



# Status and Trends of Landbird Populations in the Northern Colorado Plateau Network

*2020 Field Season*

Natural Resource Report NPS/NCPN/NRR—2021/2230



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#### ON THE COVER

Rock wren. NPS photo.

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# Status and Trends of Landbird Populations in the Northern Colorado Plateau Network

*2020 Field Season*

Natural Resource Report NPS/NCPN/NRR—2021/2230

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## Executive Summary

In 2020, the University of Delaware, in cooperation with the National Park Service (NPS), partially completed the fifteenth year of a habitat-based landbird monitoring program in NPS units of the Northern Colorado Plateau Network (NCPN). This program is designed to provide rigorous population trend data for most diurnal, regularly occurring breeding landbird species throughout the network. This information is useful for land managers and supports the National Park Service's goal of long-term monitoring of biological indicators in network parks.

Due to park closures and safety precautions related to the COVID-19 pandemic, a reduced survey effort was employed in 2020. Only sagebrush-shrubland transects were visited, and point counts were not conducted at Pipe Spring National Monument.

In 2020, university biologists surveyed 15 locations in sagebrush-shrubland habitat within five NPS units. (In a typical year, 45 surveys are conducted—15 in each of the three following habitat types: low-elevation riparian, pinyon-juniper, and sagebrush shrubland.) Over 15 years of data collection, 14,483 point-count surveys have been conducted in 11 NCPN units, detecting 173 unique species. During the 2020 field season, 210 point-count surveys were conducted, detecting 73 unique species.

Using data from 2005–2015 and 2017–2019 in low-elevation riparian and pinyon-juniper habitats, and data from 2005–2015 and 2017–2020 in sagebrush-shrubland habitat, 121 population-density trends were estimated across the three habitats. Eleven of the estimated density trends were significant ( $p$ -value  $< 0.05$ ), including nine negative trends and two positive trends. There were sufficient sample sizes to estimate the densities of 63 species in at least one of the three habitats surveyed.

In 2020, we made a change to our species trend-estimation process. Annual density estimates were only included for species in habitats with at least 10 detections within the distance cut-off (125 meters). In previous years, annual density estimates did not have to meet a detection threshold to be included in trend estimates. As a result, some previous annual density estimates were based on a low number ( $< 10$ ) of annual detections. In distance sampling, this can lead to inaccurate estimates. Due to this change in methods, some trend estimates from 2019 are no longer presented. Others have changed in significance. Thus, all trend estimates in this report should replace those found in reports from previous years.



# 1 Introduction

Detecting environmental change over broad temporal and spatial scales is an important goal of conservation science, especially in the face of climate change and other major anthropogenic disturbances. Through long-term data-collection efforts, valuable ecological information about the causes and consequences of these changes can be gathered and used to inform natural-resource management.

Diurnal bird species are commonly used as indicators of environmental health because they are sensitive to environmental change and relatively easy to monitor (Canterbury et al. 2000, Gardali et al. 2006, Gardali and Holmes 2011). Through long-term monitoring of breeding bird populations, we can estimate the population status and trends of individual species and bird communities in specific habitats, thus providing information about changes occurring in the surrounding landscape (Sauer et al. 2003, Browder et al. 2002, Gregory et al. 2007).

In 2019, Rosenberg and others estimated a loss of nearly 3 billion birds across North America since 1970 (Rosenberg et al. 2019). As bird populations decline, establishing and continuing long-term population monitoring is essential to finding causes and solutions for threatened, endangered, and declining populations.

Bird communities that rely on arid habitats, such as sagebrush shrubland, are among the most vulnerable to population declines in an era of warming temperatures and increasing anthropogenic land use (Rosenberg et al. 2016). Habitat loss and degradation due to grazing and agriculture (Rosenberg et al. 2016, Fleischner 1994), the expansion of pinyon-juniper habitat (Miller and Wigand 1994, Baruch-Mordo et al. 2013), and the widespread threat of drought (Breshears et al. 2005) are among the major threats to arid landscapes and their inhabitants (Rosenberg et al. 2016). Public lands support more than

half the breeding range of 36 aridland-obligate species in the U.S. and Canada (Rosenberg et al. 2016), but threats of habitat loss and degradation remain. Concerted monitoring efforts are important for conserving bird communities in these areas.

The NCPN landbird monitoring program is designed to provide rigorous population trend data for most diurnal, regularly occurring breeding landbird species in three habitats (low-elevation riparian, pinyon-juniper, and sagebrush shrubland) at 11 national parks in Colorado, Utah, and Wyoming. This information is useful for land managers and supports the National Park Service's goal of long-term monitoring of biological indicators in network parks. Starting in 2005, surveys for the NCPN landbird monitoring program were completed annually for 11 consecutive years by the Bird Conservancy of the Rockies (BCR), with a hiatus in 2016. In 2017, the University of Delaware resumed the monitoring.

In 2020, the University of Delaware, in cooperation with the National Park Service (NPS), partially completed the fifteenth year of a habitat-based landbird monitoring program in NPS units of the Northern Colorado Plateau Network (NCPN). Due to park closures and safety precautions related to the COVID-19 pandemic, a reduced survey effort was employed in 2020. Only sagebrush shrubland survey transects were visited.

In this report, we use distance sampling analysis to evaluate long-term density trends of all bird species present (with sufficient sample sizes) in the three focal habitats throughout the NCPN. This includes data collected in 2005–2015 and 2017–2019 in transects located in low-elevation riparian and pinyon-juniper habitats and collected in 2005–2015 and 2017–2020 in sagebrush-shrubland habitat. In future analyses, we will evaluate the driving landscape and climate variables affecting long-term, transect-level bird population trends of the species in greatest decline.



# 2 Methods

## 2.1 Study area and sampling design

Three habitats were selected for NCPN landbird monitoring when the program was established in 2005: low-elevation riparian (LR), pinyon-juniper (PJ), and sagebrush shrubland (SA). Even with some overlap, each of these habitats hosts a distinct suite of bird species. Across 11 NPS units, 45 transect locations were selected, with 15 transects established in each habitat (Figure 2-1; Table 2-1). Each transect consists of 15 point-count locations, each 250 meters apart (Figures 2-2 to 2-4).

The NPS and BCR used GIS and the Southwest Regional Re-GAP Analysis Project to randomly select PJ and SA transect locations (Lowry et al. 2005). Within those habitats, they excluded areas with >50% slope to ensure each transect could be accessed on foot. Because of the scarcity of riparian habitat in the NCPN, LR transect locations were manually selected. Sites with crossable streams were chosen, excluding the Colorado, Green, Gunnison, and Virgin rivers. Transects were ground-truthed and re-assigned if necessary.

Since 2005, all 45 transects have remained in place and are the annually scheduled surveys for this program. From 2005 to 2013, field teams surveyed each transect twice annually.

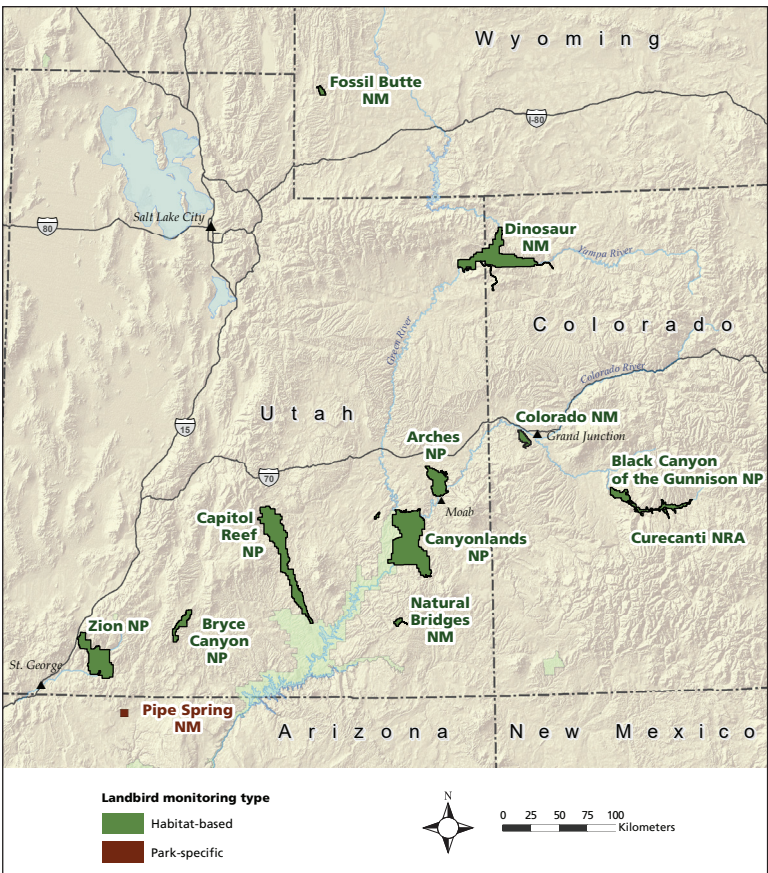


Figure 2-1. Northern Colorado Plateau Network parks where landbirds are monitored.

Starting in 2014, survey effort was reduced to one visit per year. The number of completed surveys varied by year, with >75% of planned surveys completed annually (Table 2-2).

**Table 2-1. Number of transects within each park by habitat (and their transect identification numbers).**

| Park                                       | Low-elevation riparian | Pinyon-juniper   | Sagebrush shrubland   |
|--------------------------------------------|------------------------|------------------|-----------------------|
| Arches National Park                       | 3 (1, 2, 3)            | 1 (1)            | 0                     |
| Black Canyon of the Gunnison National Park | 0                      | 1 (2)            | 1 (1)                 |
| Bryce Canyon National Park                 | 0                      | 1 (3)            | 2 (2, 3)              |
| Canyonlands National Park                  | 3 (4, 5, 6)            | 2 (14, 15)       | 0                     |
| Capitol Reef National Park                 | 2 (7, 8)               | 2 (4, 5)         | 0                     |
| Colorado National Monument                 | 0                      | 2 (6, 7)         | 0                     |
| Curecanti National Recreation Area         | 0                      | 0                | 5 (3, 4, 5, 6, 7)     |
| Dinosaur National Monument                 | 3 (9, 10, 11)          | 4 (8, 9, 10, 11) | 5 (9, 10, 11, 12, 13) |
| Fossil Butte National Monument             | 0                      | 0                | 2 (14,15)             |
| Natural Bridges National Monument          | 2 (12, 13)             | 1 (12)           | 0                     |
| Zion National Park                         | 2 (14, 15)             | 1 (13)           | 0                     |



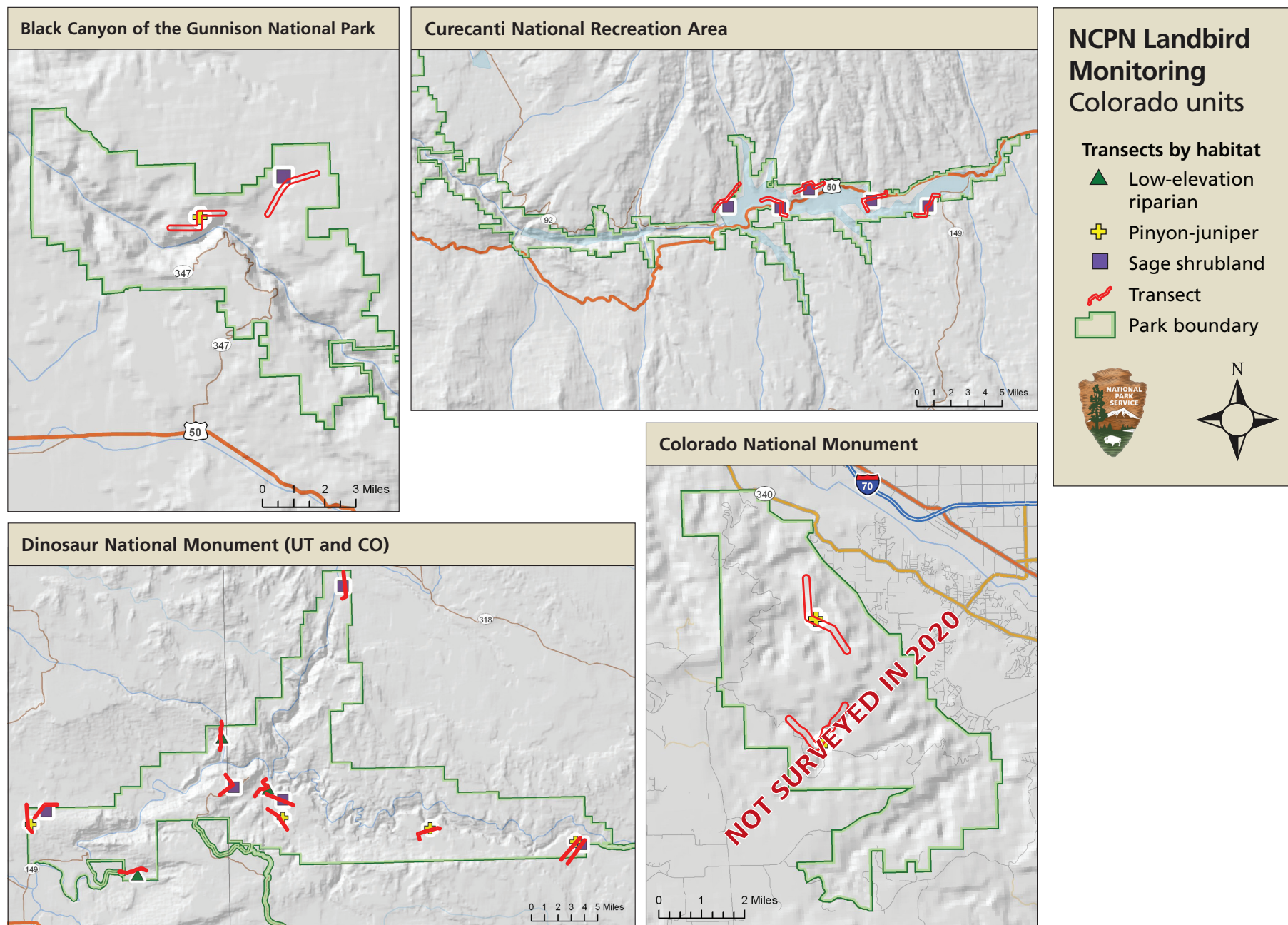


Figure 2-3. Transect locations by habitat, Colorado units.

