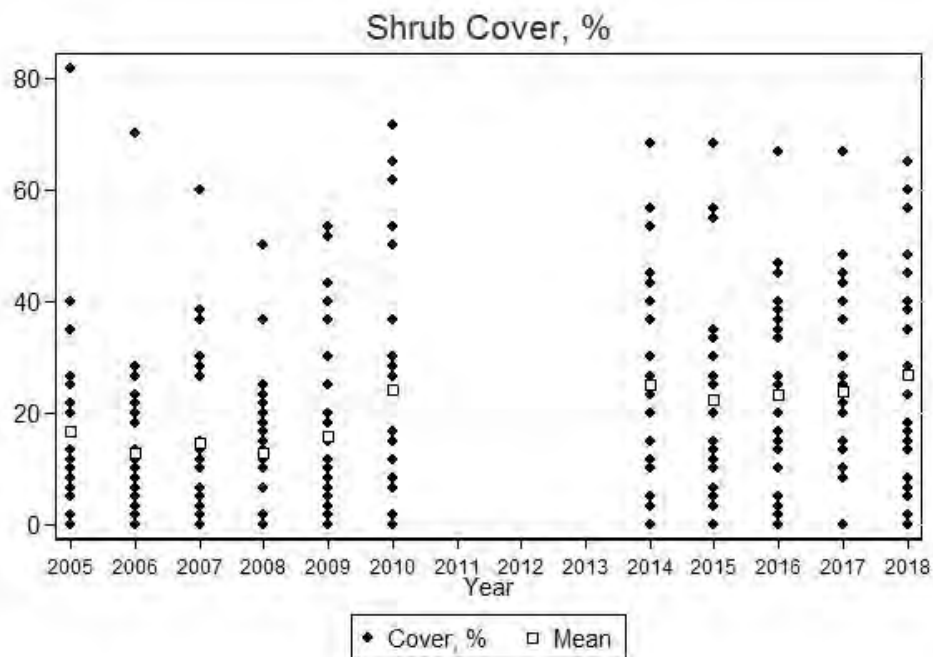


Figure 16. Mean shrub cover (%) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.078$; $P = 0.009$.

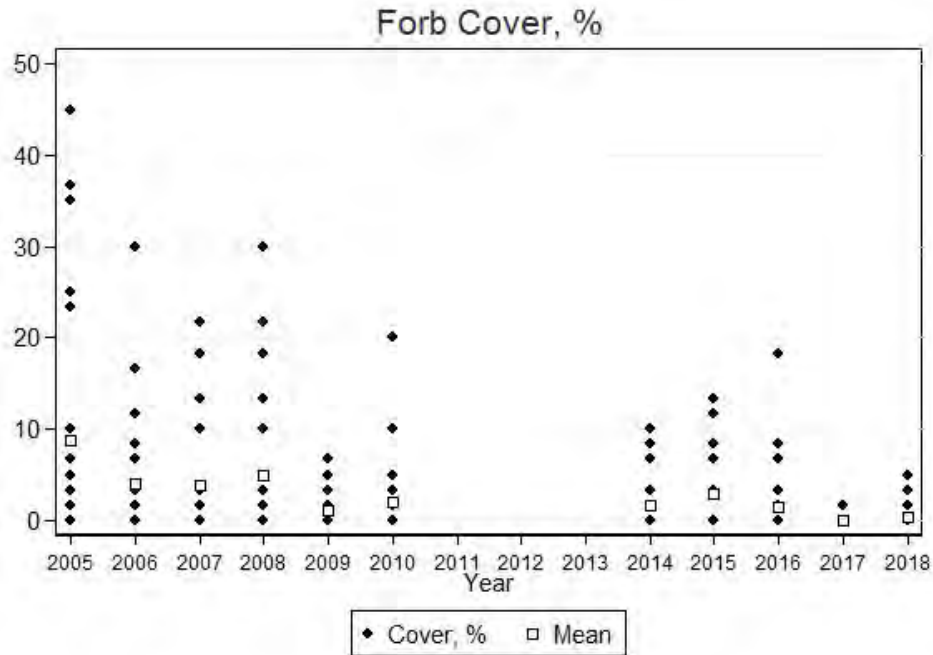


Figure 17. Mean forb cover (%) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.143$; $P < 0.001$.

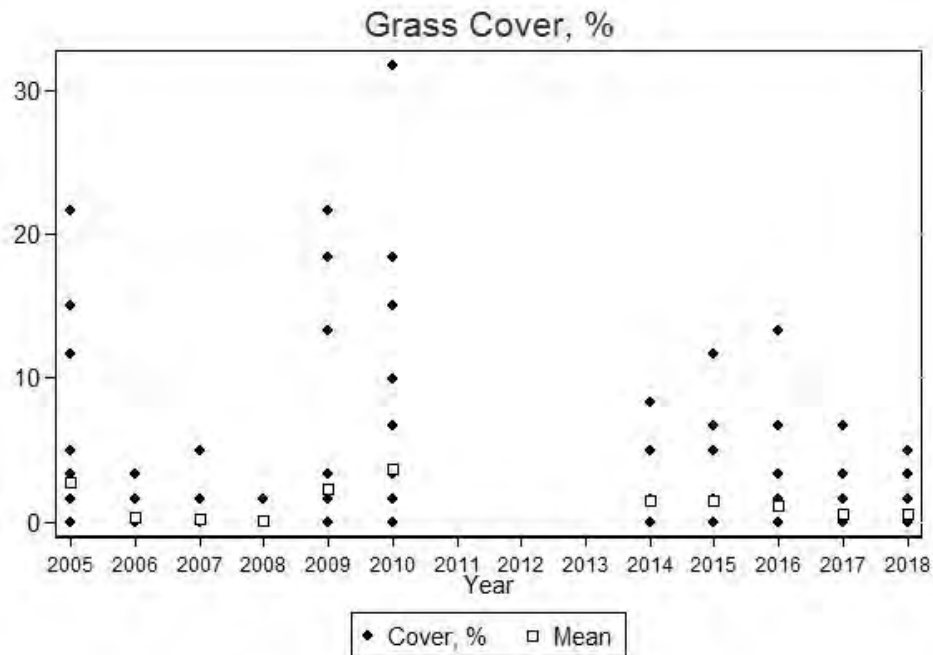


Figure 18. Mean grass cover (%) in the Las Vegas Wash by year, 2005-2018. These values do not include *Phragmites*. Adjusted $R^2 = 0.086$; $P = 0.004$.

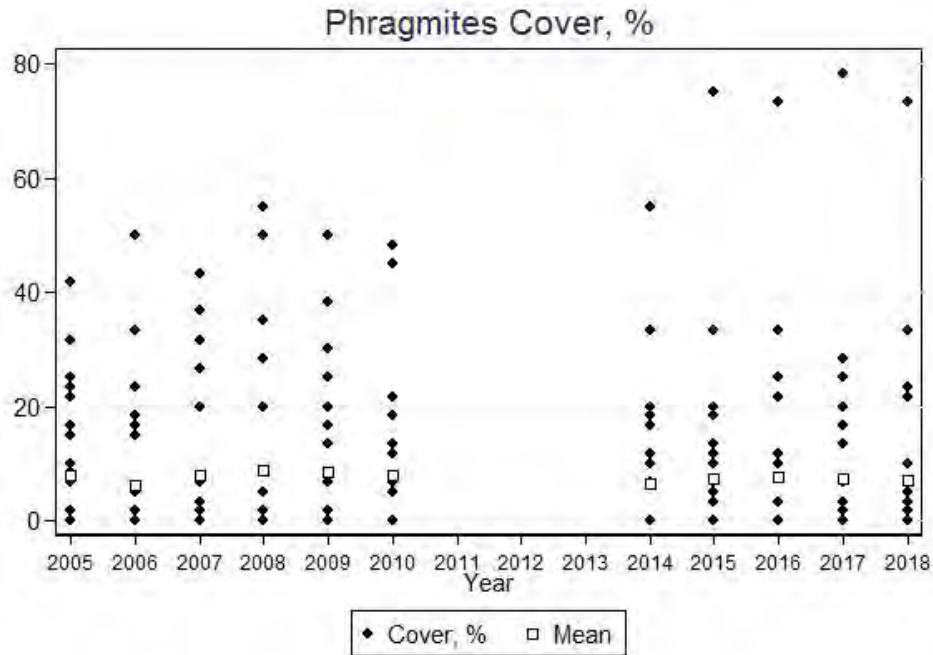


Figure 19. Mean *Phragmites* cover (%) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.003$; $P = 0.100$.

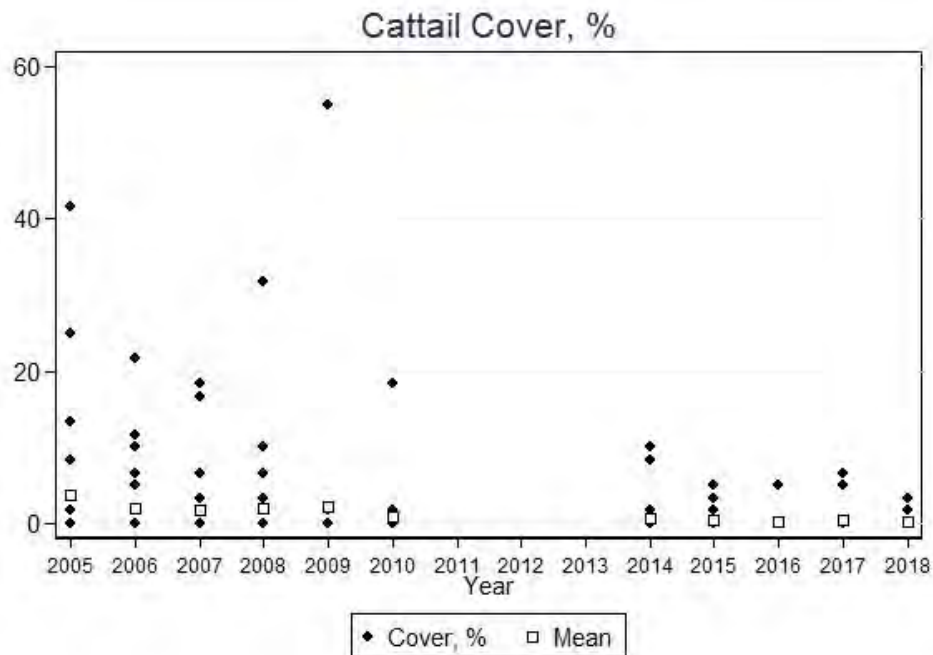


Figure 20. Mean cattail cover (%) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.041$; $P = 0.287$.

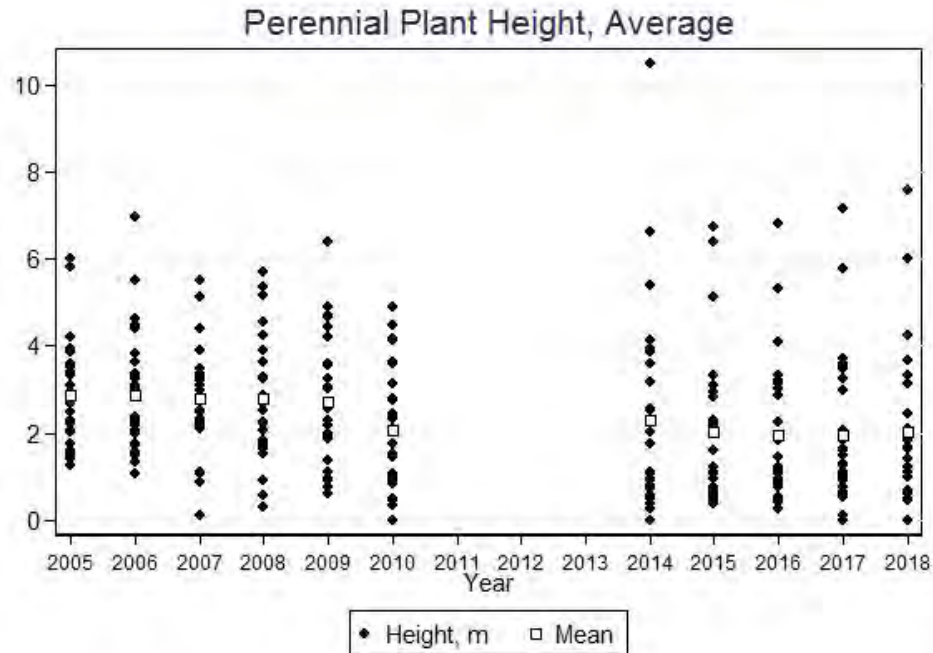


Figure 21. Mean maximum perennial plant height (m) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.050$; $P = 0.150$.

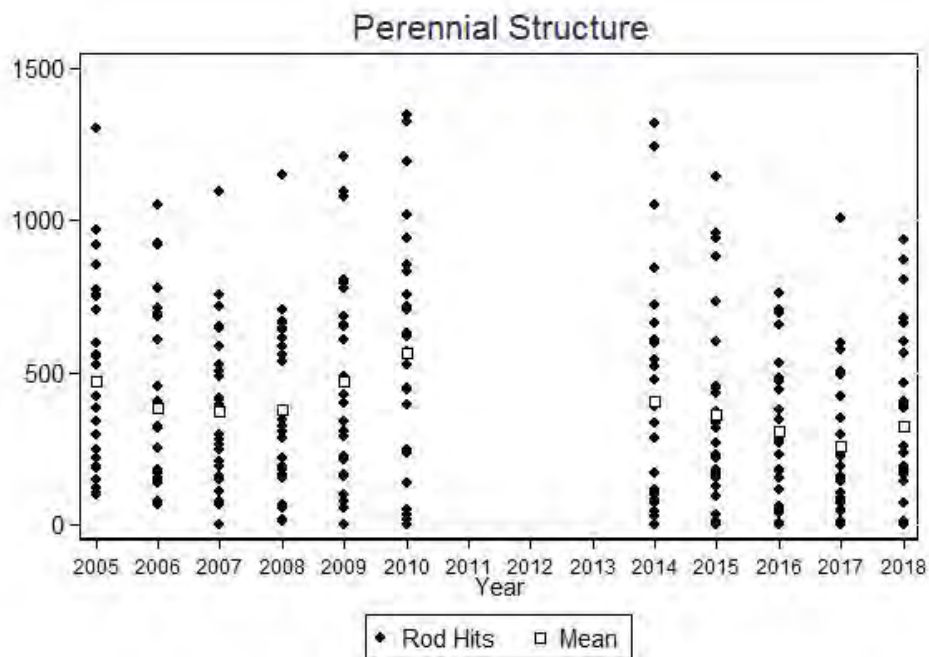


Figure 22. Perennial plant structure (number of rod hits) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.0682$; $P = 0.026$.

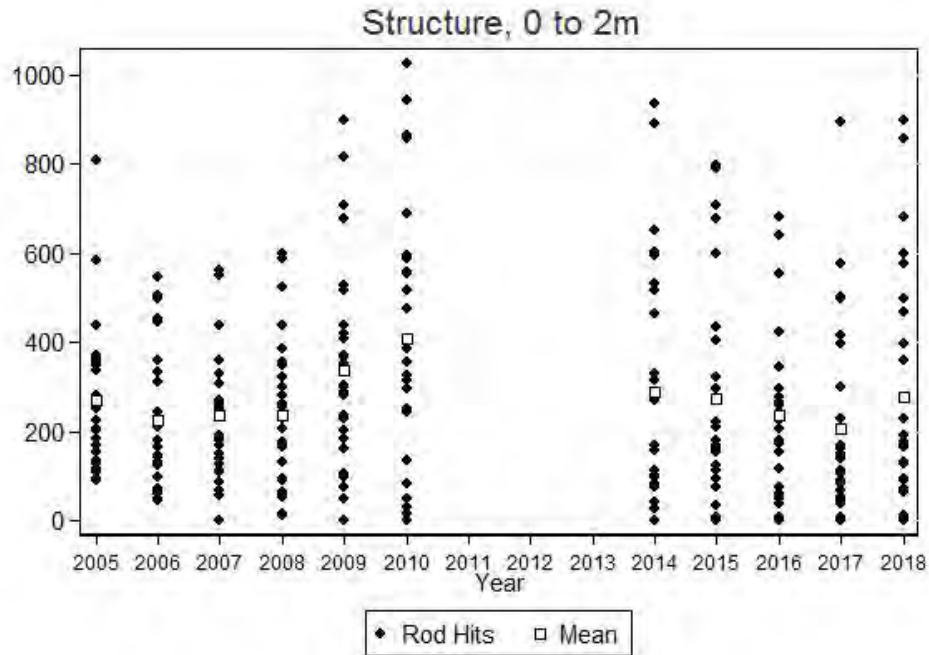


Figure 23. Perennial plant structure in the 0-2 m height category (number of rod hits) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.062$; $P = 0.047$.

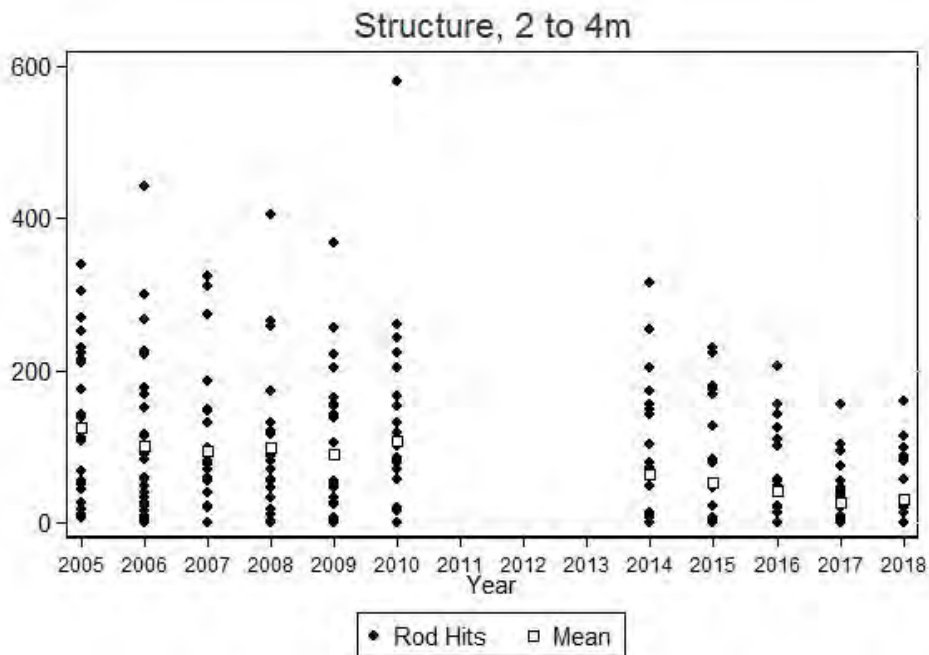


Figure 24. Perennial plant structure in the 2-4 m height category (number of rod hits) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.120$; $P < 0.001$.

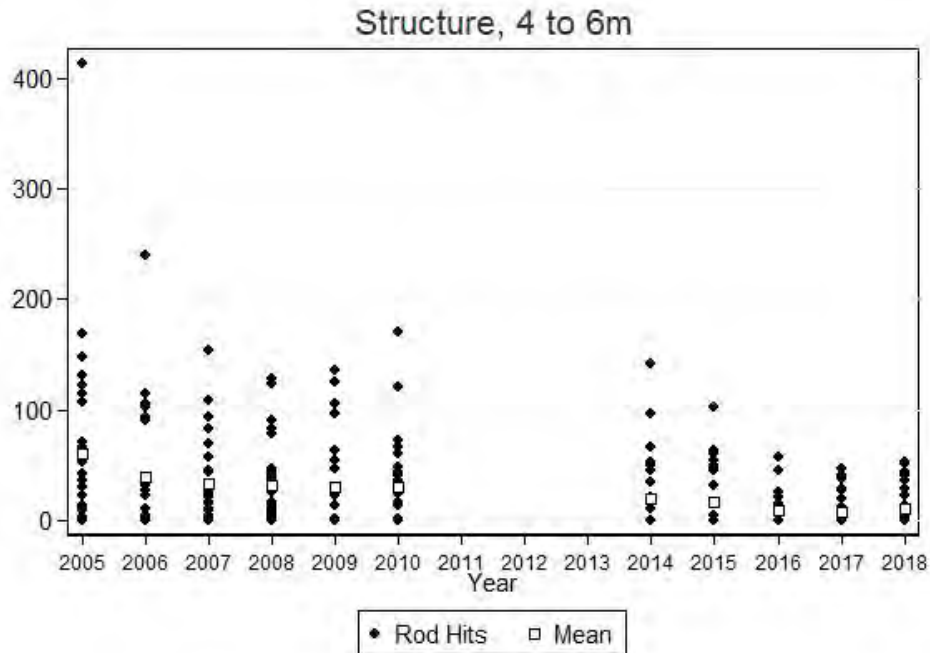


Figure 25. Perennial plant structure in the 4-6 m height category (number of rod hits) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.110$; $P < 0.001$.

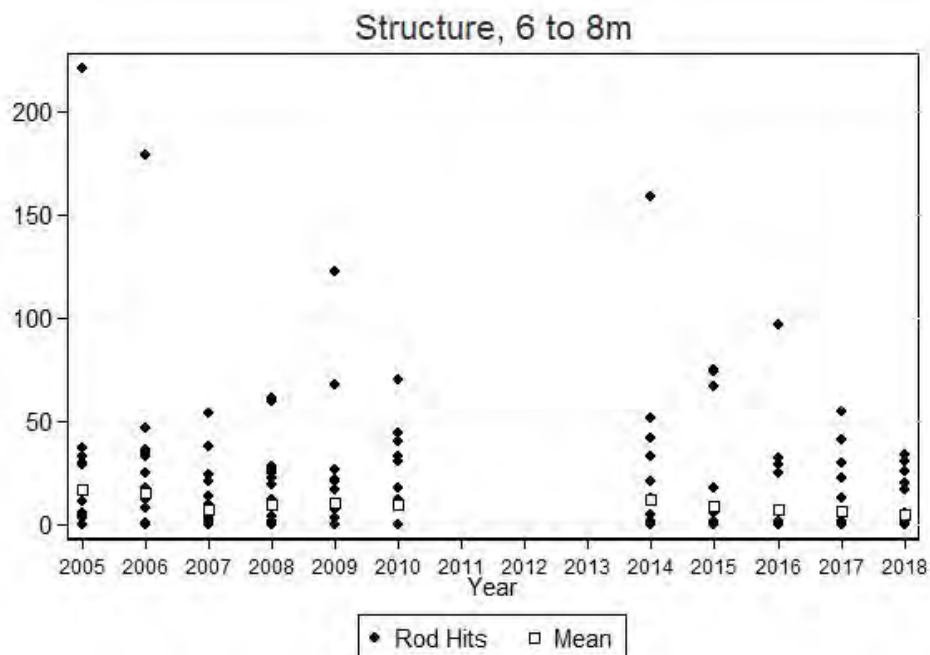


Figure 26. Perennial plant structure in the 6-8 m height category (number of rod hits) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.020$; $P = 0.836$.

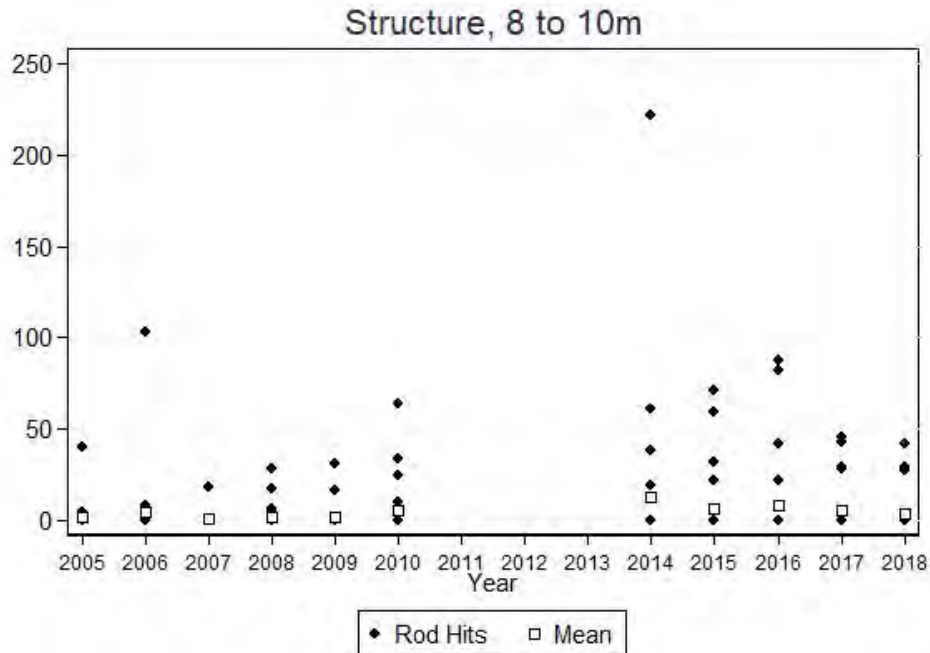


Figure 27. Perennial plant structure in the 8-10 m height category (number of rod hits) in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.032$; $P = 0.498$.

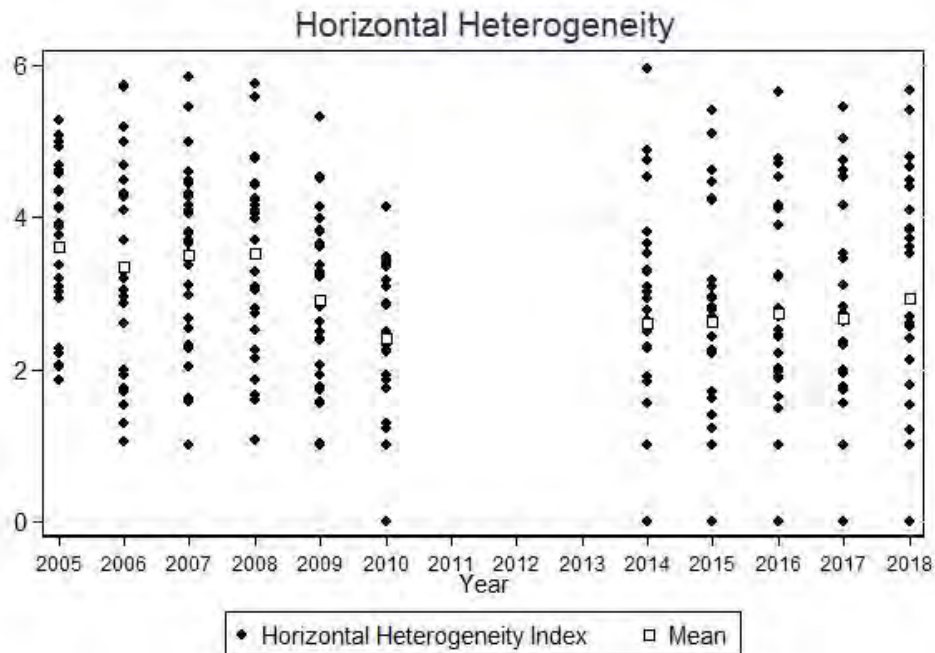


Figure 28. Horizontal vegetation heterogeneity based on the proportional number of hits for each of six vegetation transects per survey point in the Las Vegas Wash by year, 2005-2018. Adjusted $R^2 = 0.078$; $P = 0.011$.

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		
Year 13	27	1	35*	26
	29	3		
	30	16		
	31	6		
Year 14	27	1	31	26
	28	1		
	29	1		
	30	3		
	31	20		

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

Table 2. All bird species detected at Las Vegas Wash, February 2005 to August 2019, 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 flyovers, or > 100 m from a survey point. Species listed in taxonomic order.

Common Name	Scientific Name	Conservation Status	Breeding Season	Fall Transition	Non-Breeding Season	Winter Transition	Overall
Snow Goose	<i>Anser caerulescens</i>		*		X	X	X
Ross's Goose	<i>Anser rossii</i>				X	*	X
Graylag Goose	<i>Anser anser</i>		*	*	*		*
Greater White-fronted Goose	<i>Anser albifrons</i>			*	X		X
Cackling Goose/Lesser Canada Goose †	<i>Branta hutchinsii/canadensis</i>					*	*
Canada Goose	<i>Branta canadensis</i>		X	X	X	X	X
Tundra Swan	<i>Cygnus columbianus</i>	C			*		*
Wood Duck	<i>Aix sponsa</i>				X	*	X
Blue-winged Teal	<i>Spatula discors</i>		*	*	X		X
Cinnamon Teal	<i>Spatula cyanoptera</i>	C	X	X	X	X	X
Northern Shoveler	<i>Spatula clypeata</i>		X	X	X	X	X
Gadwall	<i>Mareca strepera</i>		X	X	X	X	X
American Wigeon	<i>Mareca americana</i>		X	X	X	X	X
Mallard	<i>Anas platyrhynchos</i>		X	X	X	X	X
Northern Pintail	<i>Anas acuta</i>	C	X	X	X	X	X
Green-winged Teal	<i>Anas crecca</i>		X	X	X	X	X
Canvasback	<i>Aythya valisineria</i>	C			*		*
Redhead	<i>Aythya americana</i>	C	X		*	X	X
Ring-necked Duck	<i>Aythya collaris</i>		*		X	X	X
Lesser Scaup	<i>Aythya affinis</i>	C	X		X	X	X
Bufflehead	<i>Bucephala albeola</i>		X		X	X	X
Common Goldeneye	<i>Bucephala clangula</i>		X		X	X	X
Hooded Merganser	<i>Lophodytes cucullatus</i>		X	X	X	X	X
Common Merganser	<i>Mergus merganser</i>		X	X	X	X	X
Ruddy Duck	<i>Oxyura jamaicensis</i>		*		X	X	X
Gambel's Quail	<i>Callipepla gambelii</i>	C	X	X	X	X	X
Pied-billed Grebe	<i>Podilymbus podiceps</i>		X	X	X	X	X
Horned Grebe	<i>Podiceps auritus</i>		X		X	*	X
Eared Grebe	<i>Podiceps nigricollis</i>	C	X	X	X	X	X
Western Grebe	<i>Aechmophorus occidentalis</i>	C	X		X	*	X
Clark's Grebe	<i>Aechmophorus clarkii</i>	C	*		*	*	*
Rock Pigeon	<i>Columba livia</i>		*	*	X	*	X
Eurasian Collared-Dove	<i>Streptopelia decaocto</i>		X	X	X	*	X

Common Name	Scientific Name	Conservation Status	Breeding Season	Fall Transition	Non-Breeding Season	Winter Transition	Overall
White-winged Dove	<i>Zenaida asiatica</i>		X	X	X		X
Mourning Dove	<i>Zenaida macroura</i>		X	X	X	X	X
Greater Roadrunner	<i>Geococcyx californianus</i>		X	X	X	X	X
Groove-billed Ani	<i>Crotophaga sulcirostris</i>				X		X
Lesser Nighthawk	<i>Chordeiles acutipennis</i>		X	X			X
Common Nighthawk	<i>Chordeiles minor</i>	D		*			*
Vaux's Swift	<i>Chaetura vauxi</i>		*	*	*		*
White-throated Swift	<i>Aeronautes saxatalis</i>	C	X	*	*	*	X
Black-chinned Hummingbird	<i>Archilochus alexandri</i>		X	X	X		X
Anna's Hummingbird	<i>Calypte anna</i>		X	X	X	X	X
Costa's Hummingbird	<i>Calypte costae</i>	C	X	X	X	X	X
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>			X			X
Rufous Hummingbird	<i>Selasphorus rufus</i>	C; E	X	*			X
Virginia Rail	<i>Rallus limicola</i>		X	X	X	X	X
Sora	<i>Porzana carolina</i>		X	X	X	X	X
Common Gallinule	<i>Gallinula galeata</i>		X	X	X	X	X
American Coot	<i>Fulica americana</i>		X	X	X	X	X
Sandhill Crane	<i>Antigone canadensis</i>	C	X		*	*	X
Black-necked Stilt	<i>Himantopus mexicanus</i>	C	X	X		*	X
American Avocet	<i>Recurvirostra americana</i>	C	X	X	X	X	X
Semipalmated Plover	<i>Charadrius semipalmatus</i>		X				X
Killdeer	<i>Charadrius vociferus</i>		X	X	X	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				X
Least Sandpiper	<i>Calidris minutilla</i>	C	X	X	X	X	X
Pectoral Sandpiper	<i>Calidris melanotos</i>			X			X
Semipalmated Sandpiper	<i>Calidris pusilla</i>		X				X
Western Sandpiper	<i>Calidris mauri</i>	C	X	X	X	X	X
Short-billed Dowitcher	<i>Limnodromus griseus</i>		*				*
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>	C	X	X	X	X	X
Wilson's Snipe	<i>Gallinago delicata</i>		X	*	X	X	X
Spotted Sandpiper	<i>Actitis macularius</i>		X	X	X	X	X
Solitary Sandpiper	<i>Tringa solitaria</i>		X	X			X
Lesser Yellowlegs	<i>Tringa flavipes</i>		X	X	X	X	X
Willet	<i>Tringa semipalmata</i>	C	X				X
Greater Yellowlegs	<i>Tringa melanoleuca</i>		X	X	X	X	X

Common Name	Scientific Name	Conservation Status	Breeding Season	Fall Transition	Non-Breeding Season	Winter Transition	Overall
Wilson's Phalarope	<i>Phalaropus tricolor</i>	C	*	*			*
Bonaparte's Gull	<i>Chroicocephalus philadelphia</i>		X				X
Franklin's Gull	<i>Leucophaeus pipixcan</i>	C	*				*
Ring-billed Gull	<i>Larus delawarensis</i>		X	*	X	X	X
California Gull	<i>Larus californicus</i>		X		*	*	X
Lesser Black-backed Gull	<i>Larus fuscus</i>		*				*
Caspian Tern	<i>Hydroprogne caspia</i>		X	*	*		X
Forster's Tern	<i>Sterna forsteri</i>		*				*
Neotropic Cormorant	<i>Phalacrocorax brasilianus</i>		X	*	X	X	X
Double-crested Cormorant	<i>Phalacrocorax auritus</i>		X	X	X	X	X
American White Pelican	<i>Pelecanus erythrorhynchos</i>	C	X	X	X	*	X
American Bittern	<i>Botaurus lentiginosus</i>		X	X		*	X
Least Bittern	<i>Ixobrychus exilis</i>	B; C	X	X	X	X	X
Great Blue Heron	<i>Ardea herodias</i>		X	X	X	X	X
Great Egret	<i>Ardea alba</i>		X	X	X	X	X
Snowy Egret	<i>Egretta thula</i>	C	X	X	X	X	X
Cattle Egret	<i>Bubulcus ibis</i>		*	X			X
Green Heron	<i>Butorides virescens</i>		X	X	X	X	X
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>		X	X	X	X	X
White Ibis	<i>Eudocimus albus</i>		*				*
White-faced Ibis	<i>Plegadis chihi</i>	C	X	X	X	X	X
Turkey Vulture	<i>Cathartes aura</i>		X	*	*	X	X
Osprey	<i>Pandion haliaetus</i>		X	X	X	X	X
White-tailed Kite	<i>Elanus leucurus</i>		*				*
Northern Harrier	<i>Circus hudsonius</i>		X	X	X	X	X
Sharp-shinned Hawk	<i>Accipiter striatus</i>		X	X	X	X	X
Cooper's Hawk	<i>Accipiter cooperii</i>		X	X	X	X	X
Northern Goshawk	<i>Accipiter gentilis</i>	C			*		*
Red-shouldered Hawk	<i>Buteo lineatus</i>		X	X	X	X	X
Swainson's Hawk	<i>Buteo swainsoni</i>	C	X				X
Red-tailed Hawk	<i>Buteo jamaicensis</i>		X	*	X	X	X
Golden Eagle	<i>Aquila chrysaetos</i>	C			*		*
Barn Owl	<i>Tyto alba</i>		X	X	X		X
Great Horned Owl	<i>Bubo virginianus</i>		X	X	X	X	X
Long-eared Owl	<i>Asio otus</i>	E	X	X			X
Belted Kingfisher	<i>Megasceryle alcyon</i>		X	X	X	X	X
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>		X		X	X	X
Ladder-backed Woodpecker	<i>Picoides scalaris</i>		X	X	X	X	X
Hairy Woodpecker	<i>Picoides villosus</i>				X		X