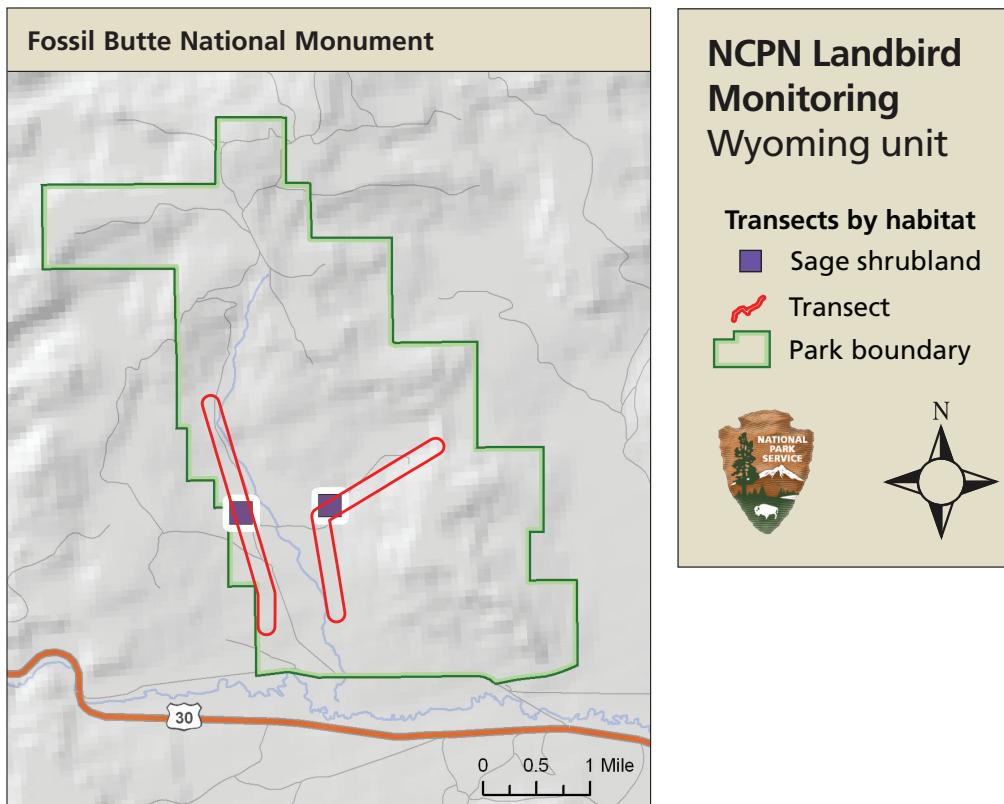


Figure 2-4. Transect locations, Fossil Butte National Monument.

**Table 2-2. Annual number of point visits within each habitat, 2005–2020 (when possible, points were visited twice from 2005 to 2013).**

| Year | Low-elevation riparian | Pinyon-juniper | Sagebrush shrubland |
|------|------------------------|----------------|---------------------|
| 2005 | 439                    | 450            | 441                 |
| 2006 | 443                    | 443            | 450                 |
| 2007 | 449                    | 447            | 450                 |
| 2008 | 450                    | 415            | 420                 |
| 2009 | 381                    | 409            | 401                 |
| 2010 | 389                    | 432            | 441                 |
| 2011 | 408                    | 390            | 435                 |
| 2012 | 371                    | 422            | 444                 |
| 2013 | 326                    | 337            | 398                 |
| 2014 | 153                    | 167            | 206                 |
| 2015 | 158                    | 153            | 196                 |
| 2017 | 225                    | 210            | 225                 |
| 2018 | 220                    | 201            | 223                 |
| 2019 | 209                    | 221            | 225                 |
| 2020 | 0                      | 0              | 210                 |

## 2.2 Field methods

Each year, field technicians attend a week-long training session to practice bird and plant identification, review field protocols, and hone distance-estimation skills (see Section 2.3.1). All transects are completed during the breeding season, which occurs between May 1 and July 15, depending on transect location. The elevation and latitudinal position of each transect are considered during the scheduling of each field season. The goal is to survey transects at each location during the peak breeding season.

Observers complete one transect per day, beginning within 30 minutes of sunrise and ending within five hours. Navigating to each point using a GPS unit, observers walk the transect, stopping at each of 15 point-count stations to record weather data, conduct a habitat assessment, and complete a five-minute point count.

At the beginning and end of each transect, observers record the following weather data: temperature, percent cloud cover, precipitation type, and estimated wind speed using the Beaufort scale. Surveys are not conducted if winds exceed 13–18 miles per hour or precipitation is heavier than a drizzle.

During habitat assessments, observers record the overstory seral stage, canopy cover, mean height, and relative abundance of the five most dominant tree or shrub species. Observers also record the seral stage, volume, mean height, and relative abundance of the five most dominant species in the understory layer. Groundcover data and the presence of additional, non-dominant habitat types are also recorded.

During the five-minute point count, observers record all bird detections, regardless of distance to the observer. For each detection, observers record species, sex, horizontal distance to the bird, method of detection (visual, call, song, or other), and, if applicable, the number of birds within a cluster. Clusters are defined as groups of conspecific birds in close proximity to each other that are not considered as separate independent observations. The exact distance to each bird or cluster of birds is estimated using

a laser rangefinder. Observers also record flyovers, defined as individuals or clusters that are detected during the point counts but are not using the immediate surrounding landscape.

During the walk between point-count stations, observers record detections of low-density and difficult-to-detect species as a method of bolstering the sample sizes for these groups.

For more detailed information about survey protocols, refer to Daw and others (2020) and BCR's Northern Colorado Plateau Network Point Transect Protocol on the Rocky Mountain Avian Data Center website, <http://rmbo.org/v3/avian/DataCollection.aspx>. Links to past and current protocols and data sheets may also be found at that site.

## 2.3 Data analysis

### 2.3.1 Distance sampling

We used the “Distance” package in program R (version 3.1.3; R Core Team 2014), which utilizes Distance 6.2 (Thomas et al. 2010) to estimate detection probabilities and bird population densities. Distance sampling relies on three main assumptions, which we met using established field protocols and training:

1. All objects at the sampling location are detected,
2. Objects are stationary or detected before movement occurs, and
3. Distances to objects are measured accurately.

In distance sampling, the distribution of observed distances of objects is dependent on the actual distribution of objects with respect to the observer and the detectability of an object. As such, detection functions must first be fit to distance-sampling data to describe the probability of detection of an object. The selected detection function is then used to estimate an average probability of detection, which allows for observed counts to be corrected and used for density estimation.

### 2.3.2 *Habitat-based density trends*

Our initial analysis focused on estimating habitat-based densities within each of the three habitat types for the full range of species present. We excluded flyovers, migrants, and juveniles from our analyses. With survey locations only 250 meters apart, there can be double-counting of individuals from multiple points. To avoid including double-counted individuals in our analyses, we set a cut-off distance of 125 meters, only including detections within this distance in our analyses.

Because low detection probabilities can result in inaccurate density estimates, we established a detection probability threshold of 0.05, removing density estimates with detection probabilities below this threshold. For each eligible species within a habitat each year, we fit a series of five pre-selected detection function models to the distribution of distances observed:

1. Uniform function with cosine series adjustments,
2. Half normal key function with no adjustments,
3. Half normal key function with cosine series adjustments,
4. Half normal key function with “observer” as a covariate, and
5. Hazard rate key function with cosine series adjustments.

We ranked models using Akaike’s Information Criterion (AICc), selecting the top model as the most parsimonious detection function for each species (Burnham and Anderson 2002). We used the top detection function for each species in each habitat in each year to estimate density. We then fit a simple linear model to the annual densities for each species to determine trend direction and significance.

In 2020, we made a change to our species trend-estimation process. Annual density estimates were only included for species in habitats with at least 10 detections within the distance cut-off (125 meters). In previous years, annual density estimates did not have to meet a detection threshold to be included in trend estimates. Instead, species were included in the trend estimation if there were at least 80 detections within a habitat across all years. As a result, some previous annual density estimates were based on a low number (<10) of annual detections. In distance sampling, this can lead to inaccurate estimates (MacKenzie et al. 2006) that are not appropriate to include. Due to this change in methods, some trend estimates from 2019 are no longer presented. Others have changed in significance. Thus, all trend estimates in this report should replace those found in previous years’ reports.

## 3 Results

### 3.1 Current field season

Over 15 years of data collection, 14,483 point-count surveys have been conducted in 11 NCPN units (see Table 2-1), detecting 173 unique species. Of those 173 species, 157 were within 125 meters of the observer, the established distance cut-off for our analyses (see Section 2.3.2). Due to park closures and safety precautions related to the COVID-19 pandemic, a reduced survey effort was employed in 2020; only sagebrush shrubland survey transects were visited, and point counts were not conducted at Pipe Spring National Monument.

From June 10 to July 8, 2020, field technicians visited all 15 sagebrush shrubland transects, for a total of 210 point-count surveys. A total of 1,868 individual birds of 73 unique species were recorded. No new species were detected for the monitoring program or any of the parks in 2020.

We excluded density estimates with a detection-probability coefficient of variance of >100. In accordance with the revised methods (see Section 2.3.2), we had sufficient sample sizes to estimate at least three annual densities of 63 species in at least one of the three habitats surveyed. In total, we estimated 121 population-density trends across the three habitats. Eleven of the estimated density trends were significant (p-value <0.05), including nine negative trends and two positive trends (Tables 3-1, 3-2).

### 3.2 Changes from past reports

Trends were estimated for species and habitats for which at least three annual density estimates were available for analysis. Because of the change in methods from 2019 to 2020 (now only estimating annual densities if there were at least 10 detections of a species in a year), some trends have changed in significance or are no longer presented because there were fewer than three annual estimates available.

For low-elevation riparian and pinyon-juniper habitats, trend changes between the 2019 annual report and this report were the result of the change in methods (Table 3-3).

**Table 3-1. Significant density trends by habitat for landbird species in the Northern Colorado Plateau Network.**

| Species                     | Low-elevation riparian | Pinyon-juniper | Sagebrush shrubland <sup>A</sup> |
|-----------------------------|------------------------|----------------|----------------------------------|
| Mourning dove               | ↓                      | ↓              | –                                |
| White-throated swift        | ↓                      | ↓              | –                                |
| Rock wren                   | ↓                      | –              | ↓                                |
| House wren                  | ↑                      | –              | –                                |
| Black-throated gray warbler | –                      | ↓              | –                                |
| Vesper sparrow              | –                      | ↑              | –                                |
| Western meadowlark          | –                      | –              | ↓                                |
| House finch                 | ↓                      | –              | –                                |

<sup>A</sup>As the only habitat surveyed in 2020, only sagebrush shrubland trends include density estimates from 2020. Trends in low-elevation riparian and pinyon-juniper may differ from the 2019 report because of changes in methods.

In sagebrush-shrubland habitat, changes in trends between 2019 and 2020 (see Table 3-3) may have been the result of the change in methods, the addition of density estimates from 2020, or a combination of those factors:

- Trends for the following species were no longer presented because of the change in methods: western wood-pewee, pinyon jay, Woodhouse's scrub-jay, and yellow-breasted chat.
- The trend in house wren changed from significantly positive to non-significant in sagebrush shrubland because of a low annual density estimate in 2020 and the exclusion of estimates due to the change in methods.
- Though the density estimate for yellow warbler was higher than average in 2020, its trend changed from significantly positive to non-significant in sagebrush shrubland because of the exclusion of estimates due to the change in methods.
- The trend for sagebrush sparrow changed from significantly negative to non-significant in sagebrush shrubland because of the exclusion of estimates due to the change in methods.
- The trend in western meadowlark changed from non-significant to significantly negative in sagebrush shrubland as a result of the addition of the 2020 density estimate.