Common Name	Scientific Name	Conservation Status	Breeding Season	Fall Transition	Non-Breeding Season	Winter Transition	Overall
Northern Flicker	<i>Colaptes auratus</i>		X	X	X	X	X
American Kestrel	<i>Falco sparverius</i>		X	X	X	X	X
Merlin	<i>Falco columbarius</i>		*		X	X	X
Peregrine Falcon	<i>Falco peregrinus</i>	C	X	*	X	*	X
Prairie Falcon	<i>Falco mexicanus</i>	C	*	*	X		X
Olive-sided Flycatcher	<i>Contopus cooperi</i>	C; D; E	X				X
Western Wood-Pewee	<i>Contopus sordidulus</i>		X	X			X
Willow Flycatcher	<i>Empidonax traillii</i>	A; B; C	X				X
Hammond's Flycatcher	<i>Empidonax hammondi</i>		X				X
Gray Flycatcher	<i>Empidonax wrightii</i>	C	X	X	X		X
Dusky Flycatcher	<i>Empidonax oberholseri</i>		X	X			X
Western Flycatcher (unidentified)	<i>Empidonax difficilis/occidentalis</i>		X	X			X
Black Phoebe	<i>Sayornis nigricans</i>		X	X	X	X	X
Eastern Phoebe	<i>Sayornis phoebe</i>				*		*
Say's Phoebe	<i>Sayornis saya</i>		X	X	X	X	X
Vermilion Flycatcher	<i>Pyrocephalus rubinus</i>	A; B			X		X
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>		X	X		X	X
Brown-crested Flycatcher	<i>Myiarchus tyrannulus</i>		X				X
Cassin's Kingbird	<i>Tyrannus vociferans</i>		*				*
Western Kingbird	<i>Tyrannus verticalis</i>		X	X			X
Eastern Kingbird	<i>Tyrannus tyrannus</i>		X				X
Scissor-tailed Flycatcher	<i>Tyrannus forficatus</i>			X			X
Loggerhead Shrike	<i>Lanius ludovicianus</i>	D	X	X	X	X	X
Bell's Vireo	<i>Vireo bellii</i>	A; B; C	X	X			X
Cassin's Vireo	<i>Vireo cassinii</i>		X	X			X
Plumbeous Vireo	<i>Vireo plumbeus</i>		X				X
Warbling Vireo	<i>Vireo gilvus</i>		X	X	X		X
Common Raven	<i>Corvus corax</i>		X	X	X	X	X
Horned Lark	<i>Eremophila alpestris</i>	D	X	X	X	*	X
Tree Swallow	<i>Tachycineta bicolor</i>		X	*	X	*	X
Violet-green Swallow	<i>Tachycineta thalassina</i>		X	X	*	*	X
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>		X	X	*	X	X
Bank Swallow	<i>Riparia riparia</i>		X	*			X
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>		X	X	X	*	X
Barn Swallow	<i>Hirundo rustica</i>		X	X	X	*	X
Verdin	<i>Auriparus flaviceps</i>		X	X	X	X	X
Bushtit	<i>Psaltiriparus minimus</i>		X	X	X	X	X
Red-breasted Nuthatch	<i>Sitta canadensis</i>			X	X	X	X
Brown Creeper	<i>Certhia americana</i>				X		X

Common Name	Scientific Name	Conservation Status	Breeding Season	Fall Transition	Non-Breeding Season	Winter Transition	Overall
Rock Wren	<i>Salpinctes obsoletus</i>		X	X	X	X	X
Canyon Wren	<i>Catherpes mexicanus</i>		X	*	X	X	X
House Wren	<i>Troglodytes aedon</i>		X	X	X	X	X
Pacific Wren	<i>Troglodytes pacificus</i>				X	X	X
Marsh Wren	<i>Cistothorus palustris</i>		X	X	X	X	X
Bewick's Wren	<i>Thryomanes bewickii</i>		X	X	X	X	X
Cactus Wren	<i>Campylorhynchus brunneicapillus</i>				*	X	X
Blue-gray Gnatcatcher	<i>Poliophtila caerulea</i>		X	X	X	X	X
Black-tailed Gnatcatcher	<i>Poliophtila melanura</i>		X	X	X	X	X
Golden-crowned Kinglet	<i>Regulus satrapa</i>				X	X	X
Ruby-crowned Kinglet	<i>Regulus calendula</i>		X	X	X	X	X
Western Bluebird	<i>Sialia mexicana</i>				X		X
Mountain Bluebird	<i>Sialia currucoides</i>				X		X
Swainson's Thrush	<i>Catharus ustulatus</i>			X			X
Hermit Thrush	<i>Catharus guttatus</i>		X	X	X	X	X
American Robin	<i>Turdus migratorius</i>		X	X	X	X	X
Gray Catbird	<i>Dumetella carolinensis</i>				X		X
Brown Thrasher	<i>Toxostoma rufum</i>				X		X
Crissal Thrasher	<i>Toxostoma crissale</i>		X	X	X	X	X
Northern Mockingbird	<i>Mimus polyglottos</i>		X	X	X	X	X
European Starling	<i>Sturnus vulgaris</i>		X	X	X	*	X
Cedar Waxwing	<i>Bombicilla cedrorum</i>		*	X	X		X
Phainopepla	<i>Phainopepla nitens</i>	A	X	*	X	X	X
House Sparrow	<i>Passer domesticus</i>		X	*	X		X
American Pipit	<i>Anthus rubescens</i>		X	X	X	X	X
House Finch	<i>Haemorhous mexicanus</i>		X	X	X	X	X
Red Crossbill	<i>Loxia curvirostra</i>				X		X
Pine Siskin	<i>Spinus pinus</i>	D	X	*	X		X
Lesser Goldfinch	<i>Spinus psaltria</i>		X	X	X	X	X
American Goldfinch	<i>Spinus tristis</i>		X		X		X
Green-tailed Towhee	<i>Pipilo chlorurus</i>	C	X	X			X
Spotted Towhee	<i>Pipilo maculatus</i>		X	X	X	X	X
Rufous-crowned Sparrow	<i>Aimophila ruficeps</i>		X				X
Canyon Towhee	<i>Pipilo fuscus</i>		X				X
Abert's Towhee	<i>Melospiza aberti</i>	C	X	X	X	X	X
Chipping Sparrow	<i>Spizella passerina</i>		X	X	X		X
Brewer's Sparrow	<i>Spizella breweri</i>	C	X	X	X		X
Vesper Sparrow	<i>Poocetes gramineus</i>		X	X			X
Lark Sparrow	<i>Chondestes grammacus</i>		X	X			X

Common Name	Scientific Name	Conservation Status	Breeding Season	Fall Transition	Non-Breeding Season	Winter Transition	Overall
Black-throated Sparrow	<i>Amphispiza bilineata</i>		X		*	*	X
Sagebrush Sparrow	<i>Artemisiospiza nevadensis</i>	C	*		X		X
Bell's Sparrow	<i>Artemisiospiza belli</i>	C		X			X
Savannah Sparrow	<i>Passerculus sandwichensis</i>		X	X	X	X	X
Fox Sparrow	<i>Passerella iliaca</i>				X		X
Song Sparrow	<i>Melospiza melodia</i>		X	X	X	X	X
Lincoln's Sparrow	<i>Melospiza lincolnii</i>		X	X	X	X	X
Swamp Sparrow	<i>Melospiza georgiana</i>				X	*	X
White-throated Sparrow	<i>Zonotrichia albicollis</i>				X	*	X
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>		X	X	X	X	X
Dark-eyed Junco	<i>Junco hyemalis</i>		X	X	X	X	X
Yellow-breasted Chat	<i>Icteria virens</i>		X	X	X		X
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>		X	X	X	*	X
Western Meadowlark	<i>Sturnella neglecta</i>		X	X	X	X	X
Hooded Oriole	<i>Icterus cucullatus</i>		X		*		X
Bullock's Oriole	<i>Icterus bullockii</i>		X	X	X	X	X
Red-winged Blackbird	<i>Agelaius phoeniceus</i>		X	X	X	X	X
Brown-headed Cowbird	<i>Molothrus ater</i>		X	X	X	X	X
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	D	X		X	*	X
Great-tailed Grackle	<i>Quiscalus mexicanus</i>		X	X	X	X	X
Ovenbird	<i>Seiurus aurocapilla</i>				X		X
Black-and-white Warbler	<i>Mniotilta varia</i>		X	*	X	X	X
Orange-crowned Warbler	<i>Oreothlypis celata</i>		X	X	X	X	X
Lucy's Warbler	<i>Oreothlypis luciae</i>	C	X	X		X	X
Nashville Warbler	<i>Oreothlypis ruficapilla</i>		X	X	X		X
Virginia's Warbler	<i>Oreothlypis virginiae</i>	C; D; E		X			X
MacGillivray's Warbler	<i>Geothlypis tolmiei</i>		X	X	X		X
Common Yellowthroat	<i>Geothlypis trichas</i>		X	X	X	X	X
Hooded Warbler	<i>Setophaga citrina</i>		*				*
Yellow Warbler	<i>Setophaga petechia</i>	B	X	X	X		X
Blackpoll Warbler	<i>Setophaga striata</i>				X		X
Yellow-rumped Warbler	<i>Setophaga coronata</i>		X	X	X	X	X
Black-throated Gray Warbler	<i>Setophaga nigrescens</i>		X	X	X		X
Townsend's Warbler	<i>Setophaga townsendi</i>		X	X			X
Wilson's Warbler	<i>Cardellina pusilla</i>		X	X	X	X	X
Summer Tanager	<i>Piranga rubra</i>	A; B	X	X			X
Western Tanager	<i>Piranga ludoviciana</i>		X	X			X
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>		X	X			X
Blue Grosbeak	<i>Passerina caerulea</i>	A	X	X	X		X

Common Name	Scientific Name	Conservation Status	Breeding Season	Fall Transition	Non-Breeding Season	Winter Transition	Overall
Lazuli Bunting	<i>Passerina amoena</i>		X	X	*		X
Indigo Bunting	<i>Passerina cyanea</i>		X	X			X
Species Richness		55	194	163	171	132	229
Conservation Priority Richness		55	46	38	37	27	55

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

Year	Breeding	Fall Transition	Non-Breeding	Winter Transition	COMBINED (avg # species/survey)	# Weirs	# Ha Reveg*
Year 1	34.0	34.0	31.7	26.3	32.3	9	30
Year 2	32.9	40.0	30.3	32.7	32.5	10	55
Year 3	35.3	34.5	35.2	29.0	34.5	10	71
Year 4	33.8	39.5	31.2	39.3	34.0	11	79
Year 5	34.8	44.5	34.0	31.3	34.8	12	105
Year 6	33.1	45.5	33.9	30.7	34.2	12	113
Year 10	46.2	41.5	43.9	44.7	44.8	19	172
Year 11	45.9	47.5	48.1	50.0	47.3	19	198
Year 12	44.9	50.0	46.2	47.3	46.0	19	204
Year 13	41.8	54.7	51.0	45.7	46.5	21	201
Year 14	46.1	51.7	45.6	44.3	46.4	21	208
COMBINED	39.0	43.9	39.2	38.3	39.4	14.8	130.5

* For Years 1-6, this number was derived from acreages reported in Las Vegas Wash Coordination Committee year-end reports as the study year ran February-January. From Year 10 onward, this number was derived from acreages reported in annual Las Vegas Wash vegetation monitoring reports, which reflect areas planted up to but not including the fall of that year, thus more closely approximating the new September-August study year.

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

Year	Breeding	Fall Transition	Non-Breeding	Winter Transition	COMBINED (avg # birds per 40 ha/survey)	# Weirs	# Ha Reveg*
Year 1	134.9	106.7	131.1	78.5	124.9	9	30
Year 2	132.3	123.8	126.2	114.7	127.5	10	55
Year 3	127.0	91.4	157.2	146.9	137.0	10	71
Year 4	143.8	109.3	151.9	156.3	145.4	11	79
Year 5	148.1	217.5	173.4	137.9	161.0	12	105
Year 6	131.3	141.7	192.1	121.4	152.0	12	113
Year 10	171.0	203.7	292.1	341.9	235.1	19	172
Year 11	193.2	167.4	302.7	452.9	259.1	19	198
Year 12	209.0	150.1	367.2	351.0	275.6	19	204
Year 13	156.7	198.3	386.4	291.7	247.8	21	201
Year 14	186.3	164.4	269.0	296.3	221.9	21	208
COMBINED	157.6	152.2	231.8	226.3	189.8	14.8	130.5

* For Years 1-6, this number was derived from acreages reported in Las Vegas Wash Coordination Committee year-end reports as the study year ran February-January. From Year 10 onward, this number was derived from acreages reported in annual Las Vegas Wash vegetation monitoring reports, which reflect areas planted up to but not including the fall of that year, thus more closely approximating the new September-August study year.

Table 5. Estimated species-specific densities (birds per 40 ha) for survey visits overall, among seasons from the full dataset (2005-2019), 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 100 m 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	Year13	Year14
American Coot	20.6	8.1	34.7	2.2	8.7	10.1	5.4	4.8	3.7	34.8	43.1	45.1	45.6	22.9
Yellow-rumped Warbler	11.1	1.5	26.7	6.2	3.2	11.5	10.7	13.7	14.4	13.3	8.6	10.1	13.8	16.9
Red-winged Blackbird	10.9	15.6	7.7	7.0	7.4	9.7	9.9	12.3	6.9	15.6	17.3	14.3	10.0	9.2
Mallard	10.4	4.6	16.0	1.0	2.1	4.6	4.0	8.4	6.3	18.0	24.5	18.4	15.7	11.4
Abert's Towhee (C)	10.3	10.6	9.4	15.6	14.3	10.2	10.8	11.5	10.9	8.6	8.1	8.9	7.7	6.8
Gadwall	10.3	3.0	16.6	0.7	1.1	1.6	1.5	2.0	2.5	12.9	20.8	30.9	20.9	18.4
Song Sparrow	8.1	9.6	6.5	12.2	12.8	10.5	9.4	7.7	9.2	5.9	6.4	6.7	4.7	3.2
American Wigeon	7.4	3.0	12.3	X	0.1	0.2	0.2	0.3	0.7	11.2	21.5	22.2	15.5	9.7
Marsh Wren	7.2	4.5	9.6	4.5	5.5	7.5	9.9	9.2	9.0	7.6	7.3	6.8	6.6	5.7
White-crowned Sparrow	6.9	0.9	16.0	4.2	4.3	5.5	5.8	8.3	8.7	6.7	5.7	7.6	9.9	8.6
Great-tailed Grackle	5.8	8.9	2.9	0.7	1.5	3.7	4.1	4.3	3.3	7.8	10.7	10.8	8.3	9.1
Verdin	5.8	6.6	4.8	3.5	4.5	3.9	4.9	5.6	5.4	5.9	5.5	6.7	8.0	9.7
Gambel's Quail (C)	5.3	6.2	4.8	1.7	1.1	1.0	1.7	3.3	8.6	6.3	5.7	8.1	9.4	11.5
Black-tailed Gnatcatcher	5.1	5.4	4.8	4.6	5.4	3.3	4.3	5.5	5.3	5.8	5.3	5.3	5.3	6.4
Bewick's Wren	5.1	5.2	4.4	7.4	8.0	4.9	6.8	6.7	5.4	4.6	4.0	3.3	2.7	2.4
American Pipit	4.9	0.9	9.9	1.3	2.7	2.1	5.8	6.0	4.9	11.4	3.5	4.7	6.4	5.4
Common Yellowthroat	4.7	9.2	0.2	4.1	4.6	4.6	6.0	4.8	4.5	4.9	5.4	6.3	3.4	3.5
Black Phoebe	3.8	2.3	5.0	3.9	4.4	3.4	3.8	3.7	3.8	4.9	3.9	4.0	3.1	3.2
Ruby-crowned Kinglet	2.8	0.5	5.9	4.7	4.2	3.4	2.2	2.3	2.4	2.3	2.0	1.8	2.6	3.4
Brown-headed Cowbird	2.6	5.6	0.0	3.3	3.8	3.6	4.4	3.1	3.0	2.1	1.6	1.6	0.9	1.3
Orange-crowned Warbler	2.5	0.5	4.2	1.7	1.1	1.8	2.0	1.7	2.7	1.2	3.0	4.2	3.6	4.0
Lucy's Warbler (C)	2.1	4.4		5.0	3.2	2.5	2.9	1.8	1.6	1.2	1.3	1.5	0.9	0.9
Mourning Dove	2.0	3.7	0.3	5.1	1.8	1.7	1.4	2.2	2.1	1.2	0.7	1.3	2.8	2.0
House Finch	1.8	1.2	2.6	0.9	1.3	1.4	1.3	4.0	2.8	0.9	2.4	1.4	1.5	1.5
Yellow-breasted Chat	1.7	3.7	0.0	3.2	2.9	2.2	3.4	1.1	1.5	1.0	1.5	0.8	0.8	0.9
Crissal Thrasher	1.7	1.4	1.9	1.9	1.4	0.8	1.2	1.8	1.9	1.6	2.0	2.3	1.9	1.7