We excluded raptors (i.e., hawks, eagles, and owls) and common ravens from density and trend estimates in 2020, and will continue to do so in future years. While these larger avian species were included in previous years' analyses (with only enough detections to estimate density trends for common

ravens), we do not believe this was appropriate. Neither our study design nor the use of point counts as a monitoring method are effective for species with minimal vocalizations and large territories, as is the case with raptors and common ravens.

**Table 3-2. Habitat-based density trend slope,  $R^2$  values, and sample size of estimated annual densities for individual species in low-elevation riparian and pinyon-juniper habitat (2005–2015, 2017–2019) and in sagebrush-shrubland habitat (2005–2015, 2017–2020).**

| Common name               | Low-elevation riparian |                |                          | Pinyon-juniper     |                |                          | Sagebrush shrubland |                |                          |
|---------------------------|------------------------|----------------|--------------------------|--------------------|----------------|--------------------------|---------------------|----------------|--------------------------|
|                           | Slope <sup>A</sup>     | R <sup>2</sup> | Sample size <sup>B</sup> | Slope <sup>A</sup> | R <sup>2</sup> | Sample size <sup>B</sup> | Slope <sup>A</sup>  | R <sup>2</sup> | Sample size <sup>B</sup> |
| Mourning dove             | -1.01 <sup>D</sup>     | 0.67           | 12                       | -1.6 <sup>D</sup>  | 0.46           | 14                       | -0.04               | 0.01           | 10                       |
| White-throated swift      | -1.04 <sup>C</sup>     | 0.40           | 14                       | -0.8 <sup>D</sup>  | 0.51           | 13                       | -1                  | 0.12           | 4                        |
| Black-chinned hummingbird | -6.02                  | 0.26           | 3                        | –                  | –              | –                        | –                   | –              | –                        |
| Broad-tailed hummingbird  | 0.69                   | 0.12           | 5                        | 0.68               | 0.23           | 3                        | 0.89                | 0.17           | 13                       |
| Hairy woodpecker          | -0.05                  | 0.01           | 4                        | –                  | –              | –                        | –                   | –              | –                        |
| Northern flicker          | –                      | –              | –                        | –                  | –              | –                        | -0.05               | 0.24           | 7                        |
| Western wood-pewee        | 0.08                   | 0.01           | 12                       | –                  | –              | –                        | –                   | –              | –                        |
| Gray flycatcher           | –                      | –              | –                        | -0.18              | 0.01           | 14                       | 0.05                | 0.07           | 7                        |
| Dusky flycatcher          | –                      | –              | –                        | -0.18              | 0.02           | 12                       | 0.08                | 0.01           | 15                       |
| Black phoebe              | 0.16                   | 0.02           | 7                        | –                  | –              | –                        | –                   | –              | –                        |
| Say's phoebe              | -0.11                  | 0.06           | 13                       | -0.13              | 0.68           | 4                        | 0.04                | 0.15           | 6                        |
| Ash-throated flycatcher   | -0.55                  | 0.12           | 14                       | -0.29              | 0.14           | 14                       | -0.62               | 0.73           | 4                        |
| Gray vireo                | 0.02                   | 0.01           | 7                        | 0.36               | 0.14           | 14                       | –                   | –              | –                        |
| Plumbeous vireo           | -0.2                   | 0.03           | 14                       | 0.11               | 0.04           | 14                       | 0.15                | 0.29           | 3                        |
| Warbling vireo            | 0.19                   | 0.04           | 14                       | –                  | –              | –                        | 0.09                | 0.22           | 5                        |
| Pinyon jay                | –                      | –              | –                        | -0.12              | 0.13           | 11                       | –                   | –              | –                        |
| Woodhouse's scrub-jay     | 0.05                   | 0.01           | 13                       | 0.34               | 0.08           | 11                       | –                   | –              | –                        |
| Black-billed magpie       | –                      | –              | –                        | –                  | –              | –                        | -0.15               | 0.17           | 11                       |
| Horned lark               | –                      | –              | –                        | –                  | –              | –                        | 0.11                | 0.04           | 11                       |
| Violet-green swallow      | 0.16                   | 0.00           | 11                       | 0.58               | 0.11           | 12                       | 0.14                | 0.08           | 12                       |
| Cliff swallow             | –                      | –              | –                        | –                  | –              | –                        | -0.14               | 0.01           | 6                        |
| Mountain chickadee        | –                      | –              | –                        | 0.17               | 0.09           | 11                       | –                   | –              | –                        |
| Juniper titmouse          | -0.29                  | 0.08           | 10                       | -0.25              | 0.01           | 13                       | –                   | –              | –                        |
| Bushtit                   | 0.19                   | 0.02           | 7                        | -0.64              | 0.05           | 7                        | –                   | –              | –                        |
| White-breasted nuthatch   | –                      | –              | –                        | -0.01              | 0.00           | 10                       | –                   | –              | –                        |
| Rock wren                 | -0.42 <sup>D</sup>     | 0.47           | 14                       | -0.18              | 0.08           | 11                       | -0.27 <sup>D</sup>  | 0.45           | 15                       |
| Canyon wren               | -0.02                  | 0.01           | 10                       | –                  | –              | –                        | –                   | –              | –                        |
| House wren                | 1.23 <sup>C</sup>      | 0.33           | 14                       | –                  | –              | –                        | 0.13                | 0.32           | 8                        |
| Bewick's wren             | -0.27                  | 0.06           | 13                       | -0.8               | 0.27           | 14                       | –                   | –              | –                        |

<sup>A</sup>Slope without lettering = p-value >0.05.

<sup>B</sup>Sample sizes are the number of years for which densities could be estimated. Models could not be fit for each species/habitat combination for all years due to low detection sample sizes.

<sup>C</sup>Significant trend; p-value ≤0.05. Positive trends also appear in green. Negative trends appear in red.

<sup>D</sup>Significant trend; p-value ≤0.01. Positive trends also appear in green. Negative trends appear in red.

<sup>E</sup>Significant trend; p-value ≤ 0.001. Positive trends also appear in green. Negative trends appear in red.

**Table 3-2 (continued). Habitat-based density trend slope,  $R^2$  values, and sample size of estimated annual densities for individual species in low-elevation riparian and pinyon-juniper habitat (2005–2015, 2017–2019) and in sagebrush-shrubland habitat (2005–2015, 2017–2020).**

| Common name                 | Low-elevation riparian |                |                          | Pinyon-juniper     |                |                          | Sagebrush shrubland |                |                          |
|-----------------------------|------------------------|----------------|--------------------------|--------------------|----------------|--------------------------|---------------------|----------------|--------------------------|
|                             | Slope <sup>A</sup>     | R <sup>2</sup> | Sample size <sup>B</sup> | Slope <sup>A</sup> | R <sup>2</sup> | Sample size <sup>B</sup> | Slope <sup>A</sup>  | R <sup>2</sup> | Sample size <sup>B</sup> |
| Blue-gray gnatcatcher       | 1.66                   | 0.03           | 14                       | 0.69               | 0.01           | 12                       | -0.17               | 0.03           | 13                       |
| Western bluebird            | –                      | –              | –                        | –                  | –              | –                        | 0.25                | 0.38           | 3                        |
| Mountain bluebird           | –                      | –              | –                        | -0.37              | 0.29           | 11                       | 0.05                | 0.01           | 15                       |
| Hermit thrush               | –                      | –              | –                        | -0.02              | 0.01           | 3                        | –                   | –              | –                        |
| American robin              | -0.01                  | 0.00           | 8                        | 0.34               | 0.23           | 9                        | 0.03                | 0.00           | 12                       |
| Sage thrasher               | –                      | –              | –                        | –                  | –              | –                        | -0.12               | 0.04           | 14                       |
| Lucy's warbler              | 1.63                   | 0.24           | 9                        | –                  | –              | –                        | –                   | –              | –                        |
| Virginia's warbler          | -0.25                  | 0.11           | 10                       | 0.45               | 0.31           | 11                       | 0.11                | 0.15           | 15                       |
| Common yellowthroat         | 0.42                   | 0.06           | 8                        | –                  | –              | –                        | –                   | –              | –                        |
| Yellow warbler              | 1.03                   | 0.05           | 14                       | –                  | –              | –                        | 0.05                | 0.03           | 6                        |
| Yellow-rumped warbler       | -0.33                  | 0.01           | 5                        | 1.58               | 0.77           | 5                        | 0.38                | 0.27           | 6                        |
| Grace's warbler             | –                      | –              | –                        | 0.1                | 0.05           | 7                        | 0.13                | 0.30           | 4                        |
| Black-throated gray warbler | -0.28                  | 0.09           | 13                       | -2.23 <sup>C</sup> | 0.39           | 14                       | -0.33               | 0.28           | 8                        |
| Yellow-breasted chat        | 0.21                   | 0.10           | 13                       | –                  | –              | –                        | –                   | –              | –                        |
| Green-tailed towhee         | –                      | –              | –                        | 0.24               | 0.82           | 4                        | -0.44               | 0.04           | 15                       |
| Spotted towhee              | 0.1                    | 0.00           | 14                       | 0.77               | 0.20           | 14                       | 0.00                | 0.00           | 15                       |
| Chipping sparrow            | -1.3                   | 0.32           | 7                        | -0.68              | 0.11           | 13                       | -0.08               | 0.00           | 14                       |
| Brewer's sparrow            | –                      | –              | –                        | –                  | –              | –                        | 0.82                | 0.03           | 15                       |
| Vesper sparrow              | –                      | –              | –                        | 0.33 <sup>D</sup>  | 0.69           | 9                        | -0.72               | 0.09           | 15                       |
| Lark sparrow                | –                      | –              | –                        | 0.49               | 0.24           | 10                       | 0.36                | 0.18           | 15                       |
| Black-throated sparrow      | -0.23                  | 0.03           | 12                       | -0.43              | 0.13           | 13                       | 0.18                | 0.21           | 6                        |
| Sagebrush sparrow           | –                      | –              | –                        | –                  | –              | –                        | -0.25               | 0.29           | 6                        |
| Song sparrow                | -0.59                  | 0.13           | 11                       | –                  | –              | –                        | –                   | –              | –                        |
| Dark-eyed junco             | –                      | –              | –                        | -0.13              | 0.02           | 4                        | –                   | –              | –                        |
| Western tanager             | 0.17                   | 0.20           | 6                        | 0.17               | 0.20           | 9                        | -0.01               | 0.01           | 5                        |
| Black-headed grosbeak       | -0.22                  | 0.28           | 10                       | 0.52               | 0.59           | 6                        | –                   | –              | –                        |
| Blue grosbeak               | 0.19                   | 0.04           | 8                        | –                  | –              | –                        | –                   | –              | –                        |
| Lazuli bunting              | -1.2                   | 0.10           | 13                       | 0.67               | 0.42           | 7                        | 0.24                | 0.14           | 7                        |
| Western meadowlark          | –                      | –              | –                        | -0.45              | 0.27           | 6                        | -0.3 <sup>C</sup>   | 0.34           | 15                       |
| Brewer's blackbird          | –                      | –              | –                        | –                  | –              | –                        | 0.03                | 0.01           | 10                       |
| Brown-headed cowbird        | -0.17                  | 0.01           | 6                        | 0.18               | 0.02           | 8                        | 0.06                | 0.01           | 7                        |
| Bullock's oriole            | -0.34                  | 0.18           | 6                        | –                  | –              | –                        | –                   | –              | –                        |
| House finch                 | -1.85 <sup>E</sup>     | 0.65           | 13                       | -0.2               | 0.01           | 13                       | 0.09                | 0.08           | 11                       |
| Lesser goldfinch            | -0.35                  | 0.02           | 13                       | 0.38               | 0.07           | 5                        | –                   | –              | –                        |

<sup>A</sup>Slope without lettering = p-value >0.05.

<sup>B</sup>Sample sizes are the number of years for which densities could be estimated. Models could not be fit for each species/habitat combination for all years due to low detection sample sizes.

<sup>C</sup>Significant trend; p-value ≤0.05. Positive trends also appear in green. Negative trends appear in red.

<sup>D</sup>Significant trend; p-value ≤0.01. Positive trends also appear in green. Negative trends appear in red.

<sup>E</sup>Significant trend; p-value ≤ 0.001. Positive trends also appear in green. Negative trends appear in red.