Species (Conservation Status)	Overall	Breeding	Non- Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12	Year13	Year14
Yellow Warbler (B)	1.7	3.3	0.0	1.0	1.0	1.3	2.7	2.4	2.2	1.1	1.7	1.8	1.7	1.3
Blue Grosbeak (A)	1.3	2.7	0.0	2.3	1.7	1.6	1.7	1.0	1.0	0.9	1.2	1.6	0.9	1.0
Killdeer	1.1	1.4	0.8	1.7	0.9	0.3	0.8	0.9	0.3	2.1	1.3	0.7	1.5	2.1
Yellow-headed Blackbird	1.0	1.2	0.0	0.9	0.3	0.0	0.3	0.3	0.1	5.4	1.7	0.7	0.4	1.2
Greater Roadrunner	1.0	1.3	0.6	0.7	0.6	0.6	0.6	0.5	0.6	1.0	1.4	2.0	1.3	1.7
Say's Phoebe	1.0	0.7	1.3	0.5	0.6	0.3	1.0	1.7	1.1	0.8	1.1	1.1	1.3	0.9
Great Blue Heron	0.9	0.7	1.0	0.2	0.3	0.3	0.2	0.7	0.4	1.4	1.7	1.8	1.5	1.0
Northern Flicker	0.8	0.1	1.7	0.4	0.5	0.9	0.9	0.6	0.7	1.0	0.9	0.8	0.8	0.9
Brewer's Sparrow (C)	0.7	0.5	0.1	0.3	0.5	1.0	1.0	2.0	0.9	0.2	0.4	0.2	0.2	0.5
Lesser Goldfinch	0.6	0.4	0.6	0.4	0.7	0.3	0.6	1.1	2.8	0.3	0.4	0.2	0.2	0.2
Anna's Hummingbird	0.6	0.7	0.4	0.1	0.0	0.0	0.0	0.1	0.0	0.6	1.0	1.5	1.8	1.5
Double-crested Cormorant	0.6	0.3	0.9	0.0	0.1	0.6	0.2	0.1	0.0	0.7	0.6	2.2	1.4	0.5
Eared Grebe (C)	0.6	1.2	0.0	0.0		0.2		0.1	X	0.0	2.0	3.3	0.3	0.2
White-faced Ibis (C)	0.5	0.8	0.1	0.1	0.2	X	0.0	0.0	0.0	0.4	0.2	0.5	1.4	3.1
Wilson's Warbler	0.5	1.0	0.0	1.1	0.8	0.6	0.5	0.5	0.2	1.0	0.1	0.2	0.7	0.2
Western Kingbird	0.5	1.0		0.2	0.3	0.6	0.4	0.5	0.4	1.1	0.6	1.2	0.3	0.1
Northern Pintail (C)	0.5	0.0	1.2	X	0.0		X	X	0.1	1.6	1.5	1.5	0.6	0.5
Dark-eyed Junco	0.5	0.1	1.1	0.1	0.2	1.6	0.9	0.9	0.4	0.3	0.4	0.1	0.3	0.0
Ring-billed Gull	0.5	0.3	0.6	X	0.6	1.2	X	0.0	X	0.1	0.9	0.0	1.2	1.2
Northern Mockingbird	0.5	0.5	0.4	0.0	0.2	0.2	0.1	0.2	0.2	0.5	1.1	1.2	0.6	0.8
Lincoln's Sparrow	0.5	0.2	0.8	0.8	0.2	0.5	0.3	0.3	0.3	0.3	0.4	0.6	0.8	0.4
Spotted Sandpiper	0.4	0.5	0.3	0.3	0.6	0.1	0.3	0.6	0.2	0.8	0.6	0.5	0.3	0.5
Canada Goose	0.4	0.3	0.3		X	0.2		0.0	0.1	0.5	0.5	1.8	0.8	0.7
Northern Rough-winged Swallow	0.4	0.8	X	0.2	0.2	0.2	1.0	0.4	0.1	0.1	0.4	0.3	0.2	1.5
Least Sandpiper (C)	0.4	0.3	0.7					1.1	0.4	1.5	0.1	0.0	0.7	0.4
Loggerhead Shrike (D)	0.4	0.3	0.4	0.4	0.2	0.1	0.2	0.6	0.2	0.5	0.6	0.5	0.4	0.3
Black-chinned Hummingbird	0.4	0.7	0.0	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.5	0.4
Northern Shoveler	0.4	0.1	0.7	0.1	0.0			0.0	X	0.4	1.5	1.4	0.0	0.4
Bufflehead	0.3	0.0	0.6			0.2	0.3	0.0	0.1	0.7	1.1	0.4	0.6	0.3
Common Gallinule	0.3	0.4	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.5	0.4	0.6	0.6	0.5
Savannah Sparrow	0.3	0.2	0.4	0.1		0.3	0.5	0.3	0.3	0.2	0.5	0.6	0.4	0.4

Species (Conservation Status)	Overall	Breeding	Non- Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12	Year13	Year14
Green-winged Teal	0.3	0.1	0.4		0.1	0.3	0.1	0.1	0.1	0.5	0.7	0.2	0.7	0.6
Pied-billed Grebe	0.3	0.3	0.4	0.1	0.1	0.5	0.2	0.1	0.1	0.1	0.5	0.8	0.5	0.3
Green Heron	0.3	0.5	0.1	0.3	0.5	0.3	0.3	0.2	0.2	0.4	0.1	0.3	0.2	0.2
Bushtit	0.3	0.0	0.5	0.6	0.4	0.2	0.0	1.2	0.5					
Greater Yellowlegs	0.3	0.1	0.4	0.3	0.3	0.1	0.2	0.2	0.3	0.5	0.6	0.1	0.3	0.2
Western Meadowlark	0.2	0.0	0.4	X	0.0		0.0	0.1	0.1	0.2	0.3	1.1	0.3	0.5
Cooper's Hawk	0.2	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.4	0.4	0.5	0.5
Belted Kingfisher	0.2	0.1	0.4	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.4	0.3	0.2	0.3
Snowy Egret (C)	0.2	0.2	0.2	0.2	0.0	0.3	0.0	0.1	0.1	0.3	0.3	0.4	0.2	0.5
Blue-gray Gnatcatcher	0.2	0.2	0.2	0.4	0.5	0.2	0.6	0.1	0.1	0.2		0.0	0.1	0.1
Cinnamon Teal (C)	0.2	0.3	0.0	0.1	X	X	0.0	0.2		0.3	0.5	0.1	0.4	0.7
Lesser Scaup (C)	0.2	0.0	0.2							0.2	0.0	0.5	0.7	0.8
Common Merganser	0.2	0.1	0.2	0.0	0.0	0.1	0.0	0.1	0.0	0.2	0.4	0.6	0.2	0.2
White-winged Dove	0.2	0.4	0.0	0.3	0.2	0.3	0.3	0.4	0.2	0.2	0.0	X	X	X
Black-crowned Night-Heron	0.2	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.1	0.2	0.1	0.4	0.4	0.3
Bullock's Oriole	0.2	0.3	0.0	0.0	0.1	0.1		0.1	0.2	0.2	0.4	0.4	0.2	0.2
Ring-necked Duck	0.2	X	0.3				X	X		0.1	0.4	0.1	0.5	0.7
American Avocet (C)	0.2	0.3	0.0	0.2				0.0	X	0.3	0.0	0.0	0.3	0.9
Costa's Hummingbird (C)	0.1	0.2	0.0	0.1	0.2	0.2	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.2
Sora	0.1	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.4	0.3	0.3
Chipping Sparrow	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.7	0.1	X	0.0	0.1	0.1	0.0
Cliff Swallow	0.1	0.3	0.0	X	X	0.1	0.7	0.1	X	X	X	X	X	0.5
Great Egret	0.1	0.1	0.2	0.1	0.0	0.1	0.1	0.2	0.1	0.1	0.2	0.3	0.1	0.2
Western Wood-Pewee	0.1	0.2		0.1	0.1	0.1	0.2	0.0	0.2	0.3	0.1	0.1	0.2	0.2
Black-necked Stilt (C)	0.1	0.3		0.1	X			0.1	X	0.1	0.0	0.0	0.2	0.9
Spotted Towhee	0.1	0.0	0.3	0.1	0.1	0.2	0.3	0.1	0.1	0.1	0.0		0.1	0.3
Osprey	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.2	0.2	0.2
Barn Swallow	0.1	0.2	0.0	X	X	1.2	0.1	X	X	X	X	X	0.0	0.0
Rock Wren	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.3	0.3	0.0	0.1	0.0	0.0	0.0
Lazuli Bunting	0.1	0.1	X	0.1	0.1	0.0	0.2	0.0	X	0.0	0.0	0.0	0.4	0.2
Red-tailed Hawk	0.1	0.0	0.2	0.1	0.0	0.1	0.1	0.0	0.1	0.2	0.1	0.1	0.1	0.1

Species (Conservation Status)	Overall	Breeding	Non- Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12	Year13	Year14
Warbling Vireo	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.2	0.0	0.1	0.2	0.1	0.1	0.1
American Kestrel	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.2	0.1
Phainopepla (A)	0.1	0.0	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.0	0.1	X	0.1	0.0
Indigo Bunting	0.1	0.2						0.1	0.1	0.1	0.2	0.3	0.1	0.1
Northern Harrier	0.1	0.0	0.2	0.0	0.1	0.3	0.1	0.0	X	0.0	0.1	0.1	0.1	0.1
Brewer's Blackbird (D)	0.1	0.0	0.2		X		0.4	0.1	0.4				0.0	
Virginia Rail	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.2	0.1	0.1	0.1	0.1	0.1
House Wren	0.1	0.0	0.2	0.0	0.0			0.0		0.0	0.1	0.2	0.3	0.2
Hooded Merganser	0.1	0.0	0.1							0.0	0.3	0.2	0.3	0.1
Sharp-shinned Hawk	0.1	0.0	0.2	0.2	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Horned Lark (D)	0.1	0.1	0.0	0.1		0.3	0.3	0.0	0.0	0.1		X	X	
Western Sandpiper (C)	0.1	0.1	0.0	0.4	0.0			0.2	0.1	0.1			X	0.0
Pine Siskin (D)	0.1	0.0	0.2	0.1		0.3			0.2		0.2			
Long-billed Dowitcher (C)	0.1	0.1	0.0		0.1					0.1	0.1	0.2	0.1	0.2
Western Tanager	0.1	0.1		0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.2	0.1
Bell's Vireo (A; B; C)	0.1	0.1		0.2		0.1			0.1	0.1	0.2	0.0	0.0	0.1
Common Goldeneye	0.1	0.0	0.1			0.0	0.1	0.0	X	0.0	0.1	0.1	0.1	0.1
American White Pelican (C)	0.1	0.1	0.1				0.0	X	0.0	0.3	0.3	0.0	X	X
Ladder-backed Woodpecker	0.1	0.0	0.1	0.0			0.0	0.0	0.2	0.1	0.1	0.1	0.0	0.0
American Robin	0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1
Black-headed Grosbeak	0.1	0.1		0.1	0.1	0.0		0.0	0.1	0.0	0.0	0.0	0.1	0.1
Red-shouldered Hawk	0.1	0.0	0.1					X	0.0	0.0	0.1	0.2	0.2	0.1
Ash-throated Flycatcher	0.0	0.1		0.1	0.0	0.1	0.0	X	0.1	0.1	0.0	0.1		0.0
Great Horned Owl	0.0	0.0	0.1		0.0	0.0		0.1	0.1	0.0	0.1	0.0	0.1	0.1
Hermit Thrush	0.0	0.0	0.1	0.1	0.2	0.0	0.0	0.0		0.0	0.0		0.0	0.0
Least Bittern (B; C)	0.0	0.1	0.0	0.0	0.0	0.1	0.1	X	0.0	0.1	0.0	0.0	0.0	0.0
Lark Sparrow	0.0	0.1				0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0
Greater White-fronted Goose	0.0		0.1						X			0.0		0.3
Common Raven	0.0	0.0	0.0	X	X	0.1	X	0.0	X	0.1	X	0.1	0.0	0.0
Nashville Warbler	0.0	0.0	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Western Flycatcher (unidentified)	0.0	0.1		0.0	0.1	0.1	0.0		X	0.1		0.0	0.0	0.0

Species (Conservation Status)	Overall	Breeding	Non- Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12	Year13	Year14
Ruddy Duck	0.0	X	0.0						X	0.2	0.0			0.1
MacGillivray's Warbler	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0		0.1		0.0
Eurasian Collared-Dove	0.0	0.0	0.0					0.0	X	0.0	0.0	0.1	0.0	0.0
Neotropic Cormorant	0.0	0.0	0.0							0.0	0.2	X	0.0	0.0
Hooded Oriole	0.0	0.0	X			0.0						0.0	0.1	0.1
Dusky Flycatcher	0.0	0.0		0.0	0.0	0.1		0.0		0.0				
Golden-crowned Kinglet	0.0		0.1	0.0		0.1	0.0	0.0	0.0					0.0
Gray Flycatcher (C)	0.0	0.0	0.0	0.0		0.1		0.0	0.0		0.0	0.0		
Wilson's Snipe	0.0	0.0	0.0					0.0	X	0.0	0.0		0.0	0.1
Bank Swallow	0.0	0.0						X			X			0.2
Townsend's Warbler	0.0	0.0							0.1	0.1			0.0	0.0
Black-throated Gray Warbler	0.0	0.0	0.0					0.0				0.0	0.1	0.1
Pacific Wren	0.0		0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	X
Red-naped Sapsucker	0.0	0.0	0.0	0.0	0.1	0.0				0.0	0.0		0.0	
Horned Grebe	0.0	0.0	0.0							0.0	0.1	0.0		
Barn Owl	0.0	0.0	0.0	0.1	0.0	0.0		0.0		X		X	0.0	X
Cedar Waxwing	0.0	X	0.0	0.1	0.0			X					0.1	X
Lesser Nighthawk	0.0	0.0		X	0.0	X	X	0.0	X	0.0	0.0	0.1	X	X
Olive-sided Flycatcher (C; D; E)	0.0	0.0		0.0		0.0			0.0	0.0	0.0	0.0		0.0
Red-breasted Nuthatch	0.0		0.0			0.0	0.0			0.0	0.0		0.0	
Lesser Yellowlegs	0.0	0.0	0.0					0.0		0.0	X		0.0	0.0
Black-throated Sparrow	0.0	0.0	X		0.0				0.1					
Solitary Vireo (unidentified)	0.0	0.0		X	0.0	0.0	0.1							X
Western Grebe (C)	0.0	0.0	0.0	X		0.0				0.0	0.0	X		X
Snow Goose	0.0	X	0.0	X				X	X		0.0		X	0.1
Vesper Sparrow	0.0	0.0						0.0	0.0	0.0			X	X
American Goldfinch	0.0	0.0	0.0					0.0		0.0			0.0	X
Violet-green Swallow	0.0	0.0	X		X	0.0	0.0	0.0	X	X	X		X	X
Brown-crested Flycatcher	0.0	0.0		0.0				X					0.0	0.0
Plumbeous Vireo	0.0	0.0					0.0			0.0	0.0		0.0	
Tree Swallow	0.0	0.0	0.0			0.0	0.0	X	X	X	X	X	X	X

Species (Conservation Status)	Overall	Breeding	Non- Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12	Year13	Year14
Dunlin	0.0	0.0								0.1				
Semipalmated Sandpiper	0.0	0.0			0.1									
Canyon Wren	0.0	0.0	0.0	0.0	0.0	X	X			X			0.0	
Merlin	0.0	X	0.0		0.0			0.0	X		0.0		X	0.0
Green-tailed Towhee (C)	0.0	0.0					0.0	0.0				0.0	0.0	
Black-and-white Warbler	0.0	0.0	0.0									0.0	X	0.0
European Starling	0.0	0.0	0.0				X	X	0.0		0.0			0.0
Redhead (C)	0.0	0.0	X				0.0		X	0.0	X	X	X	0.0
Sagebrush Sparrow (C)	0.0	X	0.0								0.0	0.0		
Willow Flycatcher (A; B; C)	0.0	0.0					0.0		0.0					
Western Bluebird	0.0		0.0	0.1	X			X						
Eastern Kingbird	0.0	0.0							0.0		0.0	0.0		
Vermilion Flycatcher (A; B)	0.0		0.0										0.0	0.0
Wood Duck	0.0		0.0				0.0			X		X	0.0	X
Cassin's Vireo	0.0	0.0											0.0	0.0
Peregrine Falcon (C)	0.0	0.0	0.0	X	X	X	0.0	0.0	X	X	X	X	0.0	X
Caspian Tern	0.0	0.0	X				X			X	X		0.0	0.0
Rock Pigeon	0.0	X	0.0	X	X	0.0	0.0	X	X			X	X	X
Swamp Sparrow	0.0		0.0										0.0	X
American Bittern	0.0	0.0			0.0			0.0				X		
House Sparrow	0.0	0.0	0.0	0.0		X				0.0				
Brown Creeper	0.0		0.0							0.0			0.0	
Prairie Falcon (C)	0.0	X	0.0	X	X			0.0	X	X	X	X	X	0.0
Rufous Hummingbird (C; E)	0.0	0.0						X	0.0					
Solitary Sandpiper	0.0	0.0											0.0	
Cactus Wren	0.0		X					X			0.0			
Summer Tanager (A; B)	0.0	0.0		X						0.0				0.0
Turkey Vulture	0.0	0.0	X	X	X	X	0.0	X	X	X	X	0.0	X	X
White-throated Swift (C)	0.0	0.0	X	X	X	X	X	X	X	X	X	X	X	0.0
Willet (C)	0.0	0.0								X	0.0			0.0
Semipalmated Plover	0.0	0.0		0.0										

Species (Conservation Status)	Overall	Breeding	Non- Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12	Year13	Year14
California Gull	0.0	0.0	X					X	X	X		X	X	0.0
Canyon Towhee	0.0	0.0			0.0									
Fox Sparrow	0.0		0.0										0.0	
Hairy Woodpecker	0.0		0.0		0.0									
Bonaparte's Gull	0.0	0.0								X	X		0.0	
Long-eared Owl (E)	0.0	X		X										0.0
Sandhill Crane (C)	0.0	0.0	X						X		X		0.0	
Swainson's Hawk (C)	0.0	0.0				X			X		X	X	0.0	
Bell's Sparrow (C)	0.0													0.0
Blackpoll Warbler	0.0		0.0								0.0			
Blue-winged Teal	0.0	X	0.0	X						X	0.0		X	X
Broad-tailed Hummingbird	0.0								0.0					
Brown Thrasher	0.0		0.0											0.0
Cattle Egret	0.0	X								X	0.0			X
Gray Catbird	0.0		0.0											0.0
Groove-billed Ani	0.0		0.0											0.0
Hammond's Flycatcher	0.0	0.0								0.0				X
Mountain Bluebird	0.0		0.0				0.0							
Ovenbird	0.0		0.0						0.0					
Pectoral Sandpiper	0.0							0.0						
Red Crossbill	0.0		0.0								0.0			
Ross's Goose	0.0		0.0					X				0.0		X
Rufous-crowned Sparrow	0.0	0.0				0.0								
Scissor-tailed Flycatcher	0.0								0.0					
Swainson's Thrush	0.0													0.0
Virginia's Warbler (C; D; E)	0.0					0.0								
White-throated Sparrow	0.0		0.0											0.0
Cackling Goose/Lesser Canada Goose	X													X
Canvasback (C)	X		X								X			
Cassin's Kingbird	X	X												X
Clark's Grebe (C)	X	X	X				X			X	X			X

Species (Conservation Status)	Overall	Breeding	Non- Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12	Year13	Year14
Common Nighthawk (D)	X												X	X
Eastern Phoebe	X		X											X
Forster's Tern	X	X									X			
Franklin's Gull (C)	X	X									X			X
Golden Eagle (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		X
Marbled Godwit (C)	X										X			
Northern Goshawk (C)	X		X						X					
Sage Sparrow (Unidentified) (C)	X		X											X
Short-billed Dowitcher	X	X											X	
Snow Goose (x Domestic Goose?)	X		X										X	
Stilt Sandpiper	X											X		
Tundra Swan (C)	X		X									X		
Vaux's Swift	X	X	X			X		X					X	
Western/Clark's Grebe	X	X									X			
Western/Least Sandpiper	X										X			
Whimbrel	X	X								X				
White Ibis	X	X										X		
White-tailed Kite	X	X								X				
Wilson's Phalarope (C)	X	X									X		X	X

Table 6. Breeding and non-breeding abundances (birds per 40 ha) by species for each of 11 survey years (2005-2019). Species listed 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 100 m 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	13	14	1	2	3	4	5	6	10	11	12	13	14
American Coot	1.2	1.4	5.5	3.3	1.3	1.1	10.5	17.5	20.4	12.3	15.0	4.5	16.8	9.6	6.0	7.7	6.7	61.1	58.6	82.9	97.1	30.2
Yellow-rumped Warbler	0.3	1.1	1.7	0.7	0.9	0.4	1.2	1.7	3.1	3.8	1.5	16.8	6.1	25.3	27.1	32.3	39.6	32.0	19.0	21.0	29.9	45.1
Red-winged Blackbird	5.3	8.7	11.7	15.1	15.6	14.1	25.4	24.0	23.6	11.8	15.9	12.9	8.8	11.1	4.4	8.2	0.6	4.4	14.4	5.9	11.3	3.0
Mallard	0.5	0.4	2.0	2.4	4.8	3.1	6.8	11.5	7.6	5.1	6.6	1.3	5.2	6.6	4.8	11.3	11.1	31.4	33.5	30.3	28.4	12.5
Abert's Towhee (C)	17.4	15.8	9.9	11.1	11.0	10.8	7.8	7.5	9.6	7.7	8.0	13.1	12.6	10.5	9.3	11.1	9.9	8.8	8.9	8.0	5.7	5.2
Gadwall	0.1	0.0	0.3	0.5	0.7	0.2	0.7	5.4	9.8	7.0	8.7	1.7	2.5	2.1	1.7	2.7	4.6	18.6	29.3	51.5	37.3	30.2
Song Sparrow	14.2	15.2	12.1	12.0	9.1	10.9	7.9	7.9	9.1	4.2	3.3	10.2	9.7	9.5	5.9	6.8	7.7	2.9	5.2	4.7	5.4	3.7
American Wigeon		X	0.1	0.3	X	X	2.5	12.0	7.0	5.2	5.7	X	X	0.3	0.1	0.3	0.6	17.5	23.9	44.1	37.4	11.2
Marsh Wren	2.0	2.9	4.7	8.2	7.6	6.9	4.1	3.4	3.5	3.6	3.1	7.1	7.6	9.7	11.0	10.5	11.2	9.9	10.5	10.2	10.2	8.0
White-crowned Sparrow	0.6	1.4	0.3	0.2	0.6	0.7	0.8	1.2	1.2	2.3	1.2	10.4	6.5	13.5	15.0	19.2	21.2	15.7	13.7	17.2	21.7	21.6
Great-tailed Grackle	0.6	2.0	5.2	5.9	7.2	4.4	13.4	17.0	16.9	11.0	14.5	1.2	1.2	2.6	2.8	1.2	2.9	2.8	3.2	3.7	5.8	4.0
Verdin	3.9	5.9	4.3	5.0	6.0	5.6	6.2	5.8	8.0	9.6	11.8	3.0	2.3	3.8	4.7	5.5	4.6	5.8	4.9	5.1	5.6	7.5
Gambel's Quail (C)	3.2	1.8	1.5	1.7	4.6	9.6	6.2	7.4	10.8	8.9	12.2	0.6	0.7	0.6	1.8	1.6	8.9	6.5	4.0	5.1	10.3	12.1
Black-tailed Gnatcatcher	5.0	6.8	3.2	4.2	5.2	4.8	6.2	5.2	5.9	6.1	6.7	3.6	4.6	3.1	4.4	5.7	5.4	4.6	5.5	4.5	4.4	6.9
Bewick's Wren	7.1	9.0	4.8	7.0	6.6	3.8	4.6	5.0	3.9	2.5	2.4	6.8	6.1	4.7	7.0	5.0	6.9	3.5	2.5	2.2	2.5	1.3
American Pipit	X	0.1	0.4	X	3.8	0.4	1.1	0.3	0.1	2.5	0.8	3.8	6.7	3.6	13.0	8.7	12.3	20.5	9.1	8.4	12.9	10.5
Common Yellowthroat	8.1	8.9	9.3	11.3	10.1	9.0	9.4	10.5	12.2	6.2	6.3	0.0		0.0	0.2		0.1	0.5	0.3	0.4	0.1	0.2
Black Phoebe	2.3	2.7	2.1	2.3	2.3	2.0	3.4	2.1	2.0	2.2	2.2	4.9	5.6	4.3	5.9	4.2	5.6	5.7	5.4	6.3	3.8	3.5
Ruby-crowned Kinglet	0.8	0.8	0.5	0.4	0.2	0.1	0.4	0.3	0.6	0.4	0.6	10.1	7.7	7.4	4.1	5.4	4.8	3.9	4.4	3.4	5.8	7.9
Brown-headed Cowbird	7.2	8.2	7.8	9.5	6.7	6.4	4.4	3.6	3.4	1.8	2.6		X		0.0			0.0				
Orange-crowned Warbler	0.4	0.4	0.4	0.1	0.3	0.4	0.2	0.3	0.8	0.7	0.8	2.9	2.0	3.1	4.0	2.6	4.5	1.4	4.9	8.0	6.1	6.9
Lucy's Warbler (C)	10.8	7.0	5.2	6.2	3.9	3.5	2.4	2.8	3.2	2.0	2.0											
Mourning Dove	10.5	3.5	3.1	2.8	4.3	4.5	2.3	1.2	2.8	3.1	2.6	0.3	X	0.3	0.1	0.2	X	0.4	0.3	0.0	0.1	1.6
House Finch	1.3	1.1	0.9	1.1	4.3	1.6	0.7	0.6	0.7	0.8	0.4	0.3	1.9	2.6	1.9	1.2	4.1	1.6	5.5	2.9	2.6	3.9
Yellow-breasted Chat	6.8	6.1	4.6	6.9	2.4	3.2	2.1	3.3	1.7	1.6	2.0			0.0								
Crissal Thrasher	1.5	1.7	0.5	1.0	1.7	1.4	1.8	1.5	2.2	1.0	1.6	2.4	0.9	1.0	1.5	2.0	2.2	1.3	2.4	2.6	2.7	2.1

Species (Conservation Status)	Breeding Season / Year											Non-Breeding Season / Year										
	1	2	3	4	5	6	10	11	12	13	14	1	2	3	4	5	6	10	11	12	13	14
Yellow Warbler (B)	2.3	2.0	2.8	5.6	4.8	4.6	2.1	3.3	3.2	3.3	2.3							0.1		0.0		
Blue Grosbeak (A)	4.4	3.5	3.3	3.5	2.3	1.9	2.0	2.3	3.2	1.7	2.0						0.0					
Killdeer	2.3	1.0	0.4	0.4	1.6	0.5	2.2	1.4	0.8	2.0	2.7	1.1	0.4	0.2	1.0	0.2	0.1	2.0	1.2	0.6	1.3	1.1
Yellow-headed Blackbird	1.9	0.2	0.1	0.4	0.7	0.2	4.9	1.4	1.1	0.5	2.3	0.0			0.3	X			0.0	X	X	X
Greater Roadrunner	0.9	1.0	1.0	0.7	0.7	0.9	1.7	1.6	2.4	1.5	1.8	0.4	0.1	0.2	0.4	0.2	0.1	0.4	0.9	1.4	1.1	1.1
Say's Phoebe	0.4	0.7	0.5	1.1	1.2	0.7	0.9	0.4	0.4	0.9	0.4	0.6	0.5	0.2	1.2	2.3	1.1	1.0	1.9	1.9	2.1	1.6
Great Blue Heron	0.2	0.1	0.3	0.1	0.8	0.3	1.5	1.5	1.0	0.6	0.9	0.2	0.4	0.3	0.2	0.6	0.4	1.4	1.7	2.6	2.2	1.0
Northern Flicker	X		0.1	0.1		0.0	0.0	0.1	0.1	X	0.2	0.9	1.1	2.1	1.9	1.0	1.7	2.0	2.0	1.7	2.1	2.1
Brewer's Sparrow (C)		0.7	1.7	0.3	0.6	1.2	0.2	0.0	0.1	0.4	X	0.3			0.5	0.4		0.0	0.3	X		
Lesser Goldfinch	0.1	0.4	0.2	0.1	0.5	1.8	0.3	0.1	0.2	0.1	0.5	0.2	0.1	0.2	0.8	0.6	3.6	0.3	0.3	0.4	0.1	0.1
Anna's Hummingbird	0.2	0.1		0.1	0.1	0.0	0.7	1.2	1.9	1.9	1.8	0.0			0.0	0.1		0.3	0.6	1.0	1.7	0.8
Double-crested Cormorant	0.0	0.1	0.2	0.1	0.2	0.0	0.5	0.5	0.8	0.2	0.2	X	0.1	1.3	0.1	0.1	X	0.3	0.9	3.5	2.7	0.6
Eared Grebe (C)	0.0		0.5		0.1		X	4.4	7.1	0.7	0.3						X	0.1	X	0.1		0.1
White-faced Ibis (C)	0.1	0.5	X	0.0	0.0	0.1	0.7	0.2	0.6	2.9	3.9	X	X		X				X	0.5	0.1	0.4
Wilson's Warbler	2.1	1.7	1.3	0.5	1.0	0.4	2.2	0.1	0.4	1.4	0.4	0.3							0.0			
Western Kingbird	0.4	0.7	1.2	0.8	0.9	0.5	2.3	1.0	2.5	0.4	0.1											
Northern Pintail (C)							X		X		0.1	X			X	X	0.2	4.3	3.1	3.4	1.7	1.0
Dark-eyed Junco	0.1			0.3			0.1				0.1	0.1	0.5	4.7	1.4	2.5	0.6	0.4	1.0	0.3	1.0	
Ring-billed Gull	X	X		X	X	X	0.0	X	X	1.5	1.7	X	1.8	3.1	X	0.1	X	0.2	1.0	0.0	0.8	0.2
Northern Mockingbird	0.1	0.3	0.2	0.0	0.2	0.2	0.8	1.2	1.1	0.7	0.9		0.2	0.0	0.1	0.3	0.2	0.4	0.8	1.4	0.3	0.7
Lincoln's Sparrow	0.1	0.1	0.3	0.1	0.1	0.0	0.1	0.2	0.4	0.4	0.0	1.9	0.2	0.9	0.7	0.5	0.7	0.8	0.5	1.0	1.1	0.7
Spotted Sandpiper	0.4	0.9	0.1	0.5	0.7	0.2	1.0	0.8	0.5	0.0	0.6	0.2	0.2		0.1	0.2	0.2	0.5	0.5	0.5	0.6	0.3
Canada Goose			0.2		X	0.1	1.0	0.3	0.2	1.0	0.3			0.4		0.1	X	0.0	0.2	1.0	0.7	1.3
Northern Rough-winged Swallow	0.2	0.4	0.3	2.0	0.7	X	0.2	0.8	0.7	0.4	2.9	X			X	X	X	X	X	X		X
Least Sandpiper (C)					1.2	0.7	0.5	0.3	X	0.1	0.5					1.6	0.0	3.5	X	0.1	1.9	X
Loggerhead Shrike (D)	0.6	0.3	0.1	0.3	0.5	0.1	0.4	0.1	0.5	0.0	0.0	0.2	0.1	0.1	0.1	0.6	0.3	0.6	0.8	0.6	0.7	0.5
Black-chinned Hummingbird	0.3	0.7	0.7	0.5	0.7	0.6	0.6	1.0	1.0	0.9	0.7				0.0			0.1	0.0	0.0		
Northern Shoveler					0.1		0.1	0.1	0.1	X	0.2	0.2					X	0.6	1.6	4.0	0.1	0.8
Bufflehead			0.0				0.1	0.0	0.2					0.5	X	0.1	0.2	1.5	2.1	0.7	1.6	0.6
Common Gallinule	0.1	0.2	0.2	0.1	0.3	0.3	0.7	0.5	0.6	0.4	0.8	0.1	0.2		0.1	0.1	0.1	0.2	0.4	0.2	0.8	0.2

Species (Conservation Status)	Breeding Season / Year											Non-Breeding Season / Year										
	1	2	3	4	5	6	10	11	12	13	14	1	2	3	4	5	6	10	11	12	13	14
Savannah Sparrow	0.2		0.4	0.2	0.0	0.1	0.2	0.1	0.1	0.2	0.2			0.2	0.6	0.5	0.4	0.1	0.5	0.6	0.8	0.3
Green-winged Teal		0.0	X	0.1	X	0.1	0.2	0.2	0.0	0.2	0.3		0.3	0.3	0.1	0.2	0.1	0.3	1.2	0.4	0.8	1.2
Pied-billed Grebe		0.0	0.4	0.3	0.2	0.1	0.1	0.5	0.5	0.3	0.5	0.2	0.2	0.7	X	0.1	0.3	0.1	0.5	1.3	0.7	0.1
Green Heron	0.5	0.8	0.4	0.5	0.4	0.4	0.9	0.3	0.4	0.4	0.3	0.1	0.2	0.1		0.0	0.1		X	0.1	X	0.1
Bushtit	0.1					0.1						1.6	1.0	0.1		3.3						
Greater Yellowlegs	X	0.1		0.0	0.1	0.3	0.3	0.3	0.0	0.3	0.1	0.7	0.2	0.3	0.3	0.2	0.1	0.5	1.0	0.3	0.4	0.1
Western Meadowlark		0.0					0.1	X	0.1	X	0.1				0.0	0.3	0.1	0.2	0.8	1.8	0.7	0.8
Cooper's Hawk	0.0		0.0	0.1	0.0	X	0.3	0.4	0.3	0.5	0.6	X	0.1	0.2	0.0	0.1	0.3	0.3	0.4	0.4	0.5	0.6
Belted Kingfisher	0.0	0.1	0.0	X	0.0	0.1	0.1	0.2	0.1	X	0.1	0.5	0.2	0.4	0.3	0.1	0.1	0.5	0.7	0.9	0.3	0.4
Snowy Egret (C)	0.3	X	0.2	0.0	0.1	X	0.4	0.4	0.3	X	0.3	X	0.1	0.5	X	0.0	0.0	0.0	0.1	0.5	0.5	0.5
Blue-gray Gnatcatcher	0.6	0.3	0.3	0.9					0.1	0.0	X	0.3			0.0	0.2	0.4	0.3			0.2	0.4
Cinnamon Teal (C)	0.2	X	X	0.1	0.1		0.1	1.0	0.2	0.6	1.4					0.1		0.3	X	X		
Lesser Scaup (C)							X	0.1	0.1	0.0	0.1							0.5	X	0.1	1.1	0.7
Common Merganser	0.1	X		0.0	X	X	0.2	0.2	0.5	X	0.1	X	0.0	0.1	0.0	X	0.0	0.2	0.5	0.6	0.2	0.3
White-winged Dove	0.6	0.4	0.7	0.7	0.8	0.5	0.3	0.1	X	X	X	0.0										
Black-crowned Night-Heron	0.1	0.1	0.0	0.0	X	0.0	0.2	0.1	0.3	0.1	0.3	X	0.2	0.1	0.0	X	0.3	0.3	0.1	0.4	0.8	0.2
Bullock's Oriole	0.0	0.3	0.2		0.1	0.2	0.4	0.7	0.8	0.4	0.4						0.0					
Ring-necked Duck							X	X		X	X				X	X		0.1	0.6	0.3	1.4	1.2
American Avocet (C)	0.4				0.1	X	0.3	X	X	0.6	2.0							0.0	X	X		X
Costa's Hummingbird (C)	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.3	0.5			X	0.0		0.0	0.2	0.1	0.0		
Sora		0.0	0.0	0.0		0.1	0.0	0.1	0.2	0.2	0.1	0.1	0.1	0.0	0.1	0.0	0.1	0.2	0.2	0.6	0.5	0.6
Chipping Sparrow	0.1		0.2		1.0	0.2				0.1					0.1	0.5		X				
Cliff Swallow	X	X	0.2	1.5	0.0	X	X	X	X	X	1.1			X	X	0.0				X		
Great Egret	0.0	X	X	0.0	0.2	0.1	0.1	0.0	0.2	0.0	0.2	0.1	0.0	0.2	0.0	0.1	0.1	X	0.2	0.5	0.3	0.2
Western Wood-Pewee	0.1	0.1	0.1	0.2	0.0	0.4	0.5	0.1	0.1	0.3	0.2											
Black-necked Stilt (C)	0.1	X			0.2	X	0.2	0.0	0.1	0.4	1.7											
Spotted Towhee	0.1		0.0	0.1		0.0				0.0	X	0.1	0.2	0.5	0.6	0.1	0.1	0.2	0.1		0.2	0.9
Osprey	X	0.1	0.0	X	0.1	0.0	0.2	0.3	0.2	X	0.2	X			0.0	X	X	0.5	0.1	0.1	0.3	0.1
Barn Swallow		X	2.6	X	X	X	X	X	X	0.1	0.0			X	X	X	X		X	X	0.1	X
Rock Wren	0.0	0.1	0.0	0.2	0.2	0.2	0.0	X				0.2	0.2	0.1	0.1	0.5	0.6	0.1	0.2	0.1	0.1	0.1