**Table 3-3. Trend changes in low-elevation riparian (LR), pinyon-juniper (PJ), and sagebrush shrubland (SA) habitats between the annual reports for 2019 and 2020.**

| Species                   | No longer presented | Significantly negative to non-significant | Non-significant to significantly negative | Significantly positive to non-significant | Non-significant to significantly positive |
|---------------------------|---------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|
| Black-chinned hummingbird | PJ                  | –                                         | –                                         | –                                         | –                                         |
| Black-headed grosbeak     | –                   | LR                                        | –                                         | PJ                                        | –                                         |
| Brown-headed cowbird      | –                   | LR                                        | –                                         | –                                         | –                                         |
| Bushtit                   | –                   | PJ                                        | –                                         | –                                         | –                                         |
| Canyon wren               | PJ                  | –                                         | –                                         | –                                         | –                                         |
| Dark-eyed junco           | –                   | PJ                                        | –                                         | –                                         | –                                         |
| Grace's warbler           | –                   | PJ                                        | –                                         | –                                         | –                                         |
| Gray flycatcher           | LR                  | –                                         | –                                         | –                                         | –                                         |
| Green-tailed towhee       | –                   | –                                         | –                                         | PJ                                        | –                                         |
| House wren                | –                   | –                                         | –                                         | SA                                        | –                                         |
| Lark sparrow              | LR                  | –                                         | –                                         | –                                         | –                                         |
| Mountain bluebird         | –                   | PJ                                        | –                                         | –                                         | –                                         |
| Northern flicker          | LR, PJ              | –                                         | –                                         | –                                         | –                                         |
| Pinyon jay                | SA                  | –                                         | –                                         | –                                         | –                                         |
| Sagebrush sparrow         | –                   | SA                                        | –                                         | –                                         | –                                         |
| Vesper sparrow            | –                   | –                                         | –                                         | –                                         | PJ                                        |
| Western meadowlark        | –                   | PJ                                        | SA                                        | –                                         | –                                         |
| Western wood-pewee        | SA                  | –                                         | –                                         | –                                         | –                                         |
| Woodhouse's scrub-jay     | SA                  | –                                         | –                                         | –                                         | –                                         |
| Yellow-breasted chat      | SA                  | –                                         | –                                         | –                                         | –                                         |
| Yellow warbler            | –                   | –                                         | –                                         | SA                                        | –                                         |

## 4 Discussion

As anthropogenic land use and climate change continue to modify the western landscape, bird populations unable to adapt are at risk for decline. The focal habitats of this study are dominant throughout the western U.S., and are among the most likely to be altered. With gradual changes affecting habitat integrity for bird populations, such as pinyon-juniper encroachment on sagebrush shrubland (Miller and Wigand 1994, Baruch-Mordo et al. 2013) and increases in regional drought (Breshears et al. 2005), long-term monitoring of bird populations is essential for detecting gradual population shifts.

In this report, we present 14-year population-density trends within low-elevation riparian and pinyon-juniper habitats, and 15-year population-density trends within sagebrush-shrubland habitat for 63 species (a total of 121 species/habitat combinations; Appendix A). The majority of density trend estimates were non-significant, indicating that many species may have stable populations.

Of the 121 trend estimates, 11 were significant, with nine negative trends and two positive trends. Trends for species with high abundance should be detected with the methods used in this study. For species that are not abundant, or are difficult to detect, it is possible that a significantly negative or positive trend exists but was not detected due to rigorous methods that do not estimate annual density for species with fewer than 10 detections per habitat, and exclude years with a low number of detections.

This study does not explore specific factors linked to trends in NCPN bird popula-

tions. It does provide evidence of long-term regional declines and increases in individual bird populations within three important habitats. Continued monitoring of these populations will be essential to acquiring significant trend estimates for a larger suite of species. With each year of additional monitoring, we will be able to more confidently assess the causes of longer-term changes to bird populations relative to surrounding landscape and climate variables.

Because of the nature of low-elevation riparian, pinyon-juniper, and sagebrush-shrubland habitat in this region, many transects in this study may contain components of more than one of these three habitat types. For example, all riparian transects in the region are thin strips of riparian vegetation fed by intermittent streams within a matrix of pinyon-juniper or sagebrush shrubland. As such, not all species detected within 125 meters of an observer during riparian point counts are directly using riparian habitat. While species may show significant trends within a specific habitat, caution should be used when interpreting the biological relevance of these trends.

Future studies using these data will seek to estimate population-density trends for individual species at the transect level. Transect-level estimates will provide a finer-scale view of population trends to complement the regionwide analyses presented in this report. Using land-cover and climate variables, we will evaluate the drivers of density trends for individual species, allowing us to identify prominent threats to declining species and estimate causes of variance in these trends across the NCPN.



## 5 Literature Cited

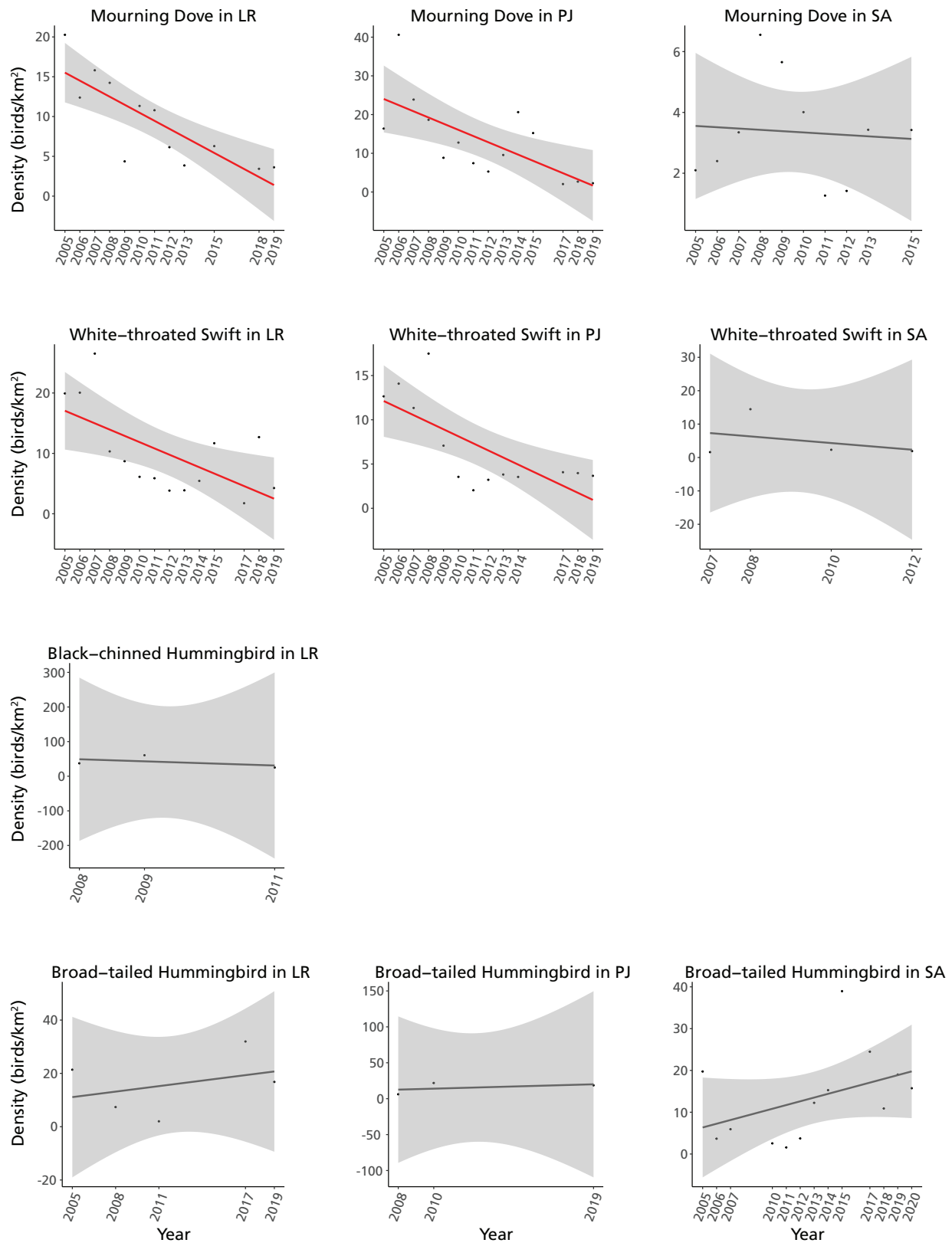
- Baruch-Mordo, S., J. S. Evans, J. P. Severson, D. E. Naugle, J. D. Maestas, J. M. Kiesecker, M. J. Falkowski, C. A. Hagen, and K. P. Reese. 2013. Saving sage-grouse from the trees: A proactive solution to reducing a key threat to a candidate species. *Biological Conservation* 167:233–241.
- Breshears, D. D., N. S. Cobb, P. M. Rich, K. P. Price, C. D. Allen, R. G. Balice, W. H. Romme, J. H. Kastens, M. L. Floyd, J. Belnap, J. J. Anderson, O. B. Myers, and C. W. Meyer. 2005. Regional vegetation die-off in response to global-change-type drought. *Proceedings of the National Academy of Sciences of the United States of America* 102:15144–15148.
- Browder, S. F., D. H. Johnson, and I. J. Ball. 2002. Assemblages of breeding birds as indicators of grassland condition. *Ecological Indicators* 2:257–270.
- Burnham, K. P., and D. R. Anderson. 2002. Model selection and multimodel inference: A practical information-theoretic approach. 2nd edition. New York: Springer.
- Canterbury, G. E., T. E. Martin, D. R. Petit, L. J. Petit, and D. F. Bradford. 2000. Bird communities and habitat as ecological indicators of forest condition in regional monitoring. *Conservation Biology* 14:544–558.
- Daw, S., M. Beer, and S. L. Garman. 2020. Landbird monitoring protocol narrative for park units in the Northern Colorado Plateau Network: Version 1.04. Natural Resource Report NPS/NCPN/NRR—2020/2119. National Park Service, Fort Collins, Colorado.
- Fleischner, T. L. 1994. Ecological costs of livestock grazing in western North America. *Conservation Biology* 8:629–644.
- Gardali, T., and A. L. Holmes. 2011. Maximizing benefits from riparian revegetation efforts: Local- and landscape-level determinants of avian response. *Environmental Management* 48:28–37.
- Gardali, T., A. L. Holmes, S. L. Small, N. Nur, G. R. Geupel, and G. H. Golet. 2006. Abundance patterns of landbirds in restored and remnant riparian forests on the Sacramento River, California, U.S.A. *Restoration Ecology* 14:391–403.
- Gregory, R. D., P. Vorisek, A. Van Strien, A. W. Gmelig Meyling, F. Jiguet, L. Fornasari, J. Reif, P. Chylarecki, and I. J. Burfield. 2007. Population trends of widespread woodland birds in Europe. *Ibis* 149:78–97.
- Lowry, J. H., R. D. Ramsey, K. Boykin, D. Bradford, P. Comer, S. Falzarano, W. Kepner, J. Kirby, L. Langs, J. Prior-Magee, G. Manis, L. O'Brien, T. Sajwaj, K. A. Thomas, W. Rieth, S. Schrader, D. Schrupp, K. Schulz, B. Thompson, C. Velasquez, C. Wallace, E. Waller, and B. Wolk. 2005. Southwest Regional Gap Analysis Project: Final report on land cover mapping methods. Logan, UT.
- MacKenzie, D. I., J. D. Nichols, J. A. Royle, K. H. Pollock, L. L. Bailey, and J. E. Hines. 2006. Occupancy estimation and modeling: Inferring patterns and dynamics of species occurrence. Burlington, Mass.: Elsevier/Academic Press.
- Miller, R. F., and P. E. Wigand. 1994. Holocene changes in semiarid pinyon-juniper woodlands. *BioScience* 44:465–474.
- R Core Team. 2014. R: A language and environment for statistical computing. Foundation for Statistical Computing, Vienna, Austria.
- Rosenberg, K. V., A. M. Dokter, P. J. Blancher, J. R. Sauer, A. C. Smith, P. A. Smith, J. C. Stanton, A. Panjabi, L. Helft, M. Parr, and P. P. Marra. 2019. Decline of the North American avifauna. *Science* 366:120–124.
- 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. Min, 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. Page 119. Partners in Flight Science Committee.
- Sauer, J. R., J. E. Fallon, and R. Johnson. 2003. Use of North American Breeding Bird Survey data to estimate population change for bird conservation regions. *The Journal of Wildlife Management* 67:372–389.
- Thomas, L., S. T. Buckland, E. A. Rexstad, J. L. Laake, S. Strindberg, S. L. Hedley, J. R. B. Bishop, T. A. Marques, and K. P. Burnham. 2010. Distance software: Design and analysis of distance sampling surveys for estimating population size. *Journal of Applied Ecology* 47:5–14.