Species (Conservation Status)	Breeding Season / Year											Non-Breeding Season / Year										
	1	2	3	4	5	6	10	11	12	13	14	1	2	3	4	5	6	10	11	12	13	14
Lazuli Bunting	0.1	0.2	0.1	0.0	0.0	X	0.1	0.1	0.0	0.8	0.1		X									
Red-tailed Hawk	X	0.0		0.0	X	X	0.1	X	X	X	0.0	0.2	X	0.2	0.1	0.1	0.4	0.4	0.2	0.3	0.5	0.3
Warbling Vireo	0.2	0.1	0.1	0.1	0.3	0.1	0.2	0.0	0.1	0.1	0.1							X		0.1		
American Kestrel	0.1	0.1	0.1		0.1	0.1	0.3	0.3	0.1	0.3	X	X	X		X	X	0.2	X	0.2	0.1	0.2	0.1
Phainopepla (A)						0.0	X		X	0.0	X	0.5	0.5	0.1	0.5	0.3	0.0	0.1	0.2	X	0.3	0.1
Indigo Bunting					0.2	0.1	0.2	0.5	0.6	0.2	0.2											
Northern Harrier		0.0	0.1	X	0.0	X	X	X	X	X	0.0	0.1	0.2	0.6	0.1	0.1	X	0.1	0.0	0.2	0.2	0.3
Brewer's Blackbird (D)					0.2					0.0			X		1.3	0.1	1.2					
Virginia Rail	0.0	0.0	0.0	0.0		0.2	0.1	0.1	0.2	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.3	X	0.1	0.1	0.2	0.1
House Wren		0.0					0.0		0.0		0.1	0.0				0.0		0.1	0.2	0.5	0.6	0.5
Hooded Merganser							X	0.0	0.1	X								X	0.4	0.2	0.5	0.4
Sharp-shinned Hawk	X	X	X		0.0	X	X	X	X	X		0.4	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.1
Horned Lark (D)	0.1		0.6	0.3	0.0		0.1		X					0.1	0.4		0.0					
Western Sandpiper (C)	0.8				0.5	0.2	X			X							X	0.2				
Pine Siskin (D)	X							0.2				0.3		0.7			0.7		0.4			
Long-billed Dowitcher (C)		0.1					0.2	0.1	0.3	X	0.0							X	X	0.1	0.2	
Western Tanager	0.1	0.0	0.1		0.1	0.1	0.0	0.1	0.0	0.4	0.1											
Bell's Vireo (A; B; C)	0.4		0.2			0.1	0.1	0.3	0.0	0.0	0.2											
Common Goldeneye							X	0.1	0.1	0.0	X			0.1		0.1	X	0.0	0.0	X	0.2	0.2
American White Pelican (C)				0.1		0.0	0.3	0.1									X	0.5	0.2	X	X	X
Ladder-backed Woodpecker	0.0			0.0		0.1	0.1	X	0.1							0.1	0.3	0.1	0.3		0.1	
American Robin								0.0			0.1	0.1	0.0	0.3	0.2	0.1		0.1	0.1	0.2	0.1	0.2
Black-headed Grosbeak	0.2	0.1			0.1	0.1	0.0	0.1	0.1	0.2	0.2											
Red-shouldered Hawk							X	0.0	0.0	0.1	0.0					X		0.0	0.2	0.2	0.2	0.1
Ash-throated Flycatcher	0.1	X	0.2	0.0		0.2	0.1	0.1	0.1		0.1											
Great Horned Owl			0.0		0.1	0.1	0.0		0.1	0.1	0.0					0.0	0.0	X	0.2	0.0	0.1	0.2
Hermit Thrush	0.0	0.0										0.3	0.2	0.0	0.0				0.1		0.1	0.1
Least Bittern (B; C)	0.0		0.1	0.1	X	0.1	0.2	0.1	0.1	0.0	0.1		0.0	0.1					X	0.1		
Lark Sparrow			0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.2												
Greater White-fronted Goose																	X			0.1		1.1

Species (Conservation Status)	Breeding Season / Year											Non-Breeding Season / Year										
	1	2	3	4	5	6	10	11	12	13	14	1	2	3	4	5	6	10	11	12	13	14
Common Raven	X	X		X	X	X	0.1	X	0.2	X	X	X	X	0.3	X	X	X	0.0	X	X	0.1	0.1
Nashville Warbler			0.1			0.0	0.1	X	0.0	X							0.0		0.0	0.0		
Western Flycatcher (unidentified)		0.0	0.2	0.0		X	0.2		0.1	0.1	0.0											
Ruddy Duck							X				X						X	0.3	0.1			X
MacGillivray's Warbler	0.0		0.0			0.0	0.0		0.0		0.1									0.0		
Eurasian Collared-Dove					0.0	X	0.1	0.0	0.1	X	0.1								0.1	0.1	X	X
Neotropic Cormorant							0.0	0.3	X	0.1	X											0.1
Hooded Oriole			0.1						0.1	0.2	0.1			X								
Dusky Flycatcher	0.0	0.0	0.3				0.0															
Golden-crowned Kinglet												0.0		0.3	0.1	0.1	0.0					0.1
Gray Flycatcher (C)	0.0		0.2		0.1			0.0	0.0										0.0			
Wilson's Snipe					0.0	X	0.0	0.0			0.0								0.0		0.1	X
Bank Swallow					X			X			0.4											
Townsend's Warbler						0.2	0.1				0.0											
Black-throated Gray Warbler									X	0.2	0.1					0.0						
Pacific Wren												0.1					0.1	0.0		X	0.1	X
Red-naped Sapsucker	0.0											0.0	0.1	0.0				0.0	0.0			
Horned Grebe							0.0	0.1	0.1									0.0	0.1	X		
Barn Owl	0.1	0.1			0.0		X							0.0		X				X	0.1	
Cedar Waxwing										X	X	0.0				X					0.3	
Lesser Nighthawk	X	0.0	X	X	0.0	X	0.1	X	0.0	X	X											
Olive-sided Flycatcher (C; D; E)	0.0		0.0			0.0	0.0	0.0	0.1		0.0											
Red-breasted Nuthatch															0.0				0.0		0.1	
Lesser Yellowlegs							0.1			0.1	0.0					X						0.1
Black-throated Sparrow		0.0				0.2											X					
Solitary Vireo (unidentified)	X	0.0	0.0	0.2							X											
Western Grebe (C)							0.1	X	X		X	X		0.0				X	0.1			
Snow Goose	X					X										X	X		X		X	0.3
Vesper Sparrow					0.1	0.0																
American Goldfinch					0.0		X									0.1		0.1			0.1	X

Species (Conservation Status)	Breeding Season / Year											Non-Breeding Season / Year										
	1	2	3	4	5	6	10	11	12	13	14	1	2	3	4	5	6	10	11	12	13	14
Violet-green Swallow		X	0.1	0.1	X	X	X	X		X	X				X	X			X			
Brown-crested Flycatcher	0.1				X					0.0	0.1											
Plumbeous Vireo				0.0			0.0	0.0		0.1												
Tree Swallow				0.1	X	X	X	X	X	X	X			0.1			X			X		
Dunlin							0.2															
Semipalmated Sandpiper		0.1																				
Canyon Wren	0.0			X						0.0			0.0									
Merlin											X		0.0			0.0	X		X		X	0.1
Green-tailed Towhee (C)				0.0					0.0													
Black-and-white Warbler											0.0											0.1
European Starling								0.0			X					X	X		X			0.1
Redhead (C)							X		X	X	0.0						X		X			X
Sagebrush Sparrow (C)									X										0.1	0.1		
Willow Flycatcher (A; B; C)				0.1		0.0																
Western Bluebird												0.1	X			X						
Eastern Kingbird						0.0		0.0	0.0													
Vermilion Flycatcher (A; B)																					0.1	0.1
Wood Duck															0.0			X		X	0.1	X
Cassin's Vireo										0.0	0.0											
Peregrine Falcon (C)			X	0.0	X	X	X	X	X	0.0		X				0.0	X	X	X	X	X	X
Caspian Tern				X			X	X		0.1	0.0								X			
Rock Pigeon	X	X	X	X	X				X	X	X			0.1	0.0							
Swamp Sparrow																					0.1	
American Bittern		0.0																				
House Sparrow							0.0					0.0										
Brown Creeper																		0.0			0.1	
Prairie Falcon (C)						X			X							0.0	X	X	X		X	0.1
Rufous Hummingbird (C; E)						0.1																
Solitary Sandpiper										0.0												
Cactus Wren																X						

Species (Conservation Status)	Breeding Season / Year											Non-Breeding Season / Year										
	1	2	3	4	5	6	10	11	12	13	14	1	2	3	4	5	6	10	11	12	13	14
Summer Tanager (A; B)											0.0											
Turkey Vulture		X	X	X	X	X	X	X	0.0	X	X								X	X		X
White-throated Swift (C)	X	X	X	X	X	X	X	X	X	X	0.1		X							X		
Willet (C)							X	0.0			0.0											
Semipalmated Plover	0.0																					
California Gull						X	X				0.0					X	X	X		X	X	
Canyon Towhee		0.0																				
Fox Sparrow																					0.1	
Hairy Woodpecker													0.0									
Bonaparte's Gull							X	X		0.0												
Long-eared Owl (E)	X																					
Sandhill Crane (C)										0.0							X					
Swainson's Hawk (C)			X			X		X	X	0.0												
Blackpoll Warbler																			0.0			
Blue-winged Teal	X						X	X		X	X	X							0.0			
Brown Thrasher																						0.1
Cattle Egret							X															
Gray Catbird																						0.1
Groove-billed Ani																						0.1
Hammond's Flycatcher							0.0				X											
Mountain Bluebird															0.0							
Ovenbird																	0.0					
Red Crossbill																			0.0			
Ross's Goose																X				0.0		
Rufous-crowned Sparrow			0.0																			
White-throated Sparrow																						0.1
Canvasback (C)																			X			
Cassin's Kingbird											X											
Clark's Grebe (C)				X				X										X	X			
Eastern Phoebe																						X

Species (Conservation Status)	Breeding Season / Year											Non-Breeding Season / Year										
	1	2	3	4	5	6	10	11	12	13	14	1	2	3	4	5	6	10	11	12	13	14
Forster's Tern								X														
Franklin's Gull (C)								X			X											
Golden Eagle (C)																						X
Graylag Goose						X										X	X					
Hooded Warbler							X															
Lesser Black-backed Gull							X															
Long-billed Curlew (C)									X		X											
Northern Goshawk (C)																	X					
Sage Sparrow (Unidentified) (C)																						X
Short-billed Dowitcher										X												
Snow Goose (x Domestic Goose?)																					X	
Tundra Swan (C)																				X		
Vaux's Swift			X							X						X						
Western/Clark's Grebe								X														
Whimbrel							X															
White Ibis									X													
White-tailed Kite							X															
Wilson's Phalarope (C)								X		X												

Table 7. Relative species abundance (percent of total bird abundance) for all 11 years (overall), among seasons, and by survey year (2005-2019). Only species that represent at least 1% of the total bird abundance in one or more periods are listed (in descending order of overall relative 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). “X” indicates the species was only detected outside of the survey period or beyond 100 m 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	Year13	Year14
American Coot	10.8	5.2	15.0	1.8	6.9	7.3	3.7	3.0	2.4	14.8	16.6	16.4	18.4	10.3
Yellow-rumped Warbler	5.9	1.0	11.5	5.0	2.5	8.4	7.3	8.5	9.5	5.7	3.3	3.7	5.6	7.6
Red-winged Blackbird	5.7	9.9	3.3	5.6	5.8	7.1	6.8	7.6	4.6	6.6	6.7	5.2	4.0	4.1
Mallard	5.5	2.9	6.9	0.8	1.7	3.3	2.8	5.2	4.1	7.6	9.5	6.7	6.3	5.1
Abert's Towhee (C)	5.4	6.7	4.0	12.5	11.2	7.5	7.4	7.1	7.2	3.7	3.1	3.2	3.1	3.1
Gadwall	5.4	1.9	7.2	0.6	0.8	1.2	1.0	1.3	1.7	5.5	8.0	11.2	8.4	8.3
Song Sparrow	4.2	6.1	2.8	9.7	10.0	7.7	6.4	4.8	6.0	2.5	2.5	2.4	1.9	1.5
American Wigeon	3.9	1.9	5.3	X	0.1	0.2	0.1	0.2	0.4	4.7	8.3	8.1	6.3	4.4
Marsh Wren	3.8	2.9	4.2	3.6	4.3	5.5	6.8	5.7	5.9	3.2	2.8	2.5	2.7	2.6
White-crowned Sparrow	3.6	0.6	6.9	3.4	3.4	4.0	4.0	5.2	5.7	2.9	2.2	2.8	4.0	3.9
Great-tailed Grackle	3.1	5.7	1.2	0.6	1.2	2.7	2.8	2.7	2.2	3.3	4.1	3.9	3.3	4.1
Verdin	3.1	4.2	2.1	2.8	3.5	2.9	3.4	3.5	3.6	2.5	2.1	2.4	3.2	4.4
Gambel's Quail (C)	2.8	3.9	2.1	1.4	0.9	0.7	1.1	2.1	5.7	2.7	2.2	2.9	3.8	5.2
Black-tailed Gnatcatcher	2.7	3.4	2.1	3.7	4.3	2.4	2.9	3.4	3.5	2.4	2.0	1.9	2.2	2.9
Bewick's Wren	2.7	3.3	1.9	5.9	6.3	3.6	4.7	4.1	3.6	2.0	1.6	1.2	1.1	1.1
American Pipit	2.6	0.5	4.3	1.1	2.1	1.5	4.0	3.7	3.2	4.8	1.4	1.7	2.6	2.4
Common Yellowthroat	2.5	5.8	0.1	3.3	3.6	3.4	4.1	3.0	3.0	2.1	2.1	2.3	1.4	1.6
Black Phoebe	2.0	1.5	2.2	3.1	3.4	2.5	2.6	2.3	2.5	2.1	1.5	1.5	1.3	1.4
Ruby-crowned Kinglet	1.5	0.3	2.5	3.7	3.3	2.4	1.5	1.4	1.6	1.0	0.8	0.6	1.0	1.6
Brown-headed Cowbird	1.4	3.6	0.0	2.7	3.0	2.6	3.0	1.9	2.0	0.9	0.6	0.6	0.4	0.6
Orange-crowned Warbler	1.3	0.3	1.8	1.4	0.9	1.3	1.4	1.1	1.8	0.5	1.1	1.5	1.5	1.8
Lucy's Warbler (C)	1.1	2.8		4.0	2.5	1.8	2.0	1.1	1.1	0.5	0.5	0.5	0.4	0.4
Mourning Dove	1.1	2.4	0.1	4.1	1.4	1.2	0.9	1.4	1.4	0.5	0.3	0.5	1.1	0.9
House Finch	0.9	0.8	1.1	0.7	1.1	1.0	0.9	2.5	1.9	0.4	0.9	0.5	0.6	0.7
Yellow-breasted Chat	0.9	2.3	0.0	2.5	2.2	1.6	2.3	0.7	1.0	0.4	0.6	0.3	0.3	0.4

Species (Conservation Status)	Overall	Breeding	Non- Breeding	Year1	Year2	Year3	Year4	Year5	Year6	Year10	Year11	Year12	Year13	Year14
Crissal Thrasher	0.9	0.9	0.8	1.5	1.1	0.6	0.8	1.1	1.2	0.7	0.8	0.8	0.8	0.8
Yellow Warbler (B)	0.9	2.1	0.0	0.8	0.8	1.0	1.9	1.5	1.5	0.5	0.6	0.7	0.7	0.6
Blue Grosbeak (A)	0.7	1.7	0.0	1.9	1.3	1.1	1.2	0.6	0.6	0.4	0.5	0.6	0.4	0.4
Killdeer	0.6	0.9	0.4	1.4	0.7	0.3	0.5	0.6	0.2	0.9	0.5	0.3	0.6	0.9
Yellow-headed Blackbird	0.5	0.8	0.0	0.7	0.2	0.0	0.2	0.2	0.1	2.3	0.7	0.3	0.2	0.5
Say's Phoebe	0.5	0.4	0.6	0.4	0.5	0.3	0.7	1.0	0.7	0.3	0.4	0.4	0.5	0.4
Brewer's Sparrow (C)	0.3	0.3	0.1	0.2	0.4	0.7	0.7	1.2	0.6	0.1	0.2	0.1	0.1	0.2
Lesser Goldfinch	0.3	0.3	0.3	0.3	0.5	0.2	0.4	0.7	1.8	0.1	0.2	0.1	0.1	0.1
Eared Grebe (C)	0.3	0.8	0.0	0.0		0.2		0.0	X	0.0	0.8	1.2	0.1	0.1
White-faced Ibis (C)	0.3	0.5	0.0	0.1	0.2	X	0.0	0.0	0.0	0.2	0.1	0.2	0.6	1.4
Dark-eyed Junco	0.3	0.0	0.5	0.1	0.2	1.2	0.6	0.5	0.3	0.1	0.2	0.0	0.1	0.0