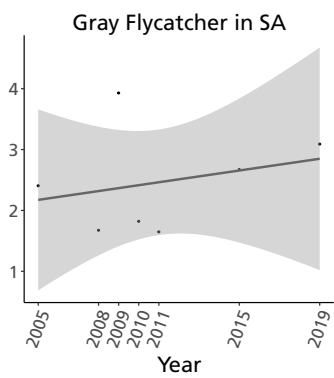
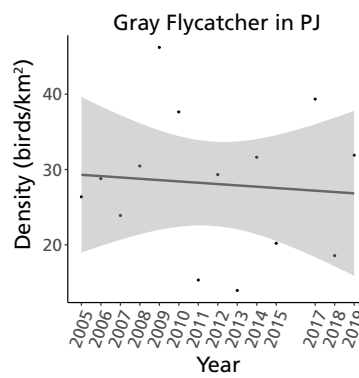
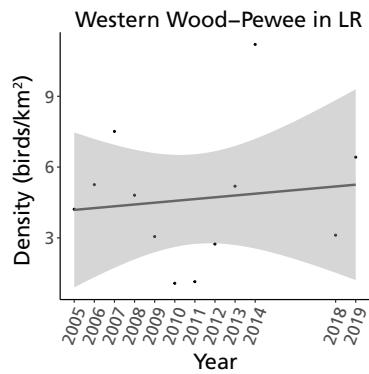
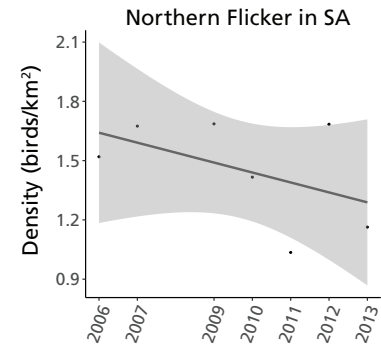
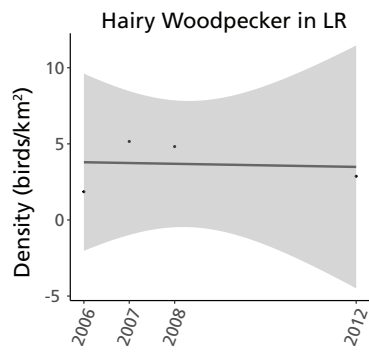
## Appendix A. Density Trends by Species and Habitat

Graphics on the following pages show trend lines for species and habitats as shown in Table 3-2 (LR = low-elevation riparian, PJ = pinyon-juniper, SA = sage shrubland). Red lines indicate significant trends from a simple linear regression model.