Table 8. Breeding and non-breeding relative species abundances (percent of total bird abundance) for each of 11 survey years (2005-2019). Only species that represent at least 1% of the total bird abundance in one or more periods are listed (in descending order of overall relative 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). “X” indicates the species was only detected outside of the survey period or beyond 100 m 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	13	14	1	2	3	4	5	6	10	11	12	13	14
American Coot	0.9	1.0	4.4	2.3	0.9	0.8	6.1	9.1	9.8	7.8	8.1	3.4	13.3	6.1	4.0	4.4	3.5	20.9	19.4	22.6	25.1	11.3
Yellow-rumped Warbler	0.2	0.8	1.4	0.5	0.6	0.3	0.7	0.9	1.5	2.4	0.8	12.8	4.8	16.1	17.9	18.6	20.6	11.0	6.3	5.7	7.7	16.8
Red-winged Blackbird	3.9	6.6	9.2	10.5	10.6	10.8	14.9	12.4	11.3	7.5	8.6	9.8	7.0	7.1	2.9	4.7	0.3	1.5	4.7	1.6	2.9	1.1
Mallard	0.3	0.3	1.6	1.7	3.2	2.4	4.0	6.0	3.7	3.3	3.6	1.0	4.1	4.2	3.2	6.5	5.8	10.7	11.1	8.3	7.4	4.7
Abert's Towhee (C)	12.9	12.0	7.8	7.7	7.4	8.3	4.6	3.9	4.6	4.9	4.3	9.9	10.0	6.7	6.1	6.4	5.2	3.0	2.9	2.2	1.5	1.9
Gadwall	0.1	0.0	0.2	0.3	0.4	0.1	0.4	2.8	4.7	4.5	4.7	1.3	2.0	1.3	1.1	1.6	2.4	6.4	9.7	14.0	9.7	11.2
Song Sparrow	10.5	11.5	9.6	8.4	6.2	8.3	4.6	4.1	4.4	2.6	1.8	7.8	7.7	6.0	3.9	3.9	4.0	1.0	1.7	1.3	1.4	1.4
American Wigeon		X	0.1	0.2	X	X	1.5	6.2	3.3	3.3	3.1	X	X	0.2	0.1	0.2	0.3	6.0	7.9	12.0	9.7	4.2
Marsh Wren	1.5	2.2	3.7	5.7	5.1	5.2	2.4	1.8	1.7	2.3	1.7	5.4	6.1	6.2	7.2	6.1	5.8	3.4	3.5	2.8	2.6	3.0
White-crowned Sparrow	0.4	1.1	0.2	0.1	0.4	0.5	0.5	0.6	0.6	1.5	0.6	7.9	5.1	8.6	9.9	11.1	11.1	5.4	4.5	4.7	5.6	8.0
Great-tailed Grackle	0.4	1.5	4.1	4.1	4.9	3.4	7.9	8.8	8.1	7.0	7.8	0.9	1.0	1.7	1.9	0.7	1.5	1.0	1.1	1.0	1.5	1.5
Verdin	2.9	4.5	3.3	3.5	4.1	4.3	3.6	3.0	3.8	6.1	6.4	2.3	1.8	2.4	3.1	3.2	2.4	2.0	1.6	1.4	1.5	2.8
Gambel's Quail (C)	2.3	1.3	1.2	1.2	3.1	7.3	3.6	3.8	5.2	5.7	6.6	0.5	0.6	0.4	1.2	0.9	4.6	2.2	1.3	1.4	2.7	4.5
Black-tailed Gnatcatcher	3.7	5.1	2.5	2.9	3.5	3.7	3.6	2.7	2.8	3.9	3.6	2.7	3.6	2.0	2.9	3.3	2.8	1.6	1.8	1.2	1.1	2.6
Bewick's Wren	5.3	6.8	3.8	4.9	4.5	2.9	2.7	2.6	1.9	1.6	1.3	5.2	4.9	3.0	4.6	2.9	3.6	1.2	0.8	0.6	0.6	0.5
American Pipit	X	0.1	0.3	X	2.5	0.3	0.7	0.1	0.0	1.6	0.4	2.9	5.3	2.3	8.5	5.0	6.4	7.0	3.0	2.3	3.3	3.9
Common Yellowthroat	6.0	6.7	7.4	7.9	6.8	6.9	5.5	5.5	5.8	4.0	3.4	0.0		0.0	0.2		0.1	0.2	0.1	0.1	0.0	0.1
Black Phoebe	1.7	2.0	1.7	1.6	1.6	1.6	2.0	1.1	0.9	1.4	1.2	3.7	4.5	2.8	3.9	2.4	2.9	2.0	1.8	1.7	1.0	1.3
Ruby-crowned Kinglet	0.6	0.6	0.4	0.3	0.1	0.1	0.2	0.1	0.3	0.2	0.3	7.7	6.1	4.7	2.7	3.1	2.5	1.3	1.5	0.9	1.5	2.9
Brown-headed Cowbird	5.3	6.2	6.2	6.6	4.5	4.9	2.6	1.8	1.6	1.2	1.4		X		0.0			0.0				
Orange-crowned Warbler	0.3	0.3	0.3	0.1	0.2	0.3	0.1	0.2	0.4	0.5	0.4	2.2	1.6	2.0	2.7	1.5	2.3	0.5	1.6	2.2	1.6	2.6
Lucy's Warbler (C)	8.0	5.3	4.1	4.3	2.6	2.7	1.4	1.5	1.5	1.3	1.1											
Mourning Dove	7.8	2.6	2.5	1.9	2.9	3.4	1.4	0.6	1.4	2.0	1.4	0.2	X	0.2	0.1	0.1	X	0.1	0.1	0.0	0.0	0.6
House Finch	0.9	0.8	0.7	0.7	2.9	1.3	0.4	0.3	0.3	0.5	0.2	0.3	1.5	1.7	1.2	0.7	2.1	0.6	1.8	0.8	0.7	1.5
Yellow-breasted Chat	5.0	4.6	3.6	4.8	1.6	2.4	1.2	1.7	0.8	1.0	1.1			0.0								

Species (Conservation Status)	Breeding Season/Year											Non-Breeding Season/Year										
	1	2	3	4	5	6	10	11	12	13	14	1	2	3	4	5	6	10	11	12	13	14
Crissal Thrasher	1.1	1.3	0.4	0.7	1.1	1.1	1.0	0.8	1.0	0.7	0.9	1.9	0.7	0.6	1.0	1.2	1.2	0.4	0.8	0.7	0.7	0.8
Yellow Warbler (B)	1.7	1.5	2.2	3.9	3.2	3.5	1.2	1.7	1.5	2.1	1.3							0.0		0.0		
Blue Grosbeak (A)	3.3	2.6	2.6	2.4	1.5	1.5	1.1	1.2	1.5	1.1	1.1						0.0					
Killdeer	1.7	0.7	0.3	0.3	1.1	0.4	1.3	0.7	0.4	1.3	1.4	0.8	0.3	0.1	0.7	0.1	0.0	0.7	0.4	0.2	0.3	0.4
Yellow-headed Blackbird	1.4	0.1	0.1	0.3	0.5	0.2	2.9	0.7	0.5	0.3	1.2	0.0			0.2	X			0.0	X	X	X
Greater Roadrunner	0.6	0.7	0.8	0.5	0.5	0.7	1.0	0.8	1.2	1.0	1.0	0.3	0.1	0.1	0.2	0.1	0.0	0.1	0.3	0.4	0.3	0.4
Say's Phoebe	0.3	0.6	0.4	0.8	0.8	0.5	0.5	0.2	0.2	0.6	0.2	0.4	0.4	0.1	0.8	1.3	0.6	0.3	0.6	0.5	0.6	0.6
Northern Flicker	X		0.1	0.1		0.0	0.0	0.1	0.1	X	0.1	0.7	0.9	1.3	1.2	0.6	0.9	0.7	0.6	0.5	0.5	0.8
Brewer's Sparrow (C)		0.5	1.3	0.2	0.4	0.9	0.1	0.0	0.0	0.2	X	0.2			0.3	0.2		0.0	0.1	X		
Lesser Goldfinch	0.1	0.3	0.2	0.1	0.3	1.4	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.5	0.4	1.9	0.1	0.1	0.1	0.0	0.0
Anna's Hummingbird	0.2	0.1		0.0	0.1	0.0	0.4	0.6	0.9	1.2	1.0	0.0			0.0	0.1		0.1	0.2	0.3	0.4	0.3
Double-crested Cormorant	0.0	0.1	0.2	0.1	0.1	0.0	0.3	0.3	0.4	0.2	0.1	X	0.1	0.8	0.1	0.1	X	0.1	0.3	1.0	0.7	0.2
Eared Grebe (C)	0.0		0.4		0.1		X	2.3	3.4	0.4	0.2						X	0.0	X	0.0		0.0
White-faced Ibis (C)	0.1	0.4	X	0.0	0.0	0.1	0.4	0.1	0.3	1.9	2.1	X	X		X				X	0.1	0.0	0.2
Wilson's Warbler	1.5	1.3	1.0	0.4	0.7	0.3	1.3	0.1	0.2	0.9	0.2	0.3							0.0			
Western Kingbird	0.3	0.5	0.9	0.5	0.6	0.4	1.3	0.5	1.2	0.3	0.1											
Northern Pintail (C)							X		X		0.1	X			X	X	0.1	1.5	1.0	0.9	0.4	0.4
Dark-eyed Junco	0.1			0.2			0.0				0.0	0.1	0.4	3.0	0.9	1.4	0.3	0.1	0.3	0.1	0.2	
Ring-billed Gull	X	X		X	X	X	0.0	X	X	0.9	0.9	X	1.4	1.9	X	0.1	X	0.1	0.3	0.0	0.2	0.1
Northern Rough-winged Swallow	0.2	0.3	0.2	1.4	0.5	X	0.1	0.4	0.3	0.2	1.6	X			X	X	X	X	X	X		X
Least Sandpiper (C)					0.8	0.5	0.3	0.1	X	0.1	0.3					0.9	0.0	1.2	X	0.0	0.5	X
Northern Shoveler					0.0		0.1	0.1	0.1	X	0.1	0.1					X	0.2	0.5	1.1	0.0	0.3
Bushtit	0.1					0.1						1.2	0.8	0.1		1.9						
Barn Swallow		X	2.0	X	X	X	X	X	X	0.0	0.0			X	X	X	X		X	X	0.0	X

Table 9. Relative frequencies (percent of survey points with detections on any of 26 surveys) of bird species in each of the 11 years of surveys in the Las Vegas Wash (February 2005 – August 2019). Number of survey points increased from 29 to 31 after the second year (see Methods; Table 1). Birds recorded incidentally, as flyovers, or > 100 m from the survey point are excluded. Species listed in descending order of average frequency. 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).

Species (Conservation Status)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 11	Year 12	Year 13	Year 14	Average Frequency
Yellow-rumped Warbler	100	97	100	97	100	90	97	100	97	94	100	97
Black Phoebe	100	100	100	94	94	90	100	97	94	94	97	96
Abert's Towhee (C)	100	100	97	97	97	94	90	97	97	94	90	96
Verdin	93	97	90	97	100	87	90	94	94	100	100	95
White-crowned Sparrow	93	100	97	97	97	84	94	97	100	88	94	94
Song Sparrow	100	97	97	97	100	87	87	90	90	88	84	92
Black-tailed Gnatcatcher	93	97	94	90	100	81	84	84	90	81	94	90
Common Yellowthroat	93	90	94	90	90	81	90	90	94	84	87	89
Bewick's Wren	97	100	90	97	97	90	84	77	77	75	68	87
Brown-headed Cowbird	97	97	94	94	94	84	77	84	84	63	77	86
Red-winged Blackbird	72	86	97	94	94	84	81	90	81	84	77	85
Orange-crowned Warbler	93	83	77	87	74	81	68	90	94	91	90	84
Ruby-crowned Kinglet	100	97	94	87	90	74	68	71	74	69	84	82
Marsh Wren	93	83	81	87	81	81	77	87	74	81	74	82
American Coot	59	69	74	74	77	74	84	77	87	75	81	76
Crissal Thrasher	90	83	77	77	90	77	61	61	68	72	65	75
Great-tailed Grackle	34	41	55	71	84	68	90	100	84	97	94	74
Blue Grosbeak (A)	97	86	81	84	74	68	68	61	65	63	65	74
Gambel's Quail (C)	76	52	48	71	58	84	84	84	84	78	87	73
Greater Roadrunner	66	66	68	71	65	58	77	68	90	78	87	72
Mallard	31	45	81	68	81	71	81	77	84	81	81	71
Say's Phoebe	52	48	35	68	97	77	68	71	81	72	74	68
Yellow Warbler (B)	59	48	55	61	74	68	55	74	84	75	84	67
Lucy's Warbler (C)	93	90	77	84	74	68	55	42	48	44	58	67
Mourning Dove	90	76	87	71	84	84	48	52	42	41	55	66

Species (Conservation Status)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 11	Year 12	Year 13	Year 14	Average Frequency
House Finch	59	76	68	68	68	68	42	68	61	66	61	64
Yellow-breasted Chat	90	76	77	84	61	65	45	58	45	44	45	63
Northern Flicker	59	66	65	77	55	52	58	58	45	50	68	59
American Pipit	59	62	77	61	52	65	52	45	68	41	52	57
Great Blue Heron	24	41	32	29	42	42	61	65	77	72	68	50
Gadwall	31	34	42	48	55	52	45	48	58	59	45	47
Wilson's Warbler	76	66	65	48	35	29	58	23	26	56	29	46
Lincoln's Sparrow	66	28	61	39	29	29	35	39	58	69	45	45
Killdeer	55	55	29	48	32	19	55	48	45	53	48	44
Loggerhead Shrike (D)	52	31	13	35	58	35	48	65	48	47	32	42
Western Kingbird	24	17	55	32	45	39	87	42	68	31	23	42
Brewer's Sparrow (C)	21	28	42	58	65	55	19	39	16	22	45	37
Spotted Sandpiper	31	34	10	32	32	29	45	55	52	31	48	36
Northern Mockingbird	7	31	23	13	29	19	32	52	68	41	48	33
Black-chinned Hummingbird	17	38	35	32	32	32	32	39	29	31	35	32
Belted Kingfisher	38	28	26	29	32	23	35	39	48	28	26	32
American Wigeon	0	3	19	13	13	13	42	68	55	66	58	32
Green Heron	21	55	32	29	19	29	52	29	35	25	23	32
Lesser Goldfinch	24	34	32	39	45	48	39	19	13	16	16	30
Dark-eyed Junco	21	24	61	45	39	29	23	29	13	16	3	27
Anna's Hummingbird	24	3	3	10	16	6	35	39	48	53	58	27
Blue-gray Gnatcatcher	52	62	29	58	10	19	23	0	3	13	16	26
Common Gallinule	10	10	16	13	19	23	29	26	52	44	35	25
Northern Rough-winged Swallow	21	21	13	45	19	16	13	23	13	13	58	23
Double-crested Cormorant	3	14	35	23	19	3	29	26	42	28	29	23
Greater Yellowlegs	31	10	13	16	13	19	32	52	19	28	16	23
Pied-billed Grebe	7	17	26	19	16	13	16	32	35	34	29	22
Savannah Sparrow	14	0	19	16	19	32	19	29	32	38	23	22
Cooper's Hawk	10	14	16	10	10	26	26	32	29	28	35	21
Western Wood-Pewee	10	17	13	26	6	29	42	13	10	25	26	20
Bullock's Oriole	3	21	16	0	13	23	19	35	39	31	16	20

Species (Conservation Status)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 11	Year 12	Year 13	Year 14	Average Frequency
Yellow-headed Blackbird	10	7	10	16	10	6	35	32	26	16	32	18
White-winged Dove	45	21	39	29	16	23	13	3	0	0	0	17
Costa's Hummingbird (C)	14	17	26	16	6	23	19	16	6	16	26	17
Snowy Egret (C)	7	3	23	6	13	13	16	29	32	13	26	16
Great Egret	14	7	13	6	13	16	13	26	26	16	29	16
Black-crowned Night-Heron	10	10	13	3	3	10	23	19	35	25	26	16
Spotted Towhee	17	14	16	39	13	10	16	10	0	6	23	15
Sora	3	7	6	10	3	10	13	19	29	31	29	15
Red-tailed Hawk	14	7	13	10	6	16	23	19	16	16	19	14
Northern Harrier	7	14	35	19	6	0	10	13	13	13	26	14
Warbling Vireo	17	14	10	10	19	6	10	19	16	13	19	14
Lazuli Bunting	17	24	6	29	3	0	6	6	3	34	23	14
American Kestrel	14	7	6	3	6	13	23	26	13	31	10	14
Western Meadowlark	0	7	0	3	10	13	19	19	39	19	23	14
Osprey	3	3	6	3	10	6	29	19	19	16	32	13
Sharp-shinned Hawk	24	7	10	19	23	13	13	10	10	9	6	13
Rock Wren	14	14	10	16	23	29	6	13	6	3	10	13
White-faced Ibis (C)	7	7	0	3	6	6	16	16	23	25	32	13
Eared Grebe (C)	3	0	3	0	6	0	6	42	45	19	16	13
Common Merganser	7	3	10	6	6	3	16	19	35	13	19	13
Virginia Rail	14	7	6	6	6	23	10	16	16	19	13	12
Green-winged Teal	0	17	13	6	6	6	19	19	10	19	19	12
Phainopepla (A)	21	31	6	23	16	6	3	10	0	9	3	12
Canada Goose	0	0	10	0	3	10	23	16	23	22	23	12
Indigo Bunting	0	0	0	0	16	10	16	26	39	9	10	11
Northern Pintail (C)	0	3	0	0	0	3	23	16	19	28	23	10
Western Tanager	10	3	6	3	10	10	3	13	6	28	19	10
Bufflehead	0	0	6	3	3	3	19	13	23	19	16	10
Chipping Sparrow	17	7	16	10	23	10	0	3	3	9	3	9
House Wren	7	3	0	0	3	0	3	13	16	28	26	9
Black-headed Grosbeak	14	14	6	0	6	13	3	6	10	9	13	9

Species (Conservation Status)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 11	Year 12	Year 13	Year 14	Average Frequency
Ash-throated Flycatcher	14	3	16	3	0	13	13	10	10	0	10	8
Bell's Vireo (A; B; C)	21	0	10	0	0	6	13	16	6	6	10	8
American Robin	7	3	16	13	6	3	6	10	10	3	10	8
Ladder-backed Woodpecker	3	0	0	3	6	23	10	23	10	3	6	8
Bushtit	31	21	6	3	16	10	0	0	0	0	0	8
Cinnamon Teal (C)	3	0	0	3	10	0	19	13	3	16	19	8
Ring-billed Gull	0	3	16	0	3	0	6	13	3	13	16	7
Great Horned Owl	0	3	3	0	10	19	3	6	3	16	6	6
Red-shouldered Hawk	0	0	0	0	0	3	6	16	16	13	16	6
Hermit Thrush	14	28	3	3	3	0	3	6	0	6	3	6
American Avocet (C)	7	0	0	0	6	0	13	3	3	19	13	6
Common Goldeneye	0	0	6	6	3	0	6	6	10	16	10	6
Northern Shoveler	3	3	0	0	6	0	6	13	6	3	19	6
Least Bittern (B; C)	3	3	6	6	0	6	6	6	6	9	6	6
Ring-necked Duck	0	0	0	0	0	0	6	19	6	16	13	6
Western Flycatcher (unidentified)	3	7	13	3	0	0	16	0	6	6	3	5
Nashville Warbler	0	0	3	6	3	6	10	10	10	9	0	5
Least Sandpiper (C)	0	0	0	0	3	10	19	3	3	6	10	5
Black-necked Stilt (C)	3	0	0	0	3	0	10	3	6	6	19	5
Lesser Scaup (C)	0	0	0	0	0	0	3	3	10	16	19	5
MacGillivray's Warbler	3	3	3	0	0	10	3	0	16	0	10	4
Lark Sparrow	0	0	6	3	3	6	10	3	3	9	3	4
Cliff Swallow	0	0	6	10	10	0	0	0	0	0	19	4
Dusky Flycatcher	3	7	23	0	3	0	3	0	0	0	0	4
Common Raven	0	0	10	0	3	0	6	0	13	3	3	4
Hooded Merganser	0	0	0	0	0	0	3	13	10	6	6	4
Pine Siskin (D)	7	0	6	0	0	13	0	10	0	0	0	3
Pacific Wren	7	3	0	0	0	3	3	3	6	6	0	3
Horned Lark (D)	3	0	10	6	3	3	6	0	0	0	0	3
Long-billed Dowitcher (C)	0	3	0	0	0	0	6	6	3	6	6	3
Eurasian Collared-Dove	0	0	0	0	3	0	10	6	6	3	3	3

Species (Conservation Status)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 11	Year 12	Year 13	Year 14	Average Frequency
Townsend's Warbler	0	0	0	0	0	13	13	0	0	3	3	3
Hooded Oriole	0	0	6	0	0	0	0	0	6	9	10	3
Red-naped Sapsucker	7	10	3	0	0	0	3	3	0	3	0	3
Western Sandpiper (C)	10	3	0	0	6	3	3	0	0	0	3	3
Gray Flycatcher (C)	3	0	6	0	6	3	0	6	3	0	0	3
American White Pelican (C)	0	0	0	3	0	3	10	10	3	0	0	3
Barn Owl	10	7	3	0	3	0	0	0	0	3	0	2
Golden-crowned Kinglet	3	0	10	3	3	3	0	0	0	0	3	2
Olive-sided Flycatcher (C; D; E)	3	0	3	0	0	3	3	3	6	0	3	2
Wilson's Snipe	0	0	0	0	3	0	3	10	0	3	6	2
Red-breasted Nuthatch	0	0	3	3	0	0	3	6	0	9	0	2
Solitary Vireo (unidentified)	0	3	3	16	0	0	0	0	0	0	0	2
Horned Grebe	0	0	0	0	0	0	6	10	6	0	0	2
Neotropic Cormorant	0	0	0	0	0	0	6	10	0	3	3	2
Black-throated Gray Warbler	0	0	0	0	3	0	0	0	3	6	10	2
Lesser Yellowlegs	0	0	0	0	3	0	6	0	0	6	6	2
Brewer's Blackbird (D)	0	0	0	3	10	3	0	0	0	3	0	2
Cedar Waxwing	10	3	0	0	0	0	0	0	0	3	0	2
Brown-crested Flycatcher	7	0	0	0	0	0	0	0	0	3	6	1
Lesser Nighthawk	0	3	0	0	3	0	3	3	3	0	0	1
Bank Swallow	0	0	0	0	0	0	0	0	0	0	16	1
Ruddy Duck	0	0	0	0	0	0	6	6	0	0	3	1
Barn Swallow	0	0	3	3	0	0	0	0	0	6	3	1
Plumbeous Vireo	0	0	0	3	0	0	3	3	0	6	0	1
Merlin	0	3	0	0	3	0	0	3	0	0	3	1
Vesper Sparrow	0	0	0	0	3	6	3	0	0	0	0	1
Violet-green Swallow	0	0	3	6	3	0	0	0	0	0	0	1
Western Grebe (C)	0	0	3	0	0	0	6	3	0	0	0	1
American Goldfinch	0	0	0	0	6	0	3	0	0	3	0	1
Green-tailed Towhee (C)	0	0	0	3	3	0	0	0	3	3	0	1
Canyon Wren	3	3	0	0	0	0	0	0	0	3	0	1

Species (Conservation Status)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 10	Year 11	Year 12	Year 13	Year 14	Average Frequency
Black-throated Sparrow	0	3	0	0	0	6	0	0	0	0	0	1
Black-and-white Warbler	0	0	0	0	0	0	0	0	3	0	6	1
Eastern Kingbird	0	0	0	0	0	3	0	3	3	0	0	1
European Starling	0	0	0	0	0	3	0	3	0	0	3	1
Redhead (C)	0	0	0	3	0	0	3	0	0	0	3	1
Sagebrush Sparrow (C)	0	0	0	0	0	0	0	3	6	0	0	1
Snow Goose	0	0	0	0	0	0	0	3	0	0	6	1
Tree Swallow	0	0	6	3	0	0	0	0	0	0	0	1
Cassin's Vireo	0	0	0	0	0	0	0	0	0	3	6	1
Peregrine Falcon (C)	0	0	0	3	3	0	0	0	0	3	0	1
American Bittern	0	3	0	0	3	0	0	0	0	0	0	1
House Sparrow	3	0	0	0	0	0	3	0	0	0	0	1
Cactus Wren	0	0	0	0	0	0	0	6	0	0	0	1
Greater White-fronted Goose	0	0	0	0	0	0	0	0	3	0	3	1
Prairie Falcon (C)	0	0	0	0	3	0	0	0	0	0	3	1
Rock Pigeon	0	0	3	3	0	0	0	0	0	0	0	1
Rufous Hummingbird (C; E)	0	0	0	0	0	6	0	0	0	0	0	1
Summer Tanager (A; B)	0	0	0	0	0	0	3	0	0	0	3	1
Turkey Vulture	0	0	0	3	0	0	0	0	3	0	0	1
Willet (C)	0	0	0	0	0	0	0	3	0	0	3	1
Willow Flycatcher (A; B; C)	0	0	0	3	0	3	0	0	0	0	0	1
Brown Creeper	0	0	0	0	0	0	3	0	0	3	0	1
Caspian Tern	0	0	0	0	0	0	0	0	0	3	3	1
Vermilion Flycatcher (A; B)	0	0	0	0	0	0	0	0	0	3	3	1
Wood Duck	0	0	0	3	0	0	0	0	0	3	0	1
Solitary Sandpiper	0	0	0	0	0	0	0	0	0	6	0	1
Swamp Sparrow	0	0	0	0	0	0	0	0	0	6	0	1
Canyon Towhee	0	3	0	0	0	0	0	0	0	0	0	0
Hairy Woodpecker	0	3	0	0	0	0	0	0	0	0	0	0
Semipalmated Plover	3	0	0	0	0	0	0	0	0	0	0	0
Semipalmated Sandpiper	0	3	0	0	0	0	0	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	Year 13	Year 14	Average Frequency
Western Bluebird	3	0	0	0	0	0	0	0	0	0	0	0
Bell's Sparrow (C)	0	0	0	0	0	0	0	0	0	0	3	0
Blackpoll Warbler	0	0	0	0	0	0	0	3	0	0	0	0
Blue-winged Teal	0	0	0	0	0	0	0	3	0	0	0	0
Broad-tailed Hummingbird	0	0	0	0	0	3	0	0	0	0	0	0
Brown Thrasher	0	0	0	0	0	0	0	0	0	0	3	0
California Gull	0	0	0	0	0	0	0	0	0	0	3	0
Cattle Egret	0	0	0	0	0	0	0	3	0	0	0	0
Dunlin	0	0	0	0	0	0	3	0	0	0	0	0
Gray Catbird	0	0	0	0	0	0	0	0	0	0	3	0
Groove-billed Ani	0	0	0	0	0	0	0	0	0	0	3	0
Hammond's Flycatcher	0	0	0	0	0	0	3	0	0	0	0	0
Long-eared Owl (E)	0	0	0	0	0	0	0	0	0	0	3	0
Mountain Bluebird	0	0	0	3	0	0	0	0	0	0	0	0
Ovenbird	0	0	0	0	0	3	0	0	0	0	0	0
Pectoral Sandpiper	0	0	0	0	3	0	0	0	0	0	0	0
Red Crossbill	0	0	0	0	0	0	0	3	0	0	0	0
Ross's Goose	0	0	0	0	0	0	0	0	3	0	0	0
Rufous-crowned Sparrow	0	0	3	0	0	0	0	0	0	0	0	0
Scissor-tailed Flycatcher	0	0	0	0	0	3	0	0	0	0	0	0
Swainson's Thrush	0	0	0	0	0	0	0	0	0	0	3	0
Virginia's Warbler (C; D; E)	0	0	3	0	0	0	0	0	0	0	0	0
White-throated Sparrow	0	0	0	0	0	0	0	0	0	0	3	0
White-throated Swift (C)	0	0	0	0	0	0	0	0	0	0	3	0
Bonaparte's Gull	0	0	0	0	0	0	0	0	0	3	0	0
Fox Sparrow	0	0	0	0	0	0	0	0	0	3	0	0
Sandhill Crane (C)	0	0	0	0	0	0	0	0	0	3	0	0
Swainson's Hawk (C)	0	0	0	0	0	0	0	0	0	3	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 (2005-2019). Species are listed in descending order of abundance from the NBC data, and include the 50 most abundant species from each of the datasets. 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).

Species (Conservation Status)	NBC		Wash	
	Abundance	Rank	Abundance	Rank
Gambel's Quail (C)	7.68	1	6.16	8
Abert's Towhee (C)	7.49	2	10.60	2
Lucy's Warbler (C)	6.14	3	4.45	14
Mourning Dove	4.96	4	3.70	15
Brown-headed Cowbird	4.58	5	5.62	9
Yellow Warbler (B)	4.20	6	3.30	17
Verdin	3.97	7	6.55	7
House Finch	3.93	8	1.22	27
Red-winged Blackbird	3.88	9	15.58	1
Song Sparrow	3.62	10	9.62	3
Bewick's Wren	3.59	11	5.15	11
Yellow-breasted Chat	3.19	12	3.69	16
Phainopepla (A)	2.82	13	0.01	
Northern Rough-winged Swallow	2.42	14	0.78	34
Black-tailed Gnatcatcher	2.24	15	5.39	10
Cliff Swallow	2.17	16	0.26	
Black-throated Sparrow	2.14	17	0.02	
Common Yellowthroat	2.05	18	9.21	4
Ash-throated Flycatcher	2.00	19	0.08	
Crissal Thrasher	1.37	20	1.45	23
Blue Grosbeak (A)	1.32	21	2.72	20
Blue-gray Gnatcatcher	1.10	22	0.20	
Bell's Vireo (ABC)	1.01	23	0.12	
Lesser Goldfinch	0.98	24	0.40	45
Spotted Towhee	0.97	25	0.02	
Great-tailed Grackle	0.96	26	8.92	5
Mallard	0.83	27	4.63	12
Say's Phoebe	0.78	28	0.69	37
Northern Mockingbird	0.75	29	0.51	40
Bullock's Oriole	0.74	30	0.32	50
Brewer's Sparrow (C)	0.70	31	0.46	43

Species (Conservation Status)	NBC		Wash	
	Abundance	Rank	Abundance	Rank
American Coot	0.64	32	8.13	6
White-winged Dove	0.62	33	0.38	47
Wilson's Warbler	0.60	34	1.03	29
Rock Wren	0.56	35	0.07	
Black-chinned Hummingbird	0.54	36	0.72	36
Killdeer	0.53	37	1.40	24
White-crowned Sparrow	0.53	38	0.95	31
Western Scrub-Jay (Unidentified)	0.53	39		
White-faced Ibis (C)	0.52	40	0.83	33
Western Kingbird	0.52	41	0.99	30
Yellow-rumped Warbler	0.51	42	1.50	22
Lazuli Bunting	0.50	43	0.14	
House Sparrow	0.49	44	0.00	
Eurasian Collared-Dove	0.45	45	0.03	
Western Meadowlark	0.44	46	0.03	
Cactus Wren	0.43	47		
Black Phoebe	0.43	48	2.32	21
Canyon Wren	0.39	49	0.01	
Common Raven	0.39	50	0.02	
American Pipit			0.86	32
American Wigeon			2.97	19
Anna's Hummingbird	0.24		0.72	35
Cinnamon Teal (C)	0.04		0.34	49
Common Gallinule			0.37	48
Eared Grebe (C)	0.03		1.19	28
Gadwall			3.02	18
Great Blue Heron	0.05		0.67	38
Greater Roadrunner	0.31		1.28	25
Green Heron	0.05		0.49	41
Marsh Wren	0.39		4.53	13
Orange-crowned Warbler	0.10		0.45	44
Ruby-crowned Kinglet	0.06		0.47	42
Spotted Sandpiper	0.18		0.53	39
Yellow-headed Blackbird	0.16		1.25	26

Table 11. Summary trends from negative binomial regression statistics for 20 species with more than 1 detection per 40 ha overall, that were detected within 100 m of survey points at the Las Vegas Wash between February 2005 and August 2019. Species listed in descending order of detections. Dark gray shading indicates significantly negative trends (six species), and light gray shading indicates significantly positive trends (11 species).

Species	No. of Visits with Detections	Total No. of Birds Detected	Overall Density Estimate (Birds/40 ha)	Incident Rate Ratio	P
American Coot	254	14107	20.6	1.21	< 0.001
Red-winged Blackbird	267	7398	10.9	1.04	0.007
Abert's Towhee	286	6987	10.7	0.95	< 0.001
Mallard	252	7131	10.4	1.20	< 0.001
Gadwall	156	7055	10.3	1.35	< 0.001
Yellow-rumped Warbler	185	7629	10.1	1.04	0.011
Song Sparrow	285	5240	8.1	0.92	< 0.001
Marsh Wren	284	4923	7.2	1.00	0.724
Verdin	286	3949	5.8	1.06	< 0.001
Gambel's Quail	246	3626	5.3	1.17	< 0.001
Bewick's Wren	284	3461	5.1	0.92	< 0.001
Black-tailed Gnatcatcher	285	3490	5.1	1.02	< 0.001
American Pipit	137	3390	4.9	1.07	0.004
Common Yellowthroat	175	3208	4.7	1.00	0.739
Black Phoebe	283	2610	3.8	0.99	0.420
Ruby-crowned Kinglet	171	1919	2.8	0.97	0.034
Orange-crowned Warbler	191	1683	2.5	1.08	< 0.000
Lucy's Warbler	128	1387	2.1	0.90	< 0.001
Yellow-breasted Chat	114	1178	1.7	0.90	< 0.001
Crissal Thrasher	266	1143	1.7	1.03	0.002

Table 12. Results of ANOVA analysis evaluating differences in vegetation measurements among years of riparian bird monitoring along the Las Vegas Wash. Where ANOVA results were significant, two-sample t-test results are shown for early and late phases of the project.

Habitat Variable	ANOVA			t-test		
	F-statistic	P	DF	Mean, Early	Mean, Late	P
Overall Tree Cover	6.26	< 0.001	10, 285	31%	16%	< 0.001
Tamarisk	14.86	< 0.001	10, 285	24%	4%	< 0.001
Native Riparian Trees (not including Mesquites)	1.11	0.351	10, 285			
Cottonwood Trees	0.18	0.997	10, 285			
Goodding's Willows	0.27	0.986	10, 285			
Sandbar Willows	0.69	0.734	10, 285			
Mesquite Trees	1.15	0.327	10, 285			
Native Riparian Tree Proportion (not including Mesquites)	1.20	0.291	10, 285			
Mesquite Proportion	2.53	0.006	10, 285	9%	27%	< 0.001
Perennial Height	1.47	0.150	10, 285			
Overall Shrub Cover	2.41	0.009	10, 285	16%	24%	< 0.001
Riparian Shrub Cover	0.41	0.942	10, 285			
Upland Shrub Cover	2.30	0.013	10, 285	15%	23%	< 0.001
Forb Cover	4.75	< 0.001	10, 285	4%	1%	< 0.001
Grass Cover	2.67	0.004	10, 285	2%	1%	0.251
Phragmites Cover	0.09	0.100	10, 285			
Cattail Cover	1.20	0.287	10, 285			
Perennial Structure	2.08	0.026	10, 285	439	330	0.003
0-2 m	1.88	0.047	10, 285	284	255	0.254
2-4 m	3.88	< 0.001	10, 285	103	43	< 0.001
4-6 m	3.51	< 0.001	10, 285	37	13	< 0.001
6-8 m	0.57	0.836	10, 285			
8-10 m	0.94	0.498	10, 285			
Horizontal Heterogeneity	2.35	0.011	10, 285	3.3	2.8	0.003