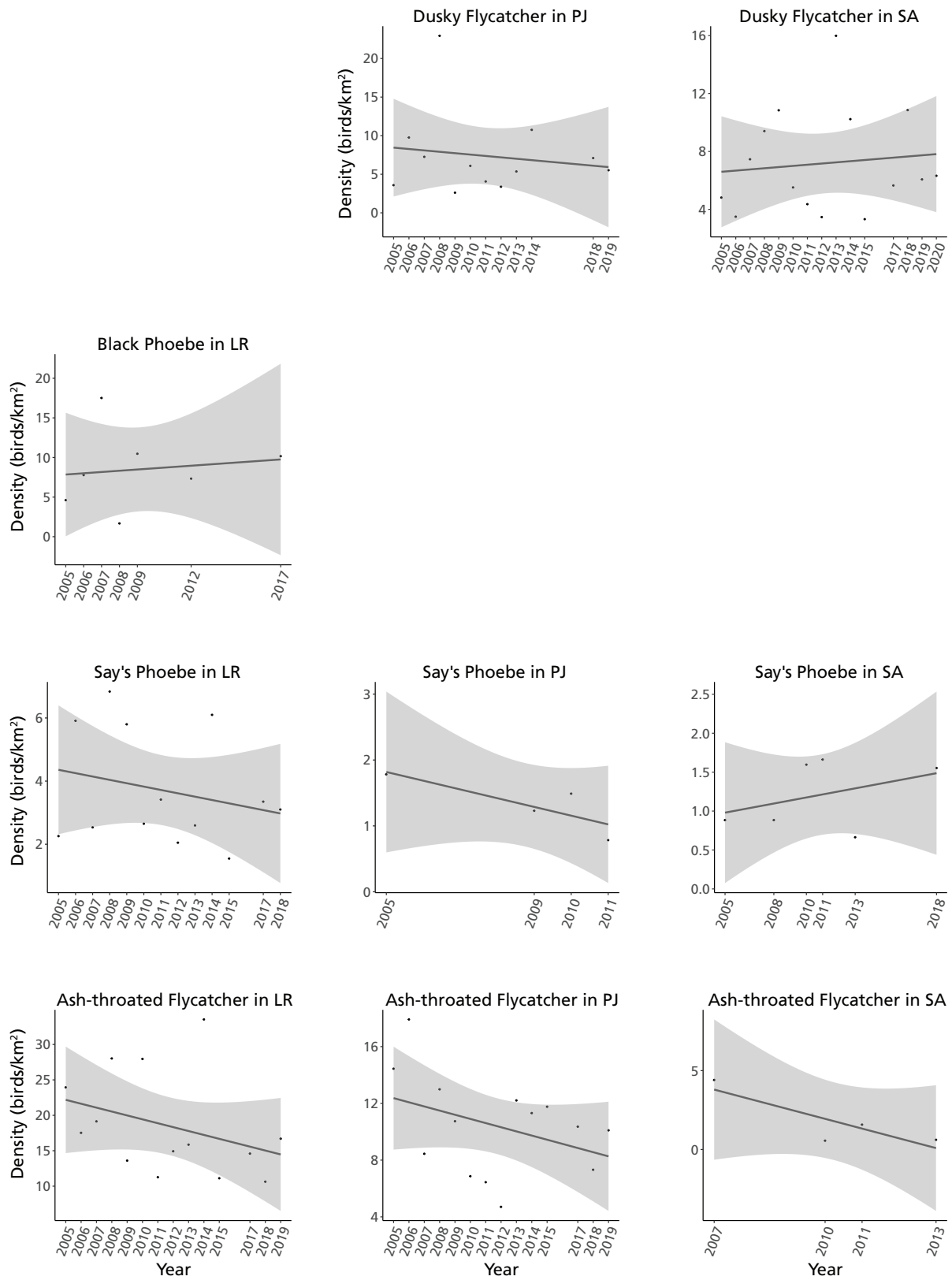
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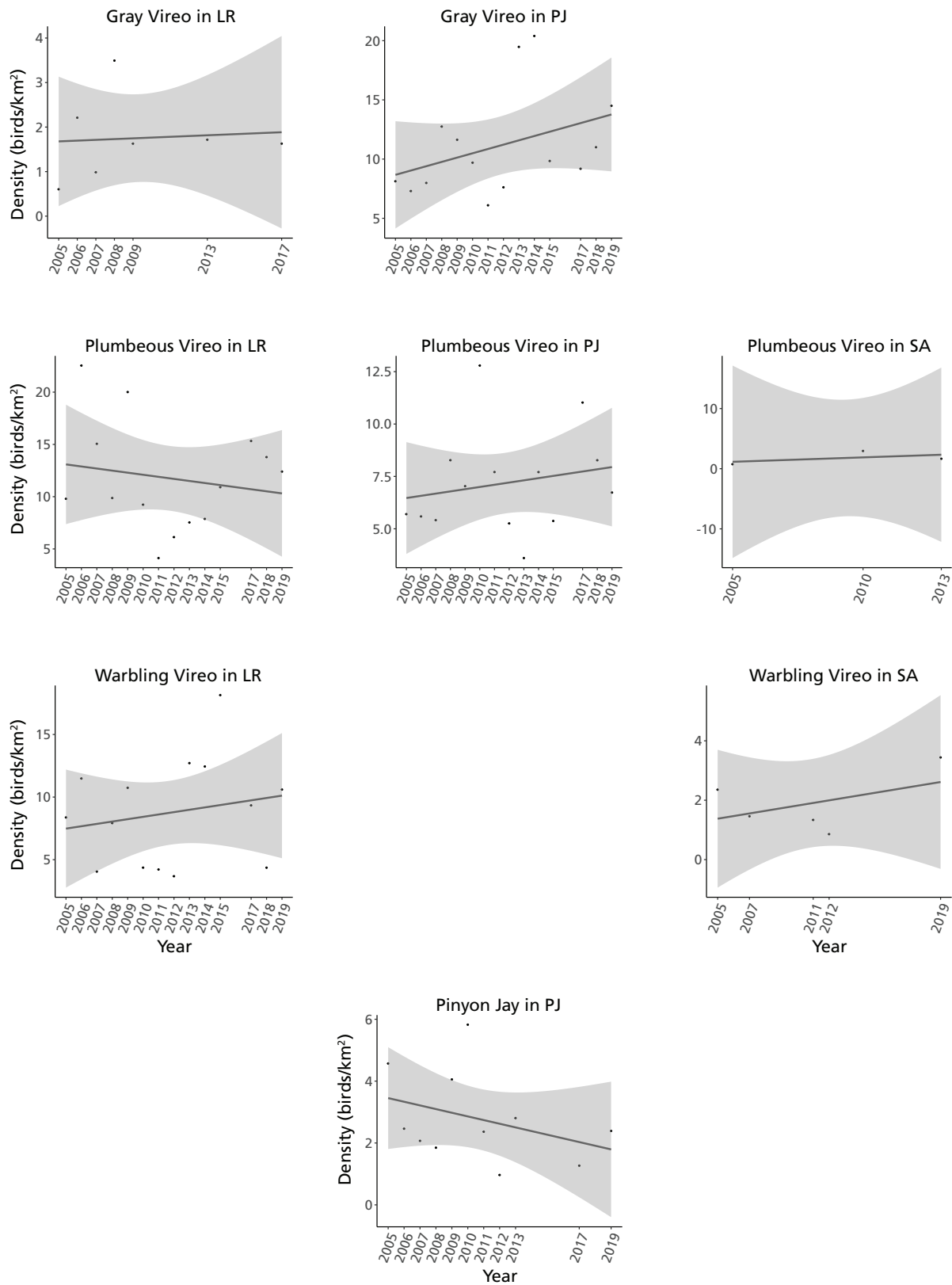
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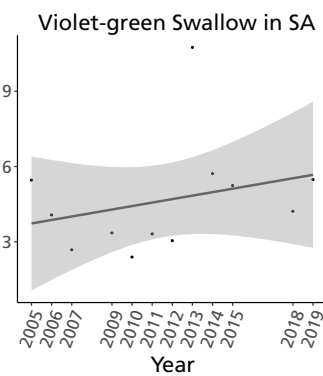
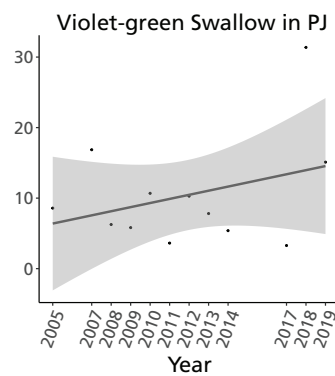
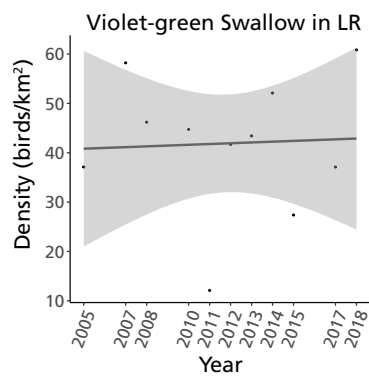
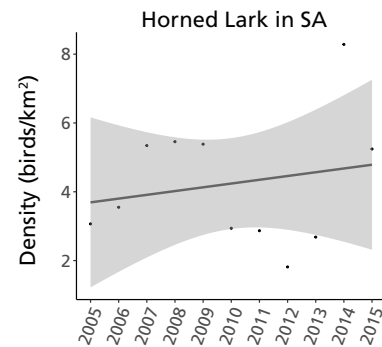
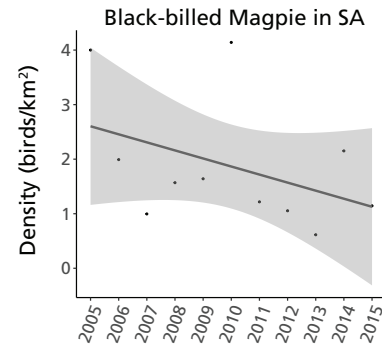
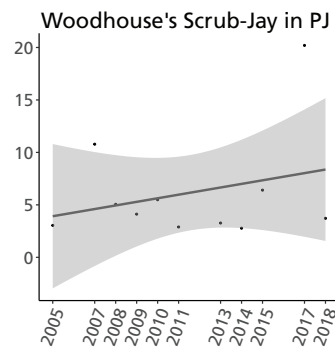
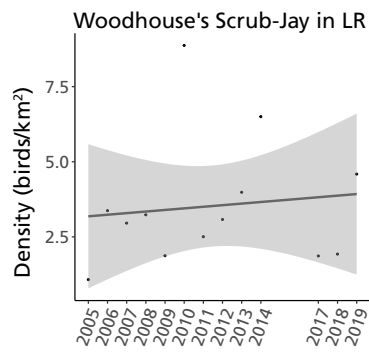
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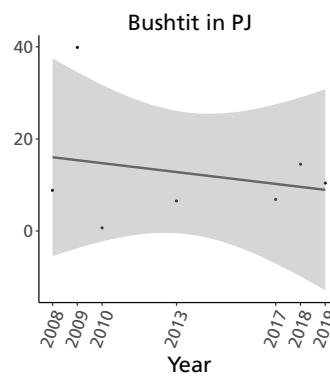
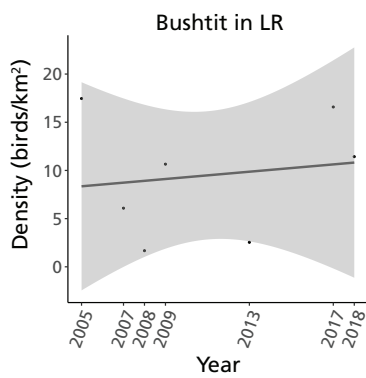
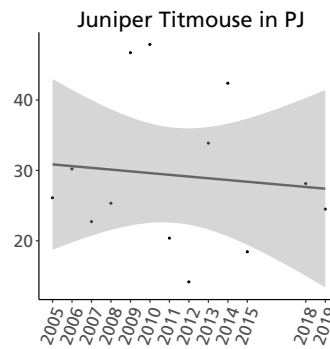
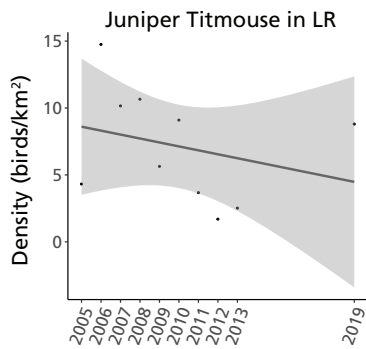
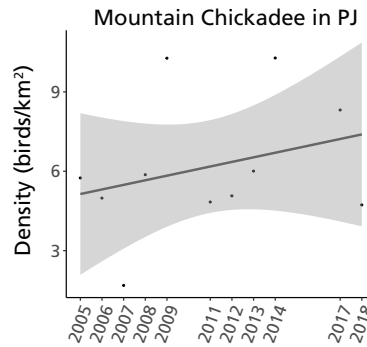
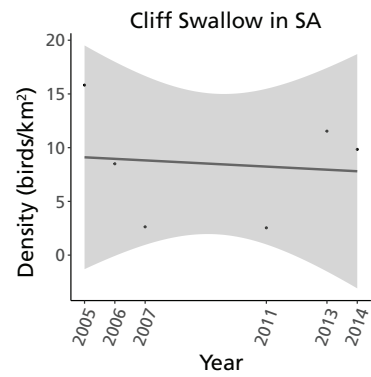
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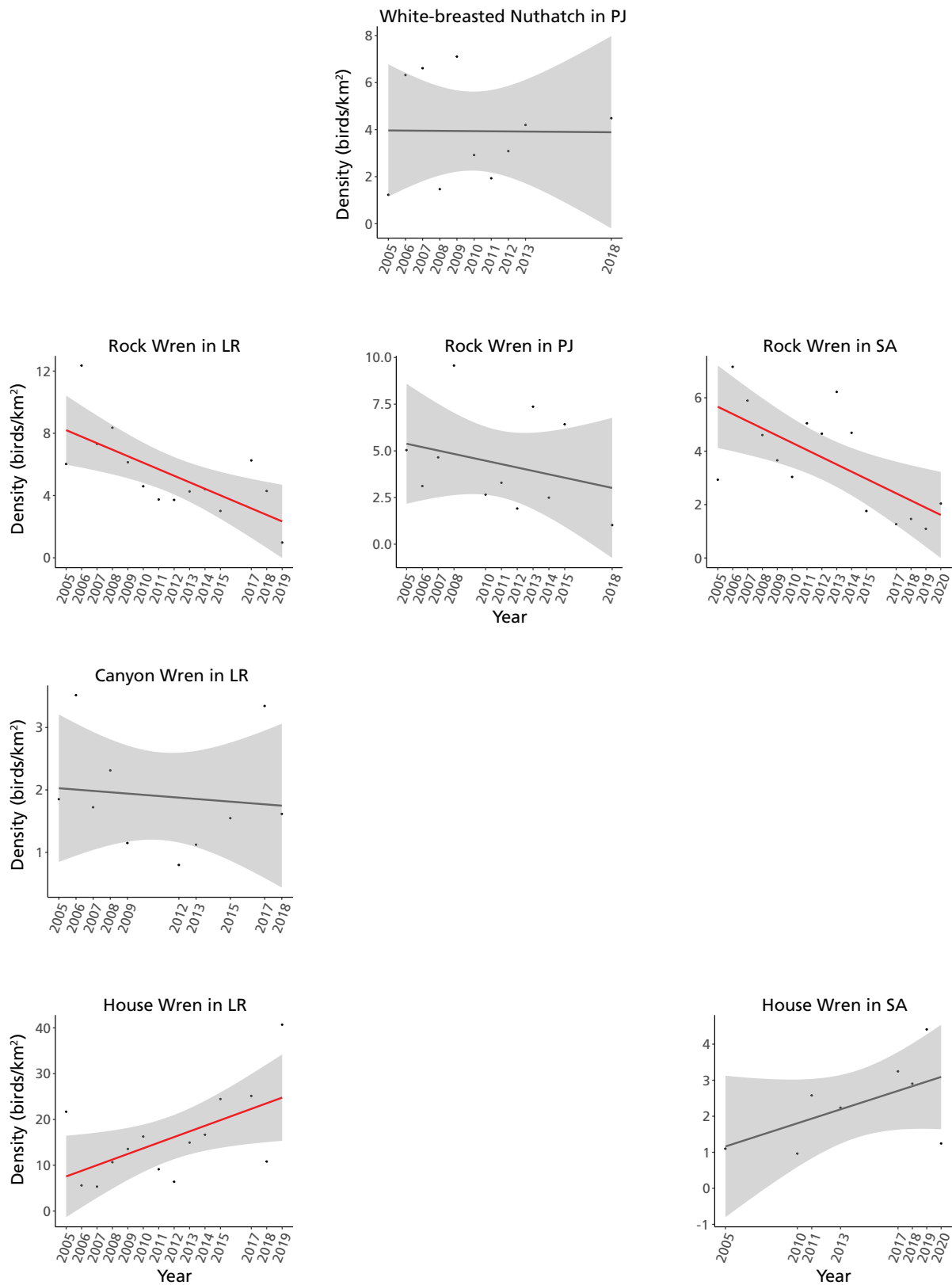
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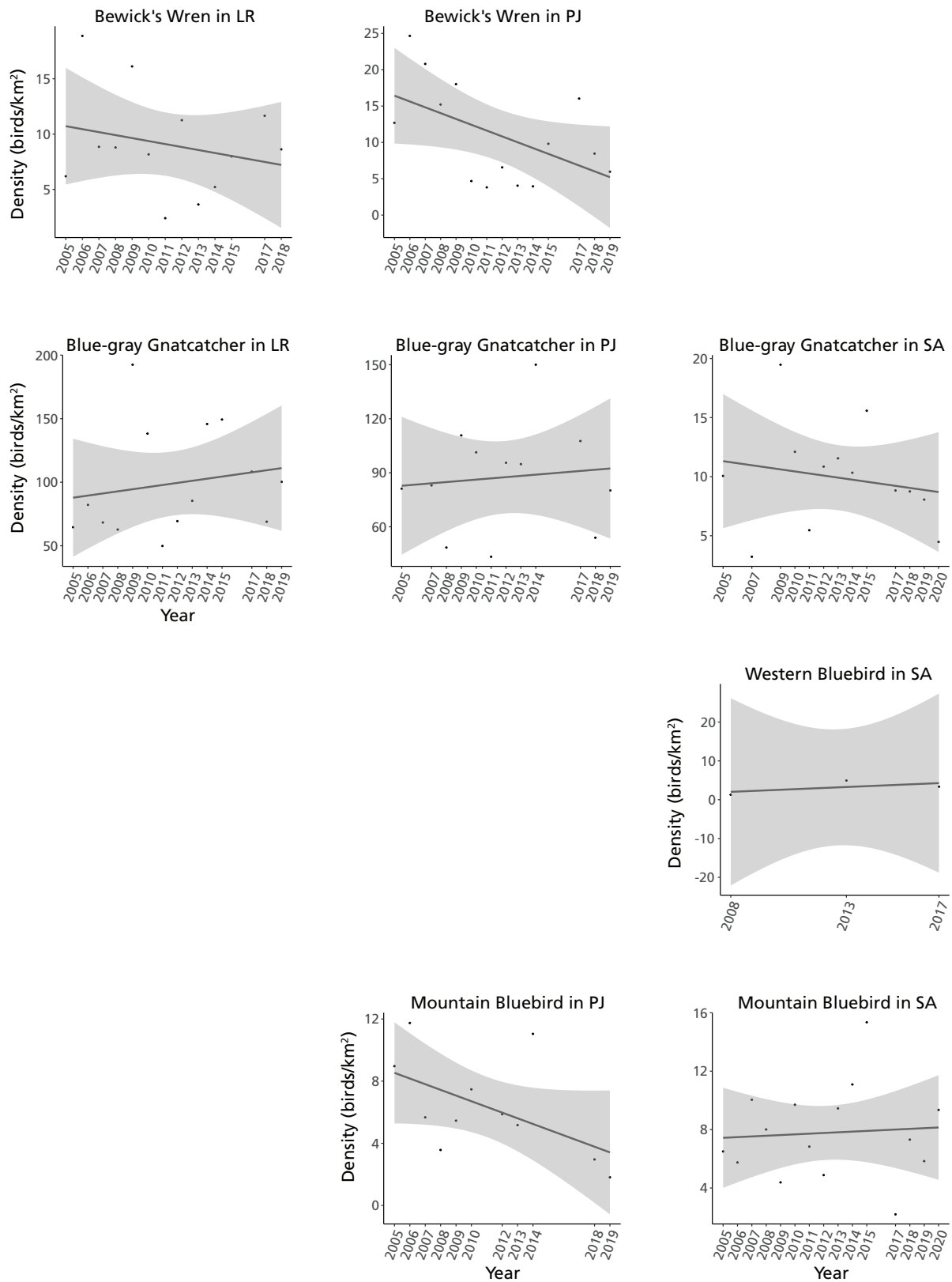
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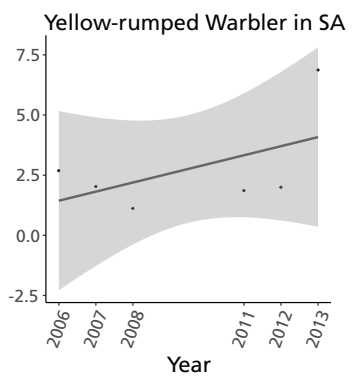
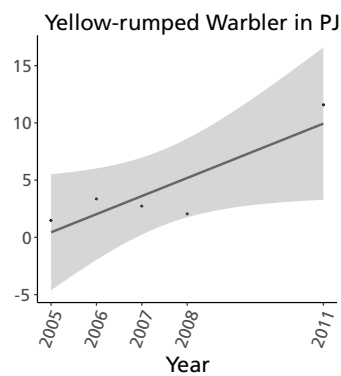
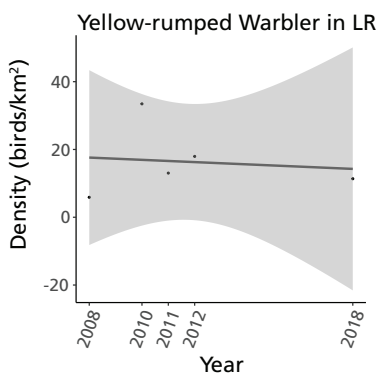
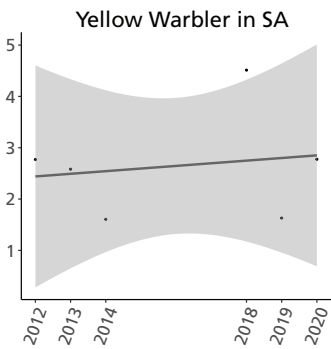
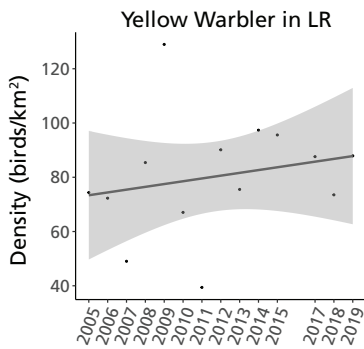
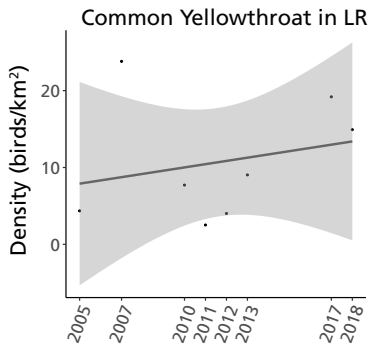
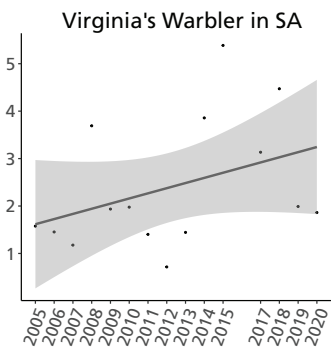
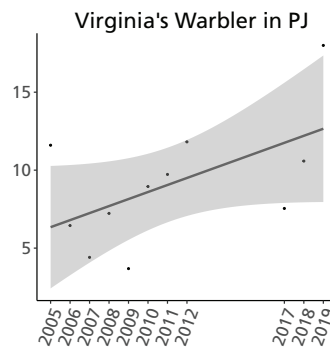
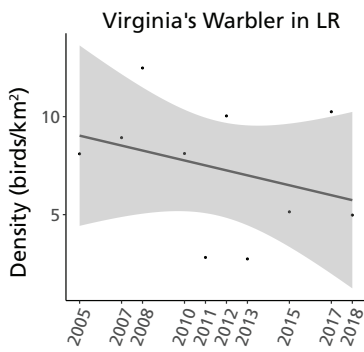
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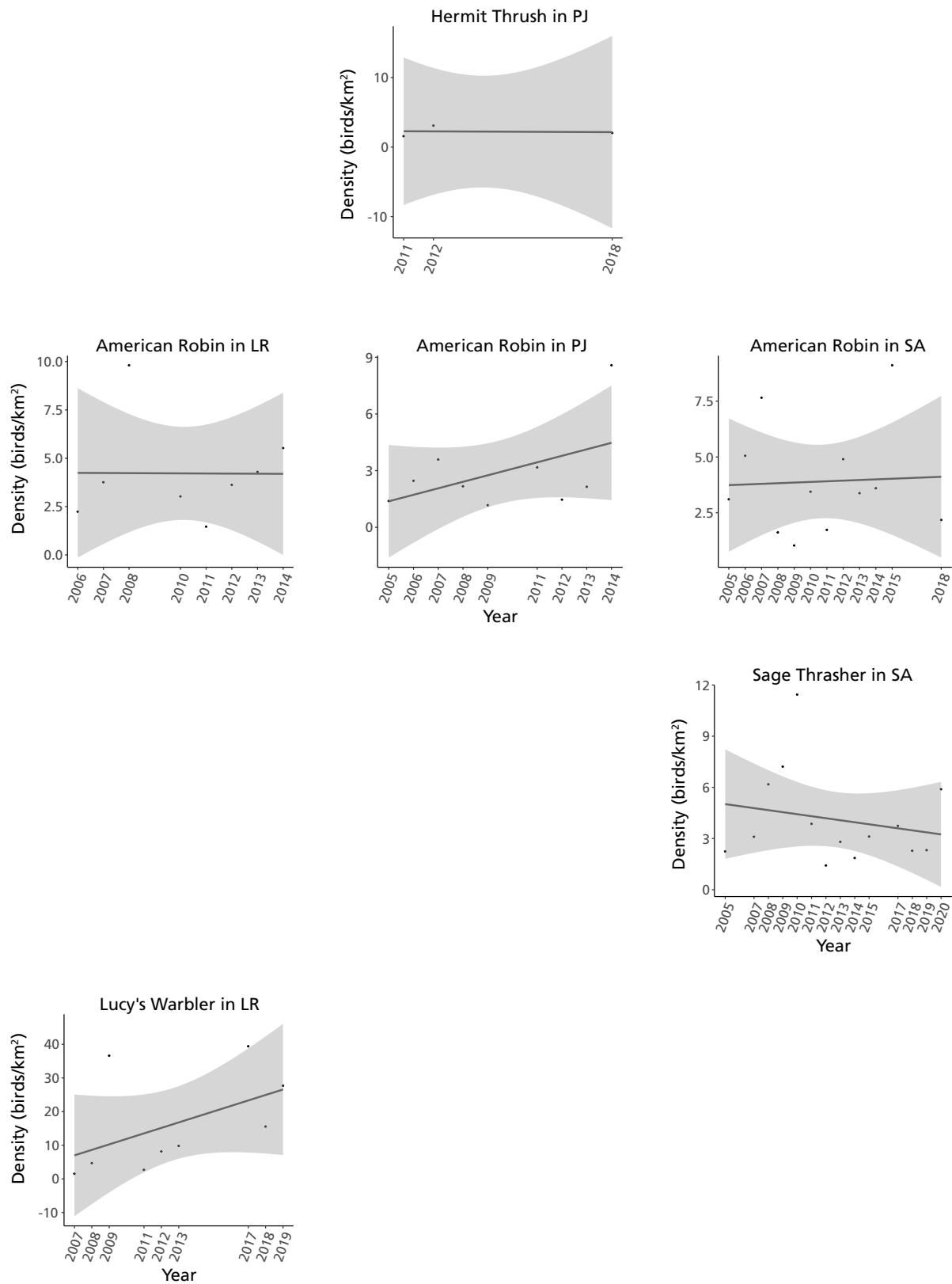
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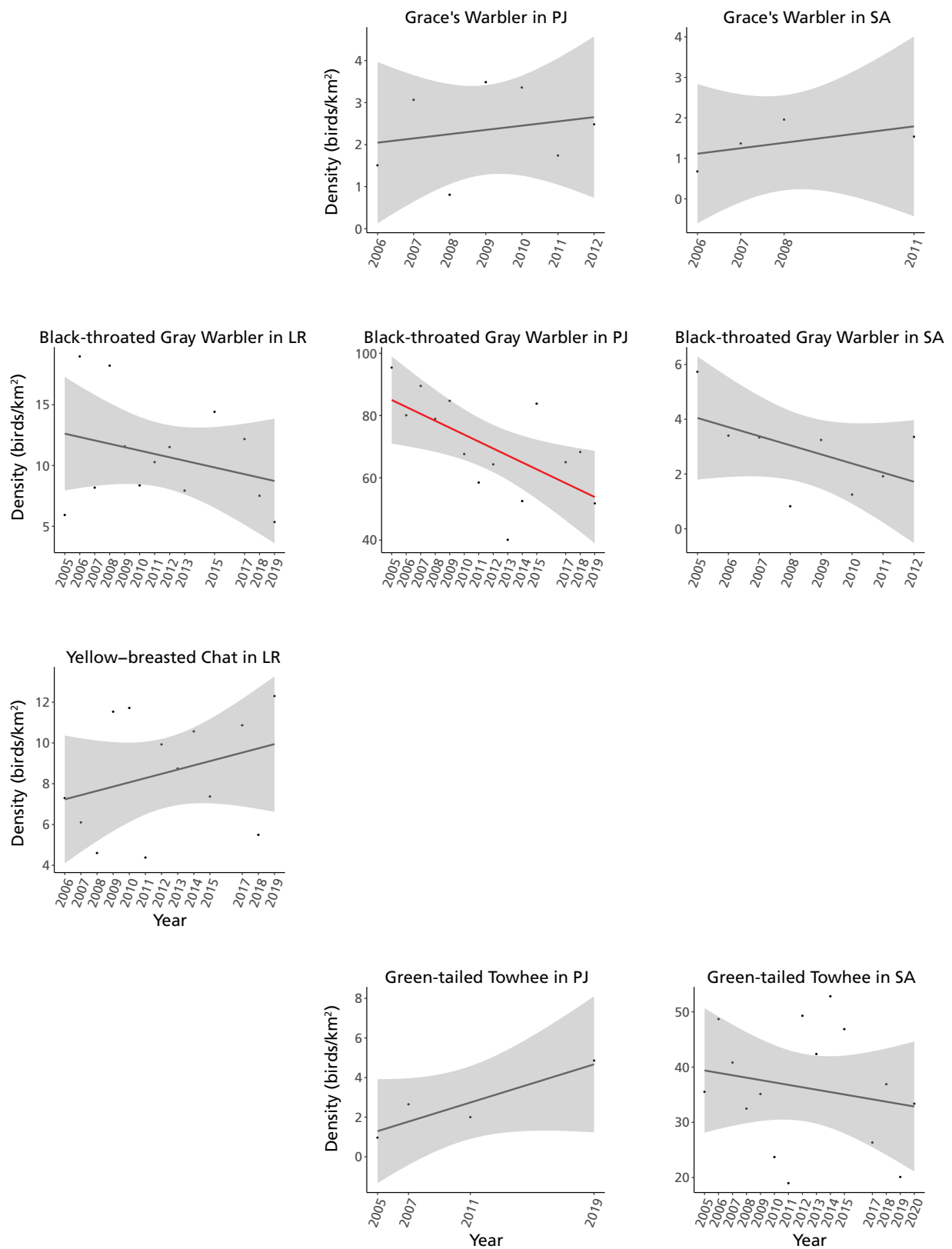
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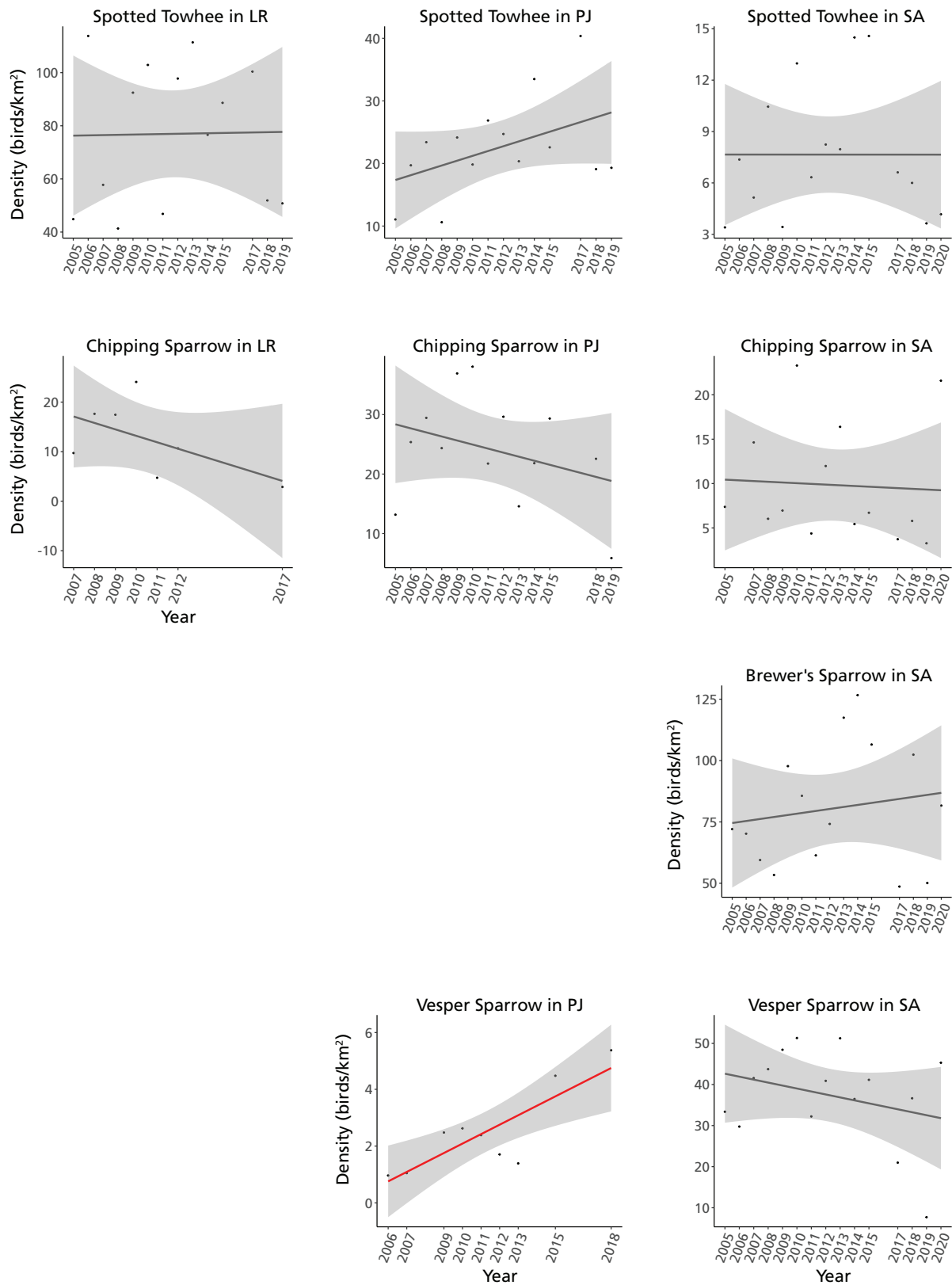
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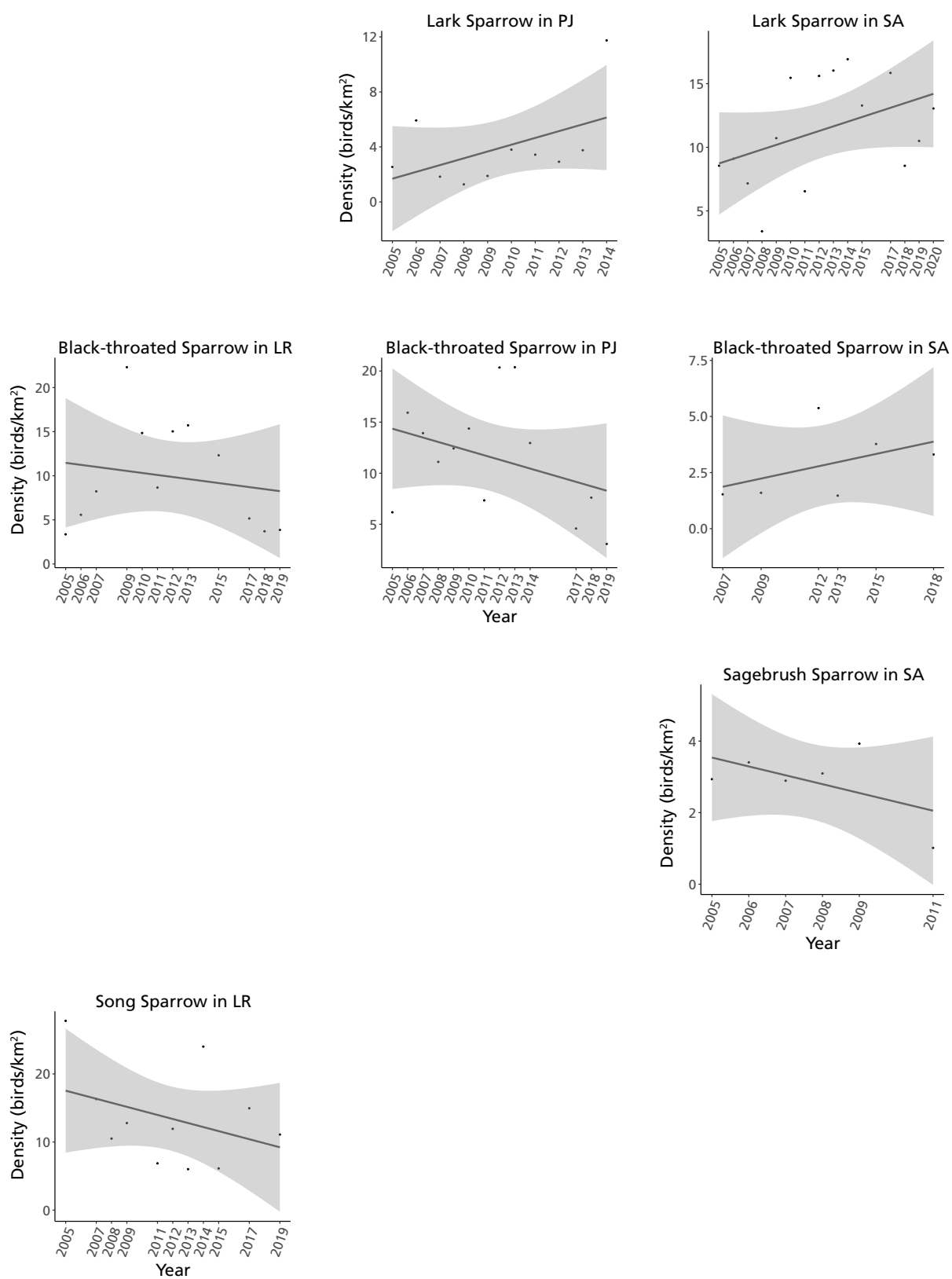
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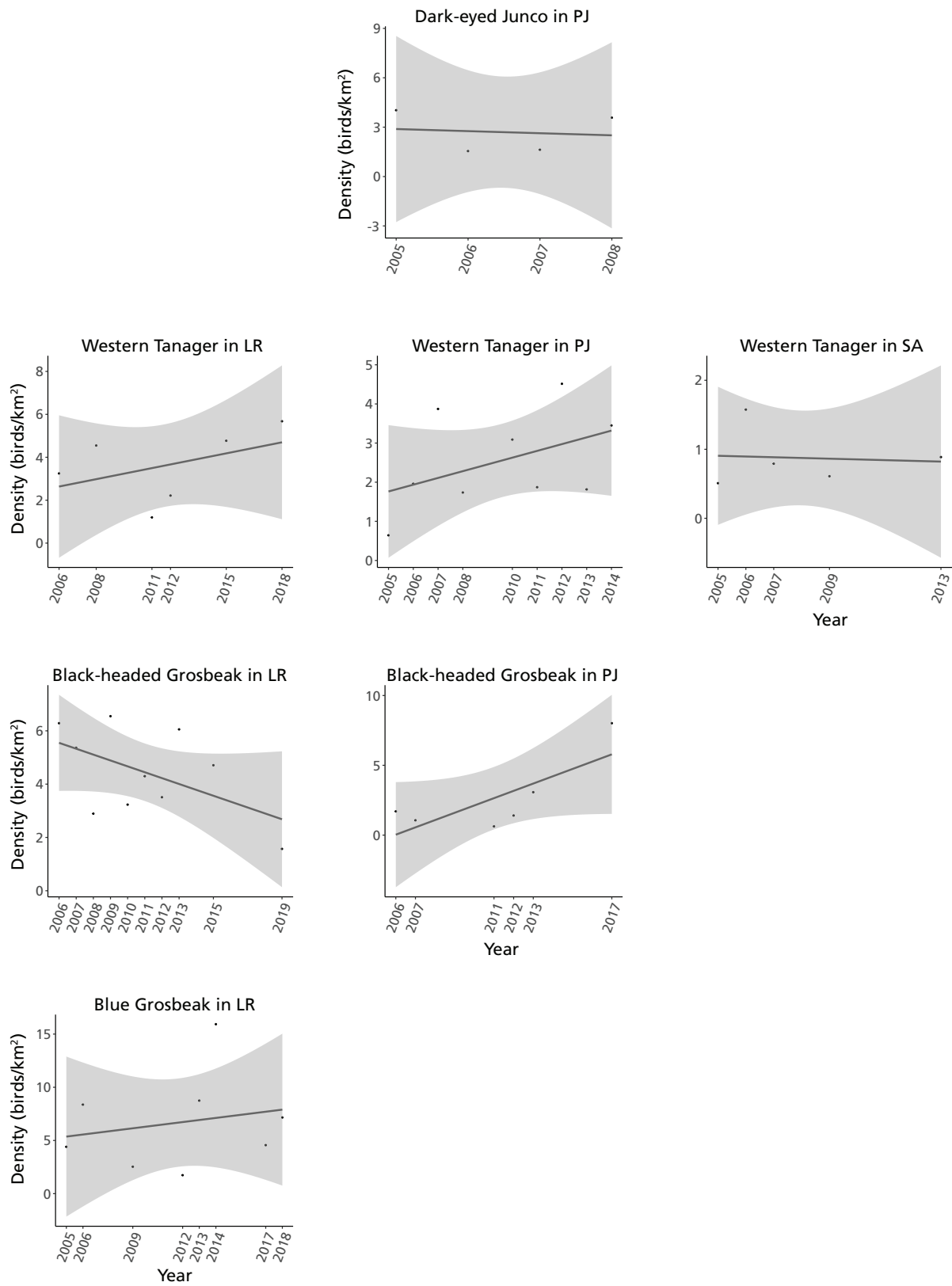
Trend lines for species and habitats as shown in Table 3-2.



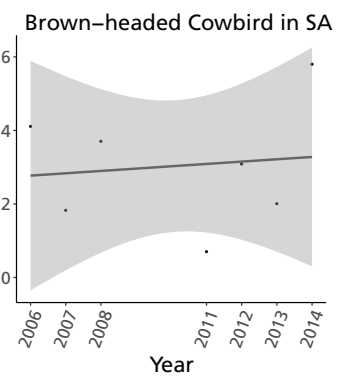
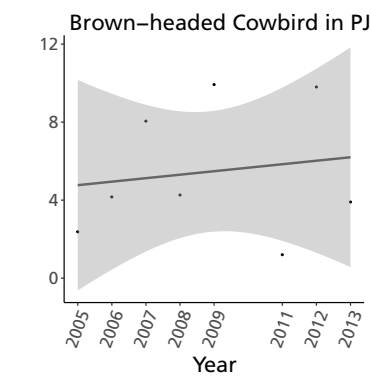
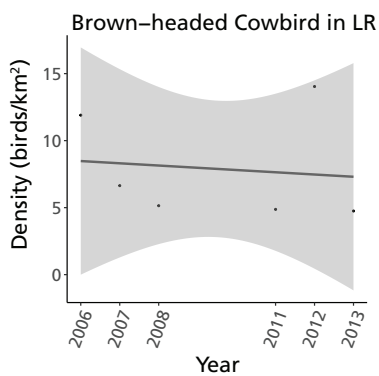
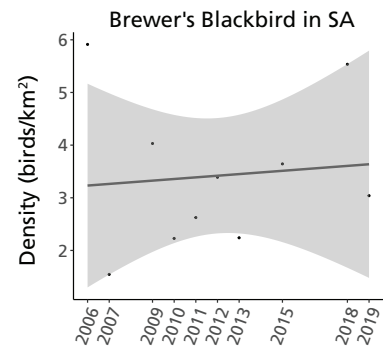
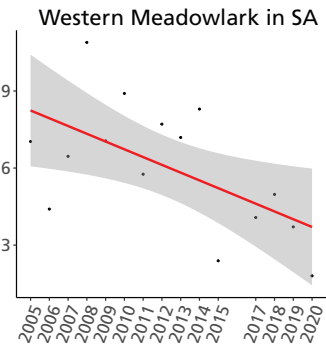
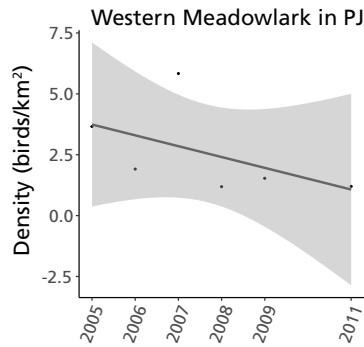
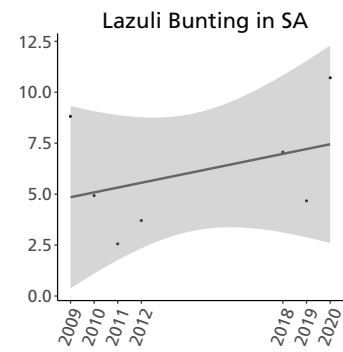
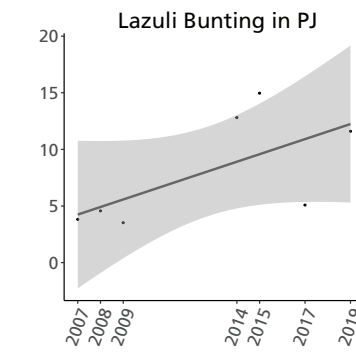
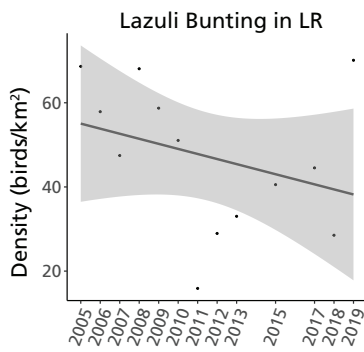
Trend lines for species and habitats as shown in Table 3-2.



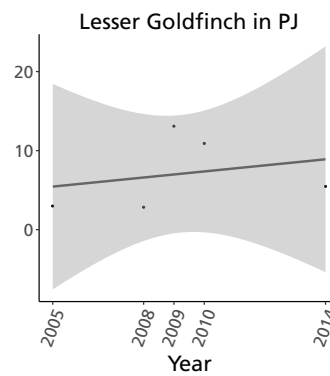
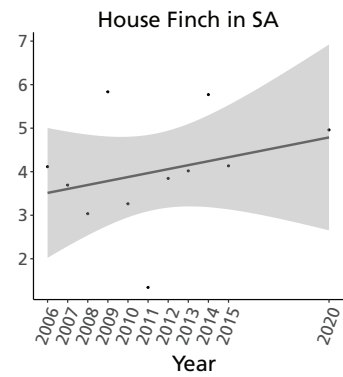
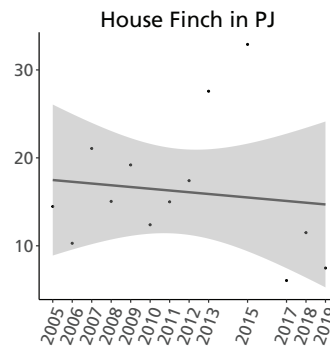
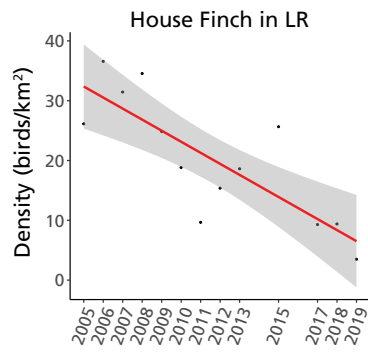
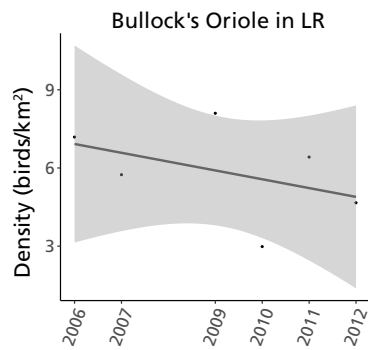
Trend lines for species and habitats as shown in Table 3-2.



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The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 960/175079, February 2021

**National Park Service**  
**U.S. Department of the Interior**



